NEW BEDFORD HARBOR
USEPA LOWER HARBOR CAD CELL

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SAMPLING AND ANALYSIS PLAN – DRAFT FINAL

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1.0 INTRODUCTION

This Draft Final Sampling and Analysis Plan (SAP) has been prepared by the New Bedford Harbor Development Commission (NBHDC) for obtaining sediment characterization and water quality data for the design and construction of the proposed USEPA Lower Harbor Confined Aquatic Disposal (CAD) Cell Project (LHCC) to be located in New Bedford Harbor, New Bedford, Massachusetts. The USEPA is constructing the LHCC to complete future dredging and disposal operations associated with cleanup of the New Bedford Harbor Superfund Site. The project site is located within the inner portion of New Bedford/Fairhaven Harbor, also referred to as the "Lower Harbor" by USEPA, between the Route 195 Bridge and the Route 6 Bridge, in New Bedford and Fairhaven, Massachusetts and is shown on Figure 1.

This SAP will serve as a guidance document to provide minimum criteria for generating chemical, geotechnical, and biological testing data of acceptable quality as may be required to support the following activities: design the CAD Cell; characterize in-place sediment to inform potential bidders for estimating construction costs; prepare a United States Army Corps of Engineers (USACOE) Suitability Determination permit application; and, monitor water quality during dredging and disposal of dredge materials. This SAP establishes criteria for the following: sample collection methodology; documentation of sampling activities; laboratory testing parameters and methodology; field/laboratory quality assurance/quality control (QA/QC) procedures; and, data report presentation format.

1.1 SITE HISTORY

The New Bedford Harbor Superfund Site (the Site) consists of approximately 1,000 acres of urban tidal estuary and shoreline areas along the Acushnet River Estuary (Estuary) and New Bedford Harbor (Harbor), and approximately 17,000 acres in Buzzards Bay (Bay). From the 1940's until the mid 1970's, PCBs were discharged directly and indirectly into the Estuary, Harbor, and Bay. These discharges contaminated the sediments at levels ranging from a few parts per million (ppm or mg/Kg) to over 200,000 mg/Kg PCBs. Other contaminants, including heavy and poly-aromatic hydrocarbons (PAHs), have also been discharged into the Site at various times since the 1800's. PCB-contaminated wetlands and salt marsh areas occur in the Estuary adjacent to the shoreline of the Towns of Acushnet and Fairhaven. As a result of the wide spread contamination, the Harbor was placed on the EPA's Superfund National Priorities List (NPL) in 1983. The current human health risks from the Site are through direct contact with PCBs in the sediment, and ingestion of fish and shellfish. In addition to the adverse public health and environmental impacts, contamination of the Harbor has also caused adverse economic impacts to the local communities. Superfund-related dredging is designed to remove contamination down to a level that no longer poses a risk to human health and the environment.

1.2 PURPOSE

The USEPA has modified the Record of Decision (ROD) for its Remedy for the New Bedford Harbor Superfund Site via an Explanation of Significant Difference (ESD) to construct the LHCC using Superfund Cooperative Agreement (CA) funding. The LHCC is to be located within the area designated for CAD Cells by the New Bedford/Fairhaven Harbor Dredge Materials Management Plan (DMMP) and will provide approximately 300,000 cy of sediment disposal space or as close to this volume as CA funding allows. The NBHDC proposes to design and construct the body of the USEPA LHCC, which the USEPA would then utilize for its cleanup operations in keeping with the ESD-modified ROD. The USEPA retains responsibility for conducting cleanup operations, and would conduct its own dredging of contaminated sediments and place those sediments in the constructed CAD Cell. The USEPA would also be responsible for the capping of the LHCC once filled and for the maintenance of the LHCC until such time that the Harbor Remediation is complete, and the long term responsibility for USEPA facilities in the Harbor are transferred to MADEP.

2.0 EXISTING DATA AND REPORTS

As cited below, field operations conducted from 1999 to the present generated significant background information that is relevant to the preparation of this SAP. Beginning in 1999 Foster Wheeler Environmental Corporation (FWENC) consulted with ACOE to create a basis for the cleanup of the Site. FWENC completed a multi-phase geophysical program that included bathymetry, side scan sonar, sub-bottom profiling, and magnetometry. In 2003, the Maguire Group completed the Final Environmental Impact Report (FEIR) to the Dredged Material Management Plan (DMMP). In 2006, Apex Companies, LLC (Apex), assisting NBHDC, completed Phase II of navigational dredging, which included work in the Borrow Pit CAD Cell and CAD Cell 1. In 2010, Apex completed Phase III dredging, which included work in CAD Cell 1, CAD Cell 2, Navigational Dredging, and DMMP expansion. A discussion of the relevant information generated by these efforts follows

2.1 FWENC MARCH 2001 REPORT

In March 2001, FWENC prepared "*Report of Marine Geophysical Surveys: Side Scan Sonar, Sub-Bottom Profiler, And Magnetics,*" which included detailed side scan images, sub-bottom profiling data and raw field images, as well as magnetic information of 36 targets in the area of the proposed LHCC. The full report is attached as Appendix A. Of particular relevance from this FWENC report are Figure 2, Figure 5, Figure 8, and the raw sub-bottom data that were crucial in determining the positions for geotechnical borings and vibracore locations for the LHCC and this SAP. As summarized in Figure 2 of this SAP, the sub-bottom data recorded ten (10) anomalies, of which six (6) are located in the 2008 Expanded DMMP. Although none of these six (6) targets are located within the existing feasibility determination area, three (3) are located at the boundary or inside the proposed feasibility determination expansion area, near its western boundary. The side scan data recorded 87 anomalies of which 47 are located within the 2008 Expanded DMMP. Of these 47, five (5) targets are within the existing feasibility determination area and an additional seven (7) targets are in the proposed feasibility determination expansion area. The MAG data recorded 131 anomalies of which 36 are located within the 2008 Expanded DMMP. Of these thirty-six, eleven (11) targets are within the existing feasibility determination area and an additional ten (10) targets are in the proposed feasibility determination expansion area.

2.2 FWENC SEPTEMBER 2001 REPORT

To improve upon characterization of sediment stratigraphy known to be deficient in certain areas, FWENC completed an additional report in September 2001 titled, "Marine Geophysical Surveys: Phase I Uniboom & Seismic Refraction and

Phase II Seismic Refraction." In these areas, biogenic gases occurring in some of the organic sediments underlying the harbor had obscured stratigraphic layers in some of the sub-bottom records by absorbing the acoustic energy generated by the sub-bottom profiler. The full report is attached as Appendix B. FWENC completed seismic refraction in order to more accurately determine sediment thickness layers and provided valuable information with respect to depth to bedrock (see Figure 5C of this FWENC report). Additionally borings, CPT tests, and probes were conducted, to correlate with the seismic data generated for the March 2001 report discussed above. The surveys completed by FWENC in 2001 show bedrock occurring between 30 to 80 feet below the mudline.

2.3 MAGUIRE GROUP OCTOBER 2003 REPORT

Dated October 15, 2003, the Maguire Group report titled, "Dredged Material Management Plan (DMMP) Final Environmental Impact Report (FEIR)" established the case that CAD cell technology was the best approach for managing PCB-contaminated sediments within the Harbor. The FEIR included a schematic for the placement of CAD cells within the footprint established by the DMMP to provide sufficient capacity for Site cleanup activities and to minimize future transport of contaminants. The DMMP CAD Cell area limits shown in the FEIR were based on a plan to use four small CAD cells and one large CAD cell with a capacity to receive 1.5 million cubic yards of contaminated sediments. Particularly relevant to the LHCC project, the sections of the report provided important information in addressing the following topics: Section 3.4- Underwater Archeological Surveys; 3.5 Physical and Chemical Analysis of Surficial Sediments; 4.0 Selection of Preferred Alternative CAD Cell Site; Appendix C – Underwater Archeological and Hazards Analysis Remote Sensing Survey; and, Appendix N – Geotechnical Report. The full Maguire Group report is attached as Appendix C.

2.4 APEX-NBHDC 2006 PHASE II NAVIGATIONAL DREDGING PROGRAM

In 2004, it became evident that the geometry and placement of CAD cells within the DMMP area as envisioned in the 2003 FEIR could not feasibly be constructed due to limitations posed by anticipated insufficient future funding levels and various logistical obstacles. To address these limitations, and to construct the CAD cells in the most cost effective manner, the original boundary of the DMMP footprint was expanded on two occasions through the appropriate regulatory channels. The first expansion occurred in 2004, at the beginning of the Phase II Navigational Dredging Program, to include the areas where the Borrow Pit CAD Cell and CAD Cell 1 are situated. As part of the pre-construction investigation of CAD Cell 1, Apex completed 48 vibracores, from which samples were tested for grain size analysis and PCB content, and eight (8) geotechnical borings. Geotechnical borings from this program are included on Figure 3. Contaminated material generated from construction of CAD Cell 1 was deposited

into an existing depression in the Harbor, which thereafter was referred to as the Borrow Pit CAD Cell. Once the contaminated material had been removed from the construction area of CAD Cell 1, the underlying uncontaminated sediments deemed “Suitable” by USACOE were excavated and used in a pilot capping project at Superfund Operable Unit 3 (OU-3).

2.5 APEX-NBHDC 2010 PHASE III NAVIGATIONAL DREDGING PROGRAM

The second expansion of the DMMP footprint occurred in 2008 to include a much larger area for CAD Cell placement, which reflected the anticipated need for a greater number of smaller CAD Cells. During the initial stage of the Phase III Navigational Dredging Program, CAD Cell 2 was constructed to the northeast of CAD Cell 1. Contaminated material overlying the CAD Cell 2 construction footprint was excavated and placed into CAD Cell 1. Once the contaminated material had been removed, underlying clean material, as confirmed by a program of sediment sampling and analytical testing, was excavated and transported to the USACOE Cape Cod Bay Disposal Site for offshore disposal. Bathymetric surveys, water quality monitoring, and construction oversight were conducted by Apex for the construction of CAD Cell 2. Records of the geotechnical borings advanced for the design of CAD Cell 2 are included in this report, and their locations are shown on Figure 3.

During the second stage of Phase III, contaminated sediment was removed from certain areas alongside sixteen (16) Harbor shoreline facilities. The contaminated material recovered from these 16 areas was transported to and deposited into CAD Cell 2. Pre- and post-dredge surficial sediment samples were obtained for analytical testing and confirmed that sediment quality conditions improved significantly as a result of the project. The full Phase III Post-Dredge / Existing Conditions Report is attached as Appendix D.

2.6 APEX-NBHDC 2011 PHASE IV CAD CELL #3 DESIGN

As part of a proposed expansion of the South Terminal marine facility, NBHDC and the Massachusetts Clean Energy Center commissioned the design of a third CAD Cell in the DMMP area for which Apex conducted a bathymetric survey and a subsurface investigation of potential CAD Cell sites. Based upon a review of the data collected and previously available data, Apex designed a CAD Cell to accommodate the contaminated material anticipated to be removed during the South Terminal expansion. Geotechnical borings advanced as part of the subsurface investigation for the design of CAD Cell 3 were used to establish locations for borings to be installed as part of this SAP for the LHCC effort. The locations of the borings advanced for the CAD Cell #3 design are included on Figure 3.

2.7 GEOLOGIC INFORMATION

Geoscientists retained by NBHDC have reviewed previously collected data to determine the most advantageous location for placement of the LHCC north of Popes Island. Based on existing information, it is anticipated that geologic material within the general area for the proposed LHCC will consist of the following: a surface layer of soft organic silt or clay, underlain by sands, inorganic silt and gravel, glacial till on top of bedrock that is typically granitic gneiss. It is also anticipated that depth to bedrock will be encountered approximately 60 to 70 feet below Mean Lower Low Water in this area, although sub-bottom profiling and geotechnical borings will be needed confirm this assumption. Previous vibracore investigations in this area have also occasionally encountered a discontinuous layer of peat in the sediment stratigraphy located within the DMMP CAD Cell area. Additional information pertaining to the physical characteristics of the sediment will also be collected to supplement available historic data as part of this SAP.

2.8 CHEMICAL CHARACTERIZATION

Chemical characterization of the surficial sediments has also been addressed in a previous Vibracore sampling program performed over the entire DMMP area, which includes the footprint of the proposed CAD cell site. While PCB levels were elevated in the upper 1 to 1.5 feet of soft sediment, analytical results from lower in the organic silt, and the glacio-fluvial strata yielded very low to non-detect levels of PCB contamination. This finding is consistent with previous sediment characterization programs within New Bedford Harbor.

Granular material underlying the proposed LHCC area has previously been evaluated for use as capping material, and for off-site reuse applications such as beach nourishment and/or open-water disposal. However, the USACE may determine that additional chemical and biological testing of the sediment underlying the shallow organic silt is required, for evaluation of reuse and/or off-shore disposal options, as a condition for issuing a Suitability Determination for the LHCC Project.

3.0 PROPOSED SCOPE OF WORK FOR THE LHCC PROJECT

The NBHDC has been awarded a grant to provide to the USEPA the services required to design and construct a LHCC to provide approximately 300,000 cubic yards of contaminated sediment disposal capacity. The project will commence with activities related to determining the most advantageous location and elevation of the top of the proposed LHCC, and verifying the initial conditions at existing CAD Cells to establish their capacity to receive either contaminated material for disposal or suitable material for capping.

Once potential footprints of the LHCC have been established, geotechnical borings will be advanced and vibracore sampling will be performed. Date collected during these efforts will be used to characterize the composition of contaminated material to be removed with construction of the top of the CAD cell and of uncontaminated material from the bottom of the CAD cell. This information will be incorporated into LHCC design considerations and to advise potential contractors of the nature of the material to be handled during construction. In addition, Russian peat core sampling and sediment probes may be completed to augment sediment data obtained by boring and vibracoring. Russian peat cores sampling and sediment probes provide an efficient means to determine the depth of surficial layers of soft organic sediment, but only complement and cannot equal the greater depths that vibracores and geotechnical borings are capable of probing.

Geophysical surveys will be conducted in the area of the proposed EPA LHCC to augment the data collected from the boring and vibracore program. First, a sub-bottom profiling survey will be conducted in the proposed CAD Cell area to determine the sediment layers' thickness and augment information generated by subsurface sampling to establish the depth to bedrock between the borings. Second, a side scan sonar imaging survey will be completed to determine if any new hazards have been deposited within the proposed EPA LHCC area since the last survey in 2001. A magnetometer survey will also be completed in the EPA LHCC area to determine if there are buried obstructions, or any targets located in the side scan survey are metallic. Using the side-scan survey with the magnetometer survey will help to quantify the mass of debris at the harbor floor and will help estimate total debris removal costs for the EPA LHCC. Lastly, a bathymetric survey will be completed and coupled with the sub-bottom profiling results to determine volumetric calculations of organic inorganic sediment.

NBHDC will incorporate the information obtained by subsurface remote sensing and the subsurface geotechnical investigation from within the dredge footprint in order to determine the final size, and develop a detailed design of the CAD Cell. The results of the sediment characterization will also support procurement of a USACOE offshore disposal Suitability Determination for the preparation of a Programmatic General Permit (PGP) application to obtain authorization for disposal of uncontaminated material in an open-ocean disposal site, including the

Rhode Island Sound Disposal Site (RISDS) and/or the Cape Cod Bay Disposal Site (CCBDS). In a Memorandum dated January 12, 2012, USACOE provided a sampling and analysis plan specifying forty-three (43) cores should be taken from the LHCC dredge area, with associated sub-sampling and testing requirements. The exact number of vibracore sampling locations and the sampling procedure for homogenous sediment cores was arrived at in subsequent email correspondence occurring between January 30 and March 6, 2012. The USACOE Memorandum and associated email correspondence are attached as Appendix E.

As an alternative to open ocean disposal, NBHDC will investigate the potential beneficial re-use options for the uncontaminated excavated material. For example, potential on-site re-use could involve using the material on USEPA's pilot capping project at OU-3, located immediately outside of the New Bedford Harbor hurricane barrier or material could be stockpiled for future use in proposed onshore/near-shore improvement locations within close proximity to the Harbor. NBHDC intends to explore and exhaust all feasible beneficial re-use options prior to sending the material offshore for open-water disposal.

4.0 SURVEY VESSELS AND REMOTE SENSING EQUIPMENT

The following sections describe the vessels and geophysical survey equipment to be employed in the completion of the field work for this project.

4.1 SURVEY VESSELS

The principal survey vessel will be the *Xepa V*; a 24-foot Hewescraft aluminum survey vessel, which will be used for most of the geophysical investigations including: side scan sonar, sub-bottom profiling, magnetometer, and bathymetric surveys. The *Xepa II*, a 20-foot Bristol Ocean Scout fiberglass work boat, will be used as needed as a survey/sampling/work vessel, especially when multiple teams are required on the water in a given day. Additionally, the *Xepa IV*, a 25-foot Ocean Crest pontoon sampling vessel, will be used for water and sediment sampling including the vibracores, and, if any, Russian peat core sampling or sediment probes as appropriate.

The survey vessels are outfitted with equipment capable of producing accurate and detailed images of the harbor bottom and shallow sub-bottom. Side scan sonar will be utilized to produce picture-like acoustic images of the harbor bottom in order to map bottom features and objects, such as pipes, fishing debris, and rocks. Sub-Bottom Profiling Units will be used to estimate the thicknesses of sediment layers and to measure depth to bedrock. The magnetometer will be used for locating metallic objects at or below the mudline. All geophysical instruments are to be integrated with survey grade Differential Global Positioning System (DGPS) equipment, to be further discussed in Section 4.2, to obtain accurate location referencing information.

4.2 GLOBAL POSITIONING SYSTEM

Horizontal positioning and navigation for the project will be accomplished using a Trimble GeoXH DGPS, or Trimble Pathfinder ProXRS DGPS. The DGPS consists of a satellite antenna and radio transmitter mounted on the roof of the vessel and the Trimble GeoXH/ProXRS processing system mounted in the cabin. Satellite positioning data will be logged at a rate of once per second, and differential corrections are obtained through WAAS or OmniStar Satellite Based Augmentation Systems, for real-time sub-meter accuracy. The DGPS generates a constant stream of corrected position information which is output to all ship board systems, including the Side Scan System, the Sub-Bottom Profiling systems, and the HYPACK navigation system. HYPACK hydrographic survey software is utilized to store the time-tagged position data in both latitude-longitude format and in the project datum (US State Plane – NAD83, Zone - Massachusetts Mainland 2001, US survey feet). The HYPACK system also

provides real-time vessel position status on a helmsman's display for running of data collection lines (track-lines). An outline of the harbor superimposed with the proposed track-lines is entered into the HYPACK system at the start of the field program. These proposed track-lines are then projected onto the helmsman's display as the survey is in progress. The position of the vessel, as determined by the DGPS system, is superimposed in real-time onto the track-line layout, so that the vessel Captain can "steer-to" navigate to stay on course and run straight and accurate data collection lines.

4.3 BATHYMETRIC SURVEY

Depth to ocean floor will be calculated using an ODEC Bathy-500DF fathometer accurate within ±0.1 foot depth reading. When interfaced with a NMEA-0183 streaming DGPS device it is a full survey-ready system. The ODEC Bathy-500DF will connect to single or dual frequency transducers. The transducer to be used during the bathymetric surveys is one of three available transducers, the dual frequency 33kHz/210kHz, the 6 degree 200kHz, or the 3 degree 200kHz transducers. The depth soundings and the DGPS vessel position will stream into the field computer using HYPACK and are shown on the helmsman's display. Sound velocity measurements will be taken at the beginning and end of the survey day, as well as after any noticeable change in conditions. The sound velocity measurements will be applied during the processing stage. Sound velocity changes as a function of depth and temperature, and salinity. The sound velocity will be collected from within the survey area to adequately capture physical differences in the water column of the survey area. Bar checks will be completed at the beginning and ending of the survey to be sure the Bathy-500DF is reading accurately. Bar checks are completed with a weighted place affixed to a graduated line. Special care is taken while conducting bar checks so that the boat does not list to the port or starboard to ensure that check reading accurately reflects the draft and roll of the survey vessel while it is underway. Tide readings are recorded using a Level Troll 5000 affixed to a graduated tide board set at a point within the harbor that has been referenced to a known bench mark. Manual readings will be taken throughout the day to ensure the data collected with the Level Troll 5000 is accurate and consistent. Tide readings will be subtracted out during processing to give depth measurements in mean lower low water (MLLW). Tide boards will be placed as close to the survey area as possible as the tides within the Harbor do not have steady ebb and flood as the harbor does not have an unrestricted tidal flow to Buzzards Bay.

4.4 SUB-BOTTOM PROFILING SURVEY

The Sub-bottom data will be collected from a survey vessel with a Edgetech 3100 top-side digital data acquisition system coupled with the Edgetech SB-216 S towfish, or equivalent. Real-time northing and easting position information will be fed into the Edgetech 3100 topside unit from the DGPS system, which logs

the position of the collected data as it streams back from the SB-216 S towfish. A tide gauge and Level Troll digital tide monitoring device will be used in the Harbor for continuous tidal monitoring during the survey.

An Edgetech SB-216 S (or similar) towfish is to be used for data collection. The towfish is a towed instrument, deployed over the side of the survey vessel, which generates a spread frequency sonar ping (or “chirp”) from an internal transducer. An internal hydrophone then “listens” for the return signal which is reflected off of the bottom sediments and the strata interfaces below. Hydrophones are highly sensitive transducers that generate a voltage that is proportional to a change in pressure (i.e., a pressure wave propagating through a medium such as mud of the harbor bottom). The SB-216 S towfish transmits this signal back to the 3100 topside unit, where it is recorded and displayed digitally. A minimum of two copies of each record are electronically copied out in the field as a backup for the digital data. The topside unit records the voltage generated by each return signal immediately after initiation of a ”chirp”, and displays the result as a profile (or cross section) of return signals recorded over time, which mimics the cross section of strata reflecting the chirp.

4.5 SIDE-SCAN SONAR IMAGING SURVEY

The side scan sonar system to be used is a Marine Sonic 600 kHz side scan sonar towfish matched with a Sea Scan PC Desktop system. The side scan towfish is towed off a starboard winch and is held at depths of approximately 6-8 feet. The Marine Sonic 600 kHz side scan sonar towfish is connected to the Sea Scan PC Desktop system via communication cable for shipboard data collection and processing. Chesapeake Technology’s SonarWiz software is used for digital data recording from the towfish and integrates the data with navigation inputs for real-time viewing of the Side Scan image in pseudo-map format. The data is stored digitally for future post-processing and interpretation using Chesapeake Technology’s SonarWiz. The data is recorded and displayed as digital location-corrected pseudo-maps of the acoustic response of the harbor bottom.

4.6 MAGNETOMETER SURVEY

The magnetic data will be collected with a Geometrics G-882 cesium vapor Marine Magnetometer system (or similar) consisting of a high-sensitivity in-water marine magnetic sensor coupled to a digital data processing computer system running Geometrics MagSea processing software. The MagSea software will be utilized to calibrate the system and to record and display the raw digital magnetic data. The G-882 system is designed for shallow water applications and is easily deployed from small survey vessels. The magnetic sensor will be deployed from the stern of the survey vessel far enough behind the vessel (50-75ft) to be beyond the effects of the magnetic field generated by the boat’s engines and electronics. The depth of the sensor will be controlled by attaching a cable

leader to a floatation device such that the swim depth of the sensor will remain constant, approximately one to two feet below the water surface. This will allow the survey to be completed in shallow or deep water conditions without the risk of hitting the bottom of the harbor with the sensor. The system will be set up to output the raw digital magnetic signature values to a computer screen for real-time initial interpretation and to project the positioning system computer (running Hypack software) for permanent data storage and later post-processing and interpretation. The Hypack software will log the raw magnetic data, time stamping each reading with a DGPS navigational position obtained from the positioning system. Readings are to be collected at one reading per second. The sensor tow fish “layback” will be entered into the Hypack system for the correct position of the sensor to be calculated and logged.

5.0 SUBSURFACE INVESTIGATIONS

Subsurface information will be collected to guide the LHCC design process with regard to angles of internal friction, slope stability, and potential methods for re-use of sediment materials. This information will also be used for obtaining a USACOE Suitability Determination by meeting the requirements of the USACOE sampling and analysis plan Memorandum dated January 12, 2012, attached as Appendix E. Subsurface conditions information regarding the types of material potentially encountered during construction of the LHCC will also be incorporated into bid specifications and provided to potential bidders as part of the procurement process. Construction subcontractors submitting a bid can thereby evaluate the level of effort required to excavate sediments as specified by the design as part of their cost quotation considerations.

Over-water subsurface borings and vibracores, and possibly Russian peat cores, will be advanced to determine the exact composition of material within the general area that the LHCC could be constructed. As the depth to bedrock is thought to be relatively deep in this area, the borings will be installed into bedrock and will require several days each to install. Sampling equipment used to collect samples for chemical analysis and biological testing will be decontaminated between sampling events using Alconox or a similar cleaning agent prior to reuse for collection of each individual sample. Single-use liners will be used when a vibracore sample collection procedure is adopted. Care will be taken to ensure that samples are not exposed to vessel exhaust fumes, grease, or other contaminants aboard the sampling vessel. The deck and work areas of the sampling vessel will be kept in a clean workman-like manner to avoid potential cross-contamination of samples.

5.1 GEOTECHNICAL BORINGS

Borings will be advanced to bedrock within the general area of the proposed footprint of the LHCC employing drive-and-wash or equivalent methodology. As the exact final location of the LHCC is unknown at the beginning of the subsurface investigation, a portion of the planned borings will necessarily be located outside of the ultimate footprint of the CAD cell. Depending upon the speed of boring advancement, up to 10 borings will be advanced to bedrock from a floating barge located within the proposed alignments of the LHCC. It is currently anticipated that each boring will take at least three days to complete and one extra day is budgeted to account for weather delays.

The boring program will require mounting a drill rig onto a floating barge to be mobilized to the site specifically for this work, and anchoring the barge in place, in order to advance casing down to bedrock. Sediment samples collected from these borings will be immediately submitted for geotechnical characterization, as

described in a subsequent section of this SAP. See Appendix F for the Geotechnical Boring Standard Operating Procedure, and Appendix G for the Geotechnical Boring Log Form. The soils collected during the boring program will be classified utilizing the modified Burmeister system.

5.1.1 GEOTECHNICAL BORING LOCATIONS

The placement of up to 10 boring locations for the proposed LHCC is based on the review of existing geotechnical data and subsurface remote sensing data. To optimize the generation of information to support design of the CAD Cell, locations for the subsurface sampling program are configured to provide preliminary sediment characterization of excavated material to aid in procuring a Suitability Determination. It is anticipated that USACE will rely upon the final location and depth of the proposed CAD Cell to ascertain whether additional testing of the sediments for determination of open-water disposal suitability would be required.

The geotechnical borings to be used in the LHCC subsurface investigation are shown on Figure 3. Test boring locations will be located in the field using a Global Positioning System (GPS) and marked with a buoy for positioning the barge mounted drill rig. Once the drill rig/sampling vessel is on station, the as-built coordinates and water depth to mudline at the boring location will be logged, and corrected for tide elevation. The boring logs will document GPS locations, soil descriptions, sampling depths, standard penetration resistance, etc. as described in Appendix G.

5.1.2 GEOTECHNICAL BORING SAMPLE COLLECTION

Split-spoon sampling will be conducted continuously for the entire boring depth. A two foot split-spoon sampler will be advanced through each interval until refusal is reached, and for each split spoon sampling interval, a Standard Penetration Test (SPT) will be conducted in order to aid in determining the stiffness and/or consolidation of underground geologic formations. Certain sample intervals may be omitted in the event that impenetrable materials are encountered by the split-spoon sampler, such as cobbles or boulders. In this situation, borings will be advanced with a roller bit to the next sampling interval. To confirm that bedrock has been reached when the split spoon reaches refusal, a 10-foot rock core will be advanced and retrieved for description and logging. Soil boring logs and rock core logs will be created summarizing the results of subsurface borings utilizing the modified Burmeister system for soil descriptions.

Sediment samples will be logged and visually characterized prior to collection in sample containers. Soil descriptions will be performed in the field at the time of sample collection in accordance with ASTM 2488-93 “Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)” with narrative soil descriptions (e.g., relative grain sizes, color, odor, strata, core length, sampling depths, penetration resistance, etc.).

5.2 VIBRACORES

Vibracores will be advanced to refusal within the proposed footprint of the LHCC in the locations as shown on the attached Figure 4 and in accordance with the amended USACOE sampling and analysis plan attached as Appendix E. As the exact final location of the LHCC is unknown at the beginning of the subsurface investigation, a portion of the planned vibracores will necessarily be located outside of the ultimate footprint of the CAD cell. It is currently anticipated that each vibracore will take at least two hours to complete. During vibracore advancement, the vessel will be anchored in place and the casing driven down to refusal. Sediment samples collected from these vibracores will be immediately submitted for geotechnical and chemical characterization, as described in a subsequent section of this SAP. This vibracoring program will require mobilizing Apex's sampling vessel to the site specifically for this work. See Appendix H for the Vibracoring Standard Operation Procedure and Appendix I for the Vibracoring Log Form.

5.2.1 VIBRACORE LOCATIONS

In its Memorandum dated January 12, 2012, as amended in subsequent email correspondence, USACOE specified the location of forty-three (43) cores to be taken from the general LHCC dredge area, and provided associated sub-sampling and testing requirements (refer to Appendix E). The results of the vibracore program for sediment characterization will support preparation of a PGP application to obtain a USACOE offshore disposal Suitability Determination for disposal of uncontaminated material in an open-ocean disposal site, which would mostly like be the RISDS and/or the CCBDS. The USACOE-specified sampling locations will be uploaded into Hypack software aboard the sampling vessel to accurately identify each exact on-the-water location. Anchors will be deployed to stay on position during each sampling event, unless there are favorable weather conditions in which the captain can adequately hold position. Once the sampling vessel is on station, depth of water and tide values will be taken to determine the elevation of the mudline at the sample location, and the as-built coordinates and water depth will be logged. Tide elevations will be continuously monitored during sample collection efforts so that actual mudline elevations may be ascertained. Vibracore logs will be kept to document GPS locations, soil descriptions, sampling depths, etc. as described in the attached Vibracoring SOP.

5.2.2 VIBRACORE SAMPLE COLLECTION

The vibracore sampler may employ a six-, ten-, or twenty-foot core barrel depending on the hardness of the soil type of the Harbor bottom. The vibracore head is an aluminum-encased vibratory motor used to advance the core barrel into the sediment. When the core barrel reaches refusal, a measurement will be

taken to determine the final depth of penetration. The vibracore is then retrieved on board the vessel, removed from the core barrel, measured, described, and sampled. Sampling personnel will maintain a log book to note depth of water, tide values, penetration depth, recovery, and sediment characteristics that are necessary for the preparation of the final vibracore logs. The vibracores will be sub-sampled for grain size and chemical analysis in accordance with the amended sampling and analysis plan specified by the USACOE, attached as Appendix E.

5.3 RUSSIAN PEAT CORES

It is not anticipated that obtaining Russian peat cores will be necessary to characterize soft sediments in the proposed LHCC project area. If needed, Russian peat cores will be advanced to refusal, the exact location of which will be determined after completion of sub-bottom profiling. As the exact final location of the LHCC is unknown at the beginning of the subsurface investigation, the location of some Russian peat core sampling locations could be outside of the ultimate footprint of the CAD cell.

5.3.1 RUSSIAN PEAT CORE LOCATIONS

The Russian peat core sampling technique could be employed in the event that additional stratigraphic information is needed for areas located between previously installed boring and vibracore sampling locations. Proposed sampling locations will be uploaded into Hypack software aboard the sampling vessel to accurately identify each exact on-the-water location. Anchors will be deployed to stay on position during each sampling event, unless there are favorable weather conditions in which the captain can adequately hold position. Once the sampling vessel is on station, depth of water and tide values will be taken to determine the elevation of the mudline at the sample location, and the as-built coordinates and water depth will be logged. Tide elevations will be continuously monitored during sample collection efforts so that actual mudline elevations may be ascertained. Russian peat core logs will be prepared to document GPS locations, soil descriptions, sampling depths, standard penetration resistance, etc. as applicable.

5.3.2 RUSSIAN PEAT CORE COLLECTION

The Russian peat core sampler employs a three-foot half barrel equipped with a swing blade sampling device. The sampler is lowered the harbor floor in the closed position and is advanced into place by hand in three-foot intervals, which are marked off on the sampler extensions. When the desired sampling depth interval is obtained, the sampler is twisted 180 degrees to close the blade against the sample cut by the rotated half barrel and the sequestered sample is then retrieved from the harbor bottom. Once on deck, the sampler is opened to record the extent of sample recovery and record sediment characteristics. On

successive sampler events at the same location, the Russian peat core is pushed to the next depth interval (e.g., 3'-6', 6'-9', etc.) to be sampled until refusal is encountered.

In the event that a full depth interval is not reached before the sampling device encounters refusal, the lowest portion of the sample below the last full interval will be kept and recorded as refusal. For example, if the Russian peat core is advanced to a depth of 4.5' and then encounters refusal, a 0 to 3' sample and a 3' to 4.5' sample will be obtained for that particular location. Because the sampler always cuts a 3-foot core sample, the second core would be from the 1.5' to 4.5' interval. In this instance, the top 1.5' of the sample representing 1.5' to 3.0' would be discarded to avoid duplication of the previous sample interval.

Sampling personnel maintain field logs recording depth of water, tide values, penetration, recovery, and sediment characteristics for the final Russian peat core logs using a modification of the Vibracoring Log Form provided in Appendix I, with notations indicating that a type of sampling technique other than vibracoring was employed.

5.4 SEDIMENT PROBES

The sediment probe sampling technique could be employed in the event that additional stratigraphic information is needed to supplement the limitations of the information obtained using the Russian peat core sampler, which often cannot penetrate glacio-fluvial or glacial marine sediments. Sediment probing is a simple way to determine depth to fluvial marine sediments at the Harbor bottom and no actual sediment sample is collected during a sediment probing event. The data collected from a sediment probe are the coordinates collected on a per point basis with the DGPS system and the depth of soft sediments penetrated. Locations of sediment probes in the LHCC will be based on the review of existing data and preliminary subsurface remote sensing data collection activities.

Proposed sediment probe sampling locations will be uploaded into Hypack software aboard the sampling vessel to accurately identify each exact on-the-water location. Anchors will be deployed to stay on position during each sampling event, unless there are favorable weather conditions in which the captain can adequately hold position. Once the vessel is on station, depth of water and tide values will be taken to determine the elevation of the mudline at the sample location, and the as-built coordinates and water depth will be logged. Tide elevations will be continuously monitored during sample collection efforts so that actual mudline elevations may be ascertained. A field log book will be maintained to document GPS locations, sampling depths, and any other notable observations.

5.4.1 SEDIMENT PROBE SAMPLING

A sediment probe employs the use of a long ½-inch or ¾-inch pipe fitted with a pipe cap at the sampling end to prevent contaminated sediment from entering the pipe. The sediment probe can be shortened or lengthened according to accommodate the various depths of sediment encountered. The diameter of the probe allows penetration into the soft sediments with relative ease, although sometimes friction of the sediment against the pipe can be used to discern inorganic silt versus sandy silt materials. Sampling personnel push the sediment probe through the soft sediments at the Harbor bottom until refusal is encountered, which is typically presented by very dense sand or silt. Stratigraphic information obtained by sediment probe sampling but will be interpreted in the context of that obtained by geotechnical boring, vibracoring, and/or Russian peat core sampling techniques.

6.0 LABORATORY TESTING

An analytical testing program will be required to adequately characterize certain physical and chemical properties of the sediment to be dredged during the construction of the LHCC. In addition to sediment sample collection, water samples must be collected prior to initial dredge activities to establish baseline water quality characteristics for comparison to water quality monitoring data obtained during ongoing dredge and disposal activities.

Samples requiring physical characterization will be sent to a qualified geotechnical testing laboratory. The laboratory utilized for the chemical analyses must meet Regional Implementation Manual (RIM) requirements of the New England District of the USACE for the laboratory tests being performed (see http://www.nae.usace.army.mil/reg/rim.htm)[1]. In addition to meeting RIM laboratory requirements cited above, sample analysis required for chemical characterization will be performed by an independent laboratory certified by MADEP or accredited by the National Environmental Laboratory Accreditation Conference (NELAP).

QA/QC samples will be collected as part of the sampling protocol in accordance with requirements specified by the laboratory conducting the chemical and/or biological analyses, which may exceed the standards established by USEPA and USACOE. The sampling protocol may include the collection of duplicate, blank, and split samples at a rate sufficient to meet guidelines of the environmental chemistry laboratory. Every effort will be made to deliver samples collected for chemical testing to the laboratory and specify testing parameters within 24 hours of sample collection. Samples will be hand-delivered or couriered to the laboratory in sample coolers in order to maintain appropriate sample conditions. Chain-of-custody (COC) protocols will be maintained for each sample shipment to the point of delivery at the laboratory and fully executed COC forms will accompany all data reports.

6.1 GEOTECHNICAL TESTING – PHYSICAL CHARACTERIZATION

As geotechnical borings are advanced, a number of samples will be collected in order to characterize the geologic layers encountered during subsurface investigation. In addition to cataloguing the field description at the time of sample collection, representative samples from major strata encountered will be submitted to a qualified geotechnical laboratory for grain size analysis, Atterberg

[1] "Regional Implementation Manual for the Evaluation of Dredged Material Proposed for Disposal in New England Waters." Prepared by U.S. EPA New England and the U.S. Army Corps of Engineers, New England District. April 2004.

limits, and hydraulic conductivity. The grain size analysis will allow for a more precise determination of the composition of geologic formations within the location of the CAD Cell. It is anticipated that approximately 75 samples obtained from geotechnical borings will be assigned for determination of grain size distribution. In addition, each sediment core layer obtained from vibracoring for chemical testing will also be tested for grain size distribution.

The proposed geotechnical analytical testing parameters are outlined below:

Parameter	Test Standard	Test Description
Grain Size Distribution	ASTM, 1998a	Gravel through Clay Size
Atterberg limits	ASTM, 1998c	Liquid, Plastic Limit, Plasticity
Hydraulic Conductivity	ASTM, D5084	Ability of the Soil to Transmit Water

6.2 CHEMICAL CHARACTERIZATION

The potential LHCC alignments are situated partially within an envelope for which USACE previously issued a Suitability Determination for dredge materials to be disposed of at the CCBDS. Additional chemical characterization of sediment to support the effort to obtain a new or revised Suitability Determination will be required beyond the limits of the previously permitted envelope and for potential disposal of dredge materials at the RISDS. From the amended USACOE sampling and analysis plan, vibracore sediment samples obtained as described in Section 5.2.2 will be analyzed for copper, chromium, and zinc. The proposed vibracore analytical testing parameters are outlined below:

Parameter	EPA Analytical Method	Method Detection Limit (mg/Kg)
Chromium	6020	0.5
Copper	6020	0.5
Zinc	6020	1.0

6.3 WATER QUALITY MONITORING

All construction activities related to dredging and disposal must be performed in such a manner as to minimize adverse impacts to water quality. As part of the SER, Performance Standards for maintaining water quality during dredge projects were established that follow the guidelines of the MADEP Water Quality Program Standards. NBHDC will be responsible for water quality sampling and testing required for monitoring construction activities to ensure conformance with the Performance Standards. If water quality performance standards are

exceeded during either dredging or disposal operations, the Contractor may be required to implement a Contingency Plan to regain conformance with the MADEP Water Quality Program Standards. Prepared by the Contractor, the Contingency Plan provides details of specific actions to be taken by the Contractor which may consist of additional operational controls, alternate procedures and equipment, and modification of the timing of dredging/disposal events.

6.3.1 PRE-DREDGE WATER QUALITY CHARACTERIZATION

For previous dredging and disposal operations, NBHDC has characterized a pre-dredge water quality sample at a reference point in the Harbor to establish a baseline standard for water quality samples to be compared against. This sample is taken just south of the Route 195 Bridge at the northern most mooring location. This location was selected because it is upstream of the DMMP area but south of the EPA upper harbor Superfund Site clean-up.

Prior to initiation of dredging activities associated with construction of the LHCC, NBHDC will collect background water column data from reference locations for laboratory analysis of the following parameters: dissolved metals (arsenic, cadmium, copper, chromium, lead, mercury, nickel, zinc) and PCBs, as well as total suspended solids (TSS), turbidity and dissolved oxygen (DO). The sample analyzed from this location will be a composite sample taken from three depths within in the water column: top, middle, and bottom. Using a Kemmerer sampler to obtain a discrete sample at an exact specified depth, top and bottom samples are obtained two feet from the top and bottom of the harbor, respectively. The middle sample is obtained from the middle of the water column. The sampler is opened and lowered to the correct depth where it resides for a few seconds for natural inflow of Harbor water before a signal is sent down the line to close the sampler. The sampling device is retrieved onto the vessel where sampling personnel open a stop-cock to collect the sampled water into a pre-cleaned compositing pail. After decontamination, the sampler is reused at the next compositing depth or location.

6.3.2 DREDGE ACTIVITY MONITORING

Turbidity monitoring will be performed by the NBHDC prior to the start of dredging and every two (2) hours thereafter on the first day of dredging operations. Turbidity monitoring will be performed at random in the same manner at a rate of at least three (3) days per week during the first week of dredging and at least two (2) days per week thereafter until the conclusion of the project. This monitoring schedule may be less frequent if in-water dredging activities do not occur on a daily basis or are otherwise suspended during the course of the project. The exact schedule of monitoring activities will be determined by the NBHDC in consideration of the Contractor's proposed daily schedule of operations, progress of work, and if any changes in dredging procedures and/or equipment occurs.

Frequency of subsequent monitoring will be established by the NBHDC based on review of monitoring and sampling data, and relative compliance with the SER Performance Standards. In general, the water quality monitoring program is most stringent during construction of the top of the LHCC, as it is essentially environmental dredging that requires all of the monitoring and controls in keeping with previous environmental/navigational dredging projects. However, with construction of the bottom of the LHCC, the removal of uncontaminated materials deemed suitable for offshore disposal by USACOE are not subject to the same strict requirements; some turbidity monitoring may be needed, but to a lesser extent as with contaminated sediment, and chemical water quality is not applicable when uncontaminated material is handled.

Two locations will be selected for turbidity monitoring of dredging activities: a reference location approximately 200 ft up current from the dredging activity, and a monitoring location established 200 feet down-current from the dredging operation. If silt curtains are deployed as a measure to contain suspended dredge material, a monitoring location will be established outside of and within fifteen (15) feet of the silt curtain. Turbidity will be measured at three depths within the water column at each location: near the surface, mid-depth, and near the bottom. The three measurements will be averaged together to obtain a single representative value for comparison purposes. Turbidity measured at the down-current location which exceeds the up-current reference by the following values in two consecutive monitoring events shall be considered an exceedance:

If silt curtains are deployed:

Reference Site Turbidity (NTUs)	Permissible Turbidity Increase
<10	Reference plus 20 NTUs
11-20	Reference plus 15 NTUs
>21	Reference plus 30% of reference

If silt curtains are not deployed:

Reference Site Turbidity (NTUs)	Permissible Turbidity Increase
<10	Reference plus 20 NTUs
11-20	Reference plus 15 NTUs
21-30	Reference plus 10 NTUs
>31	Reference plus 30% of reference

An exceedance will trigger collection of water column samples by NBHDC for analyses and the results will be compared to the reference data generated for water column collected prior to the start of dredging. Water column samples, composited over the entire water column, will be collected from both the monitoring and reference sites by the NBHDC and submitted for analysis at a certified laboratory for the following analyses: TSS, DO, TPH, pH, PCBs and selected dissolved and/or total metals.

6.3.3 DISPOSAL OPERATION MONITORING

Water quality monitoring during dredge material disposal is conducted only when contaminated sediments excavated generated by construction of the top of the LHCC are deposited into a CAD Cell located within the DMMP area of the Harbor. This activity does not apply to the disposal of uncontaminated sediment that USACOE has approved as suitable for open ocean disposal at CCBDS and/or RISDS, and/or for use as capping material at OU-3.

NBHDC will perform turbidity monitoring during the disposal operation at both of the following locations:

- Monitoring Location #1 will be obtained at a point outside the influence of the disposal plume, i.e., up-gradient;
- Monitoring Location #2 will be obtained at a point approximately 500 feet down current of the disposal site at the time that the peak concentration of the plume would pass through this monitoring point.

Turbidity will be measured at three depths within the water column at each location: near the surface, mid-depth, and near the bottom. The three measurements will be averaged together to obtain a single representative value for comparison. Turbidity monitoring data will be used as a trigger for collection of samples for analysis of other parameters.

The Contractor will be required to coordinate disposal activities to meet the requirements of the water quality monitoring program. NBHDC will conduct water column turbidity monitoring of the disposal operation during the following disposal events:

- Disposal Monitoring Event #1 will occur following the first disposal event;
- Disposal Monitoring Event #2 will occur following the next disposal event that occurs during an incoming or outgoing tide (only necessary if the Disposal Monitoring Event #1 occurs during a slack tide); and
- Additional monitoring of the disposal operations will occur if any changes to disposal procedures, equipment, and/or discharge quantity is planned, or periodically, as determined by NBHDC's Port SER dredging consultant.

Frequency of subsequent monitoring will be established by the NBHDC based on review of monitoring and sampling data and relative compliance with the SER

Turbidity measured at Monitoring Location #2, the down-current location, which exceeds the turbidity measured at Monitoring Location #1, up-current reference location, by more than 50 NTUs in two consecutive monitoring events shall be considered an exceedance, and will trigger collection of water column samples for analysis. In such event, NBHDC will collect water samples composited over the entire water column from both the monitoring and reference sites by and

submitted for analysis at a certified laboratory for TSS, DO, TPH, pH, PCBs and selected dissolved and/or total metals.

6.3.4 FREE LIQUID DISCHARGE MONITORING

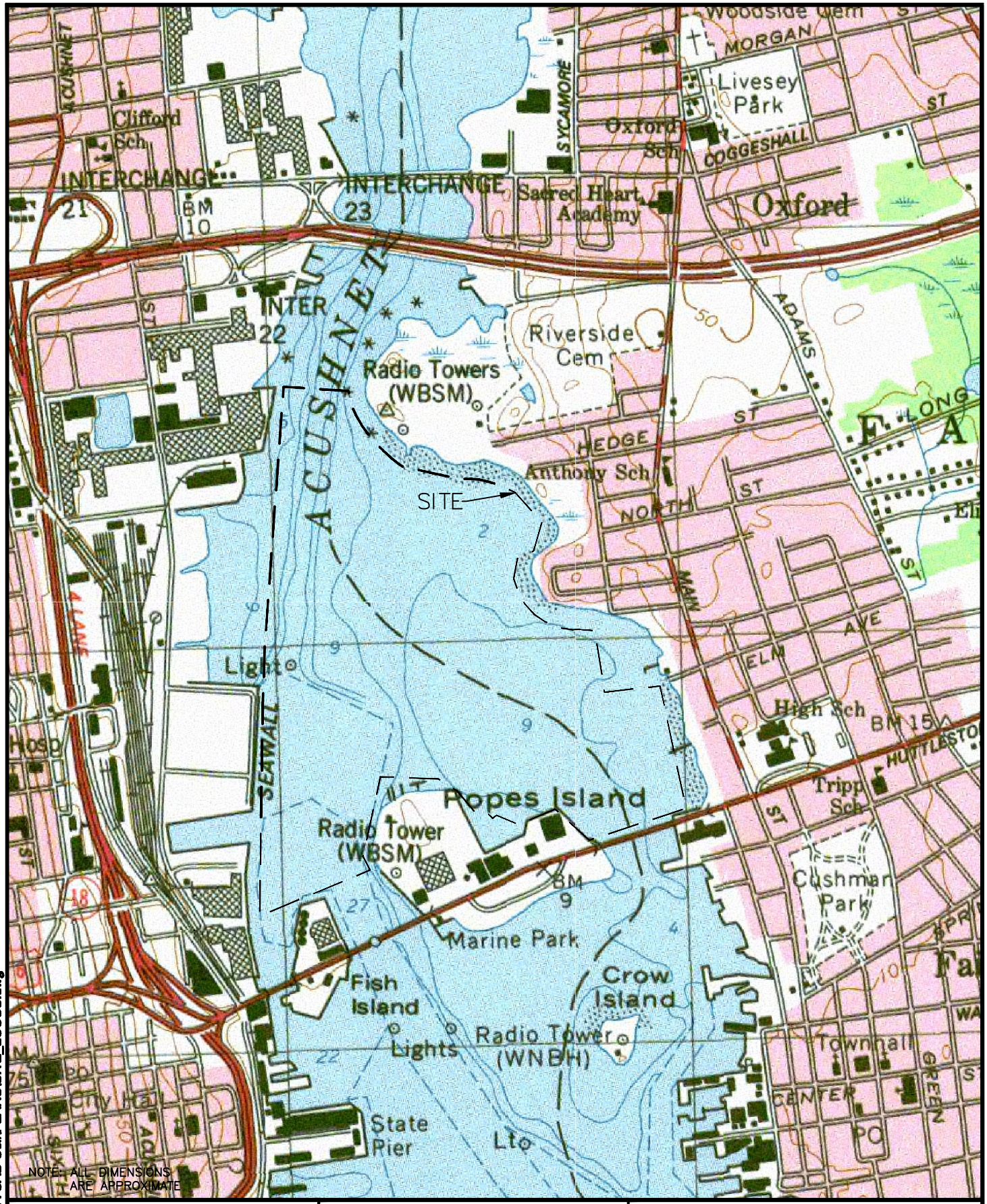
Standing water or free liquid removed from scows before disposal shall be pumped through a sand media filter or equivalent to be approved by NBHDC prior to discharge into the harbor. NBHDC will monitor the discharge effluent turbidity from the filter periodically during the first discharge event and subsequently over the course of the construction phase of the project as necessary. It is the Contractor's responsibility to: (1) provide a sampling port or other suitable sampling mechanism to facilitate sampling of the discharge; and, (2) to assure that the discharge has a turbidity of less than 50 NTUs. Monitoring of the discharge will also occur if any changes to the discharge procedures and/or equipment are implemented. If the turbidity monitoring of the discharge liquid exceeds 50 NTUs, the Contractor will stop discharging effluent until the Contractor demonstrates that turbidity of the discharge can be maintained within required limits.

6.3.5 EXCEEDANCES OF WATER QUALITY PROGRAM STANDARDS

In consideration of the elevated levels of contaminants of concern present in the sediment within the project site, the SER has established site-specific water quality criteria as a dredging performance standard. Dredging performance relative to water quality will be evaluated by comparing laboratory analytical data for the individual parameters of concern from the down current samples with the reference, or up current sample data for each sampling round. An exceedance of project water quality standards shall be attributed to project activities when turbidity measured at the down-current location which exceeds the up-current reference in two consecutive monitoring events according to the values stated above.

If water samples, composited over the entire water column, collected as described above in response to an exceedance fail to meet water quality standards and can be attributed to project activities as specified above, confirmatory samples shall be obtained by NBHDC under similar conditions within 24 hours after the laboratory provides the results of the first set of samples. The confirmatory samples shall be analyzed for the parameter(s) of concern. If the results for confirmatory water samples collected in response to an exceedance fails to meet water quality performance standards as specified above, the Contractor shall immediately implement the mitigation measures included in the Contingency Plan as appropriate and as pre-approved by NBHDC. See Appendix J for the Water Quality Monitoring Form.

FIGURES



NOTE: ALL DIMENSIONS ARE APPROXIMATE

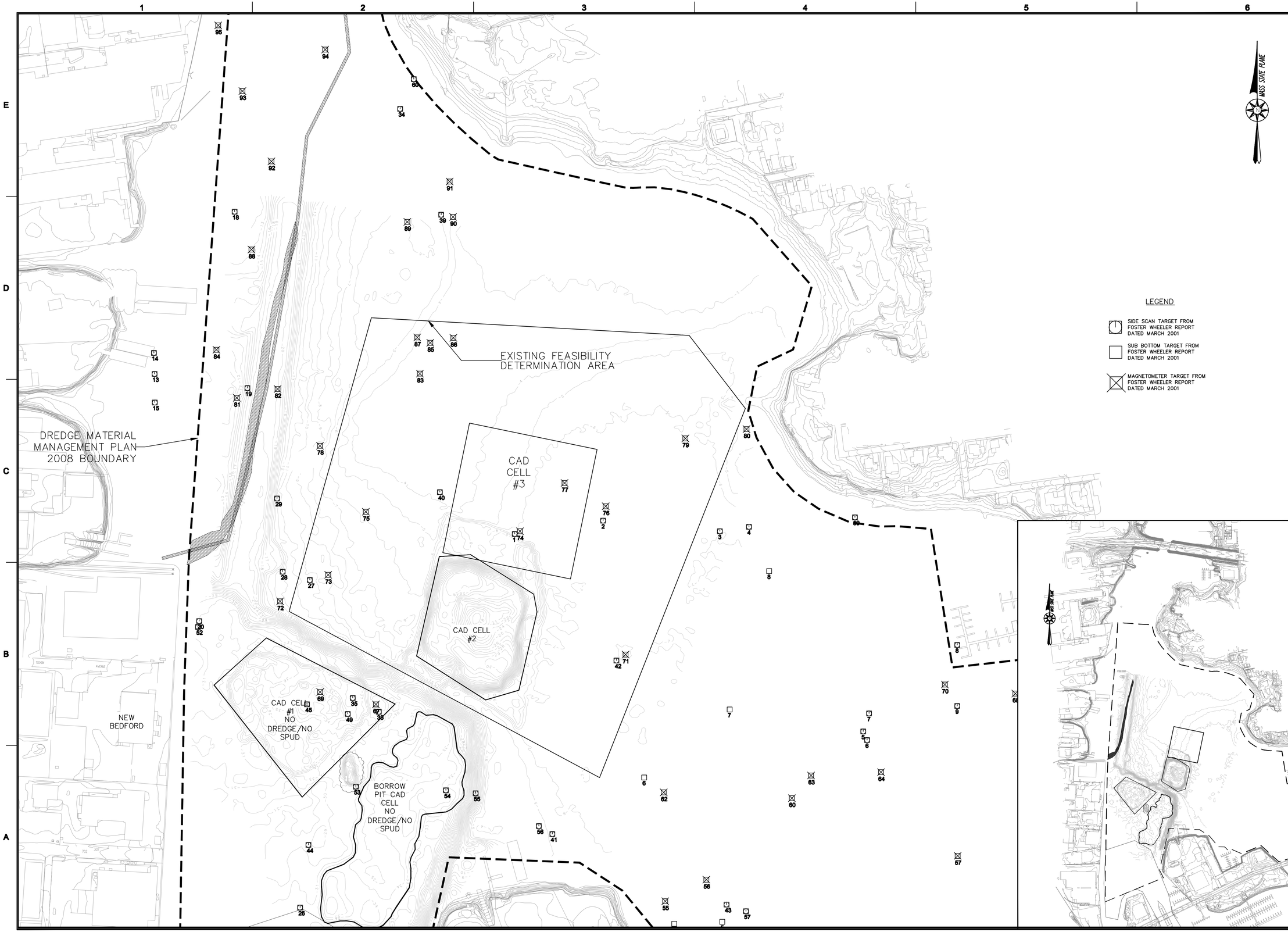
P:\Jobs\6724 EPA CAD Cell\PLANS\SITE_LOCUS.dwg

Figure 1: SITE LOCUS

NEW BEDFORD HARBOR
US EPA LOWER HARBOR CAD CELL
CFDA NO.:66.802
FOR: NEW BEDFORD HARBOR DEVELOPMENT COMMISSION

APEX

184 High Street, Suite 502
Boston, Massachusetts
Phone: (617) 728-0070



APEX

ROCKVILLE, MD
SOUTH WINDSOR, CT - BOSTON, MA - NEW BEDFORD, MA - HOLYOKE, MA

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PROJECT

NEW BEDFORD HARBOR
USEPA LOWER HARBOR CAD CELL
CFDA NO.:66.802

OWNER

NEW BEDFORD HARBOR DEVELOPMENT COMMISSION
52 FISHERMAN'S WHARF
NEW BEDFORD, MA 02745

NO.	DATE	DESCRIPTION	BY

PROJECT NO.	6724
CADD FILE	SAP FIGURE2-6
DESIGNED BY	GCD
DRAWN BY	GCD
CHECKED BY	CMM
DATE	11/8/11
DRAWING SCALE	1"=150'

GRAPHIC SCALE

SCALE: 1"=150'

0 150 300 FEET

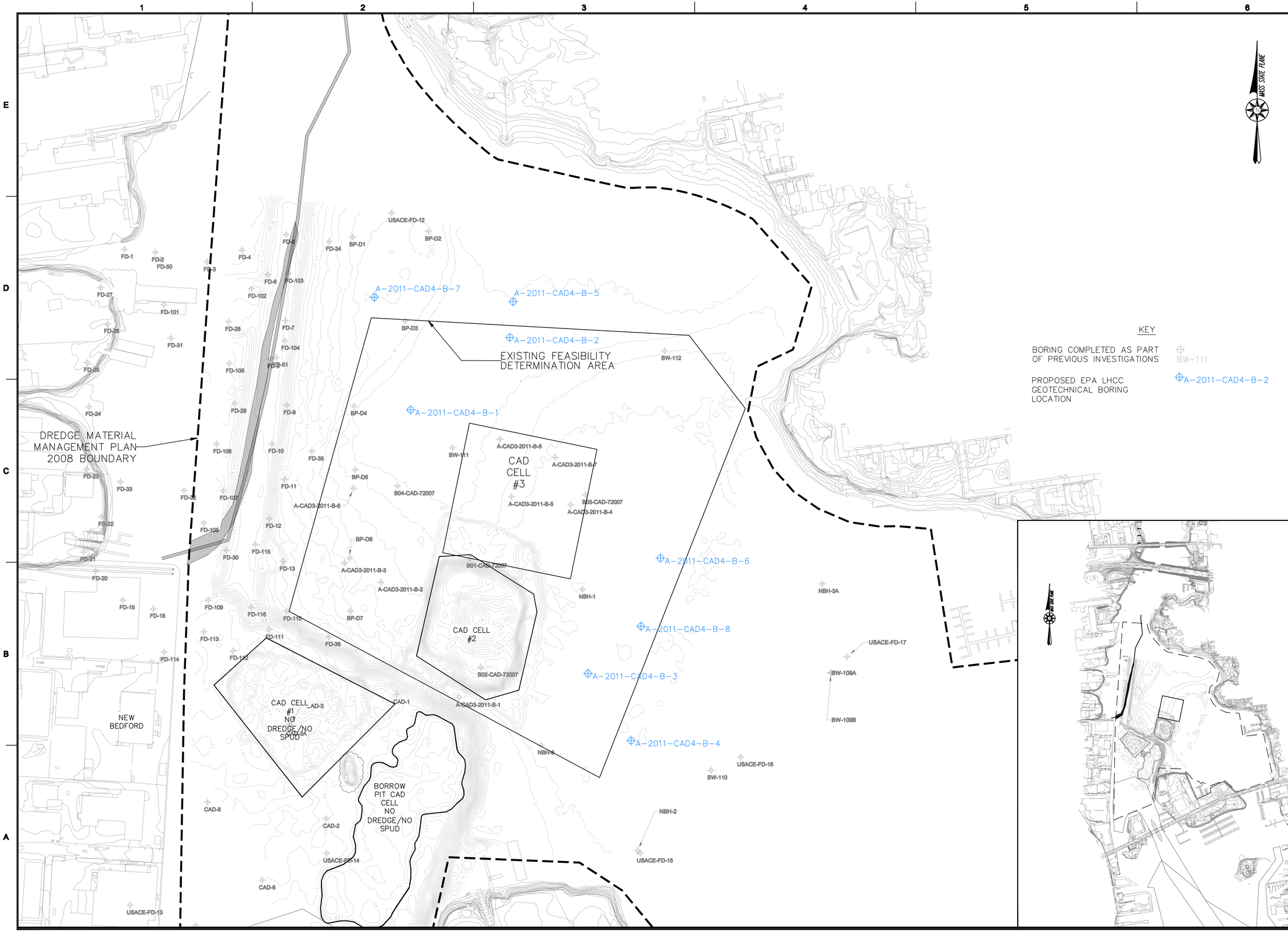
SHEET TITLE

SAMPLING AND ANALYSIS PLAN
FWENC
GEOPHYSICAL TARGETS PLAN

DRAWING NO.

FIG-2

P:\Jobs\6724 FPA CAD Cell\P ANS\SAP FIGURE2-6.dwg



APEX

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NO.	DATE	DESCRIPTION	BY

PROJECT NO.	6724
CADD FILE	SAP FIGURE3-6
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CHECKED BY	CMM
DATE	11/8/11
DRAWING SCALE	1"=150'

GRAPHIC SCALE
SCALE: 1"=150'
0 150 300 FEET

SHEET TITLE
SAMPLING AND ANALYSIS PLAN GEOTECHNICAL BORING LOCATION PLAN

DRAWING NO.
FIG-3

5 OF 6

P:\Jobs\6724 EPA CAD Cell\P ANS\SAP FIGURE3-6.dwg

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NO.	DATE	DESCRIPTION	BY

PROJECT NO.	6724
CADD FILE	SAP FIGURE3-6
DESIGNED BY	GCD
DRAWN BY	GCD
CHECKED BY	CMM
DATE	11/8/11
DRAWING SCALE	1"=150'

GRAPHIC SCALE

SCALE: 1"=150'

0 150 300 FEET

SHEET TITLE

SAMPLING AND ANALYSIS PLAN VIBRACORE SAMPLE LOCATIONS

DRAWING NO.

FIG-4

APPENDICES

APPENDIX A

"Report of Marine Geophysical Surveys: Side Scan Sonar, Sub-Bottom Profiler, and Magnetics"

(June 2001)

by Foster Wheeler Environmental Corporation

USACE CONTRACT NO. DACW33-94-D-0002
TASK ORDER NO. 017
TOTAL ENVIRONMENTAL RESTORATION CONTRACT

REPORT OF MARINE GEOPHYSICAL SURVEYS: SIDE SCAN SONAR, SUB-BOTTOM PROFILER, AND MAGNETICS NEW BEDFORD HARBOR SUPERFUND SITE OPERABLE UNIT #1 New Bedford, Massachusetts

June 2001

Prepared for

U.S. Army Corps of Engineers
New England District
Concord, Massachusetts

2001-017-0201
06/20/01

USACE CONTRACT NO. DACW33-94-D-0002
TASK ORDER NO. 017
TOTAL ENVIRONMENTAL RESTORATION CONTRACT

REPORT OF MARINE GEOPHYSICAL SURVEYS: SIDE SCAN SONAR, SUB-BOTTOM PROFILER, AND MAGNETICS NEW BEDFORD HARBOR SUPERFUND SITE OPERABLE UNIT #1

New Bedford, Massachusetts

June 2001

Prepared for

U.S. Army Corps of Engineers
New England District
Concord, Massachusetts

Prepared by

Foster Wheeler Environmental Corporation
133 Federal Street
Boston, MA 02110

Revision	Date	Prepared By	Reviewed By	Pages Affected
1	6/20/01	J. Borkland	R. Funk	All

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EXECUTIVE SUMMARY

A focused, multi-phase marine geophysical survey of portions of the Upper Harbor, Lower Harbor, and Outer Harbor of New Bedford Harbor, Massachusetts was conducted by Foster Wheeler Environmental Corporation and it's subcontractors. The surveys attempted to identify hazards (natural or manmade) on the harbor bottom or in the harbor sub-bottom, which might affect future dredging operations or operations related to the construction of the future Confined Disposal Facilities (CDFs) which are intended as part of the remedy for the Site.

The surveys covered the areas of interest using three distinctly different, yet mutually beneficial geophysical survey techniques: Side Scan Sonar, Magnetometry, and Sub-bottom Profiling. The data was processed and interpreted by geophysicists, and summary maps of potential targets, which may represent hazards to the future operations, were identified and registered on summary maps of the areas. These target summary maps, included in the figures section of this report as Figure 1 (for the Upper Harbor), Figure 2 (for the Lower Harbor), and Figure 3 (for the Outer Harbor), display the locations of the potential hazards identified in a geographic referenced format. Specific results of the processing and interpretation of the data collected by each of the three geophysical methods utilized are presented in this report as Figures 4 through 9, and in Appendices A and B. These maps and appendices display the processed images of the data utilized to generate the interpretive summary maps. Maps showing the areas of data coverage for this study are included in this report as Figures 10 through 12.

Numerous targets of interest were identified that may represent hazards to the future dredging or construction operations. These targets included both potentially manmade and natural objects and features. The "cultural" objects identified included: linear features which are thought to be indicative of the presence of pipelines and cables; individual targets thought to generally represent stand-alone features such as mooring blocks, anchors, and miscellaneous dropped objects; groups of targets clustered together and thought to generally represent structures (or the remnants of structures) such as existing or remnant piers, pilings, bulkheads, modern vessel debris, or engineered structures (submerged water intakes or waste outfalls). Examples of the types of apparent manmade features interpreted from the data included:

- Bottom pipelines and cables which are apparently laying on the harbor bottom or raised slightly above the harbor bottom (including one potential set of pipes on the east side of the Lower Harbor which appears to have previously received anchor damage);
- Cables and/or pipelines buried in the harbor sub-bottom (such as the electric lines which cross the Upper Harbor);
- Miscellaneous common harbor bottom obstructions such as mooring blocks, chain, cable, anchors, and anchoring features;
- Piers and pilings from existing wharves or docks, and the remnants of piers or pilings from old wharves or docks that have been partially destroyed;
- The semi-intact hulls of sunken vessels, boats, and/or barges (such as those at the former Herman McIlville Shipyard), and the debris and remnants of miscellaneous modern vessels, boats, or barges which have broken apart or been partially buried in sediment; and
- The remnants of a section of railroad tracks in the upper portion of the Lower Harbor, (apparently formerly spanning a section of the harbor, potentially destroyed by a storm, and now laying on the harbor bottom).

The "natural" objects identified from the geophysical data are thought to consist primarily of large boulders, either resting on the harbor bottom or buried in the shallow sub-bottom; or areas where the

bedrock surface is elevated and exposed or covered with only a thin layer of sediment (see the Geophysical Target Summary Plan Maps in Figures 1, 2, and 3 for the location of these features).

Plotting of the targets interpreted from the individual geophysical data sets on the summary maps of the harbor segments revealed that many of the targets identified individually from the various geophysical methods agree in location with targets identified from the other geophysical methods. This agreement between data types lends confidence to the interpretations. It is anticipated that at locations where localized Magnetic anomalies are coincident with localized Side Scan or Sub-bottom anomalies, the objects identified are either metallic or contain significant metallic parts. In general, objects or features, which are identified by such coincident localized anomalies, are interpreted as being manmade.

From the geophysical data collected during this study, numerous features were identified which may represent significant hazards to future dredging and/or CDF construction operations scheduled for the harbor areas of interest. It is anticipated that the plans and information presented within this report will be utilized by various project stakeholders in the design of future operations at the New Bedford Harbor Site. Several of the targets identified (such as the potential section of former railway, the several large partially exposed pipelines, or the areas of potential shallow bedrock), may represent significant and difficult issues for future dredging or other project operations, and may require further investigation to determine exactly how these features may impact future operations.

1.0 INTRODUCTION

This "Report of Marine Geophysical Surveys: Side Scan Sonar, Sub-Bottom Profiler, and Magnetics" was prepared by Foster Wheeler Environmental Corporation for the U.S. Army Corps of Engineers - New England District (USACE) under Task Order #17 (TO#17) of the New England Total Environmental Restoration Contract (TERC) (Contract No. DACW33-94-D-0002). The work was completed as part of the New Bedford Harbor Superfund Site (Site) cleanup, which the USACE is undertaking on behalf of the U.S. Environmental Protection Agency (USEPA). As part of the remediation of the Upper and Lower New Bedford Harbors (known as Operable Unit #1), the remedy calls for the dredging of sediments contaminated with PCBs from sections of the harbor, and placement and capping of these sediments in shore-line Confined Disposal Facilities (CDFs). The areas of interest for this phase of the New Bedford Harbor remediation work are the Upper Harbor, Lower Harbor, and a portion of the Outer Harbor in New Bedford, Massachusetts (see Figure 1 for the locations of the study area).

Marine Geophysical Surveys were conducted at New Bedford Harbor to identify the bottom and sub-bottom characteristics below the mean high water mark. A multi-phase geophysical program was conducted, utilizing mutually beneficial instrumentation. The harbor was surveyed along regular track lines with integrated precision location control equipment to record the position of the survey vessel at all times along the survey route. The survey work will be carried out in portions of the harbor where future construction or pre-construction intrusive activities will be conducted for both the Harbor Dredging Work, the CDFs construction, and the Combined Sewer Overflow (CSO) relocation work.

The purpose of these investigations was to provide information on the character of the harbor bottom and sub-bottom in the vicinity of the proposed CDFs as well as in areas where dredging and removal of contaminated sediment are likely to be required. The information generated by this investigation represents background data that will be used for a variety of project purposes including:

- Cultural resources screening of the harbor area prior to dredging and CDF construction;
- Hazard/obstruction screening of the harbor areas affected by dredging and CDF construction;
- Identifying submerged and/or buried utility pipe/cable/transmission lines;
- Cultural Resources specialists conducting project impact assessment on marine and upland archaeological and architectural resources;
- Engineers designing near-shore disposal cells for permanent internment of approximately 450,000 cubic yards of contaminated sediments;
- Engineers and scientists designing the dredging plan that will be implemented to remove the contaminated sediment from over 170 acres of the harbor bottom; and
- Engineers designing the removal and/or relocation of multiple utility lines that discharge to or run under portions of the harbor.

The objective of the marine geophysical investigation was to detect and characterize potential cultural resources objects and/or sites, and in-water hazards to construction operations (specifically dredging and CDF construction) such as submerged boulder fields; submerged piers, pilings, moorings, and/or significant harbor debris; and submerged or buried metallic pipes, submerged former foundations, or other potential obstructions and hazards within the survey area. These features may impact pre-design investigations and/or construction activities planned for the Site. The geophysical data will also be integrated with other complementary geotechnical data collected at the Site to contribute to the overall Site characterization process.

A report on the findings of the marine geophysical work conducted from a cultural resources point of view was completed and submitted under separate cover (Draft Underwater Archaeological Remote Sensing Survey, Dolan Research, Inc./John Milner Associates, Inc., January, 2000). The objective of the engineering phase of the Marine Geophysical Investigation was to detect and map objects and harbor bottom characteristics that might affect future dredging operations. This report presents the analysis of the geophysical data for identifying significant cultural and natural features either laying on the harbor bottom, or in the shallow sediments of the harbor bottom, that could pose a hazard to or create difficulty for the dredging sediment removal program. For this phase of work, the marine geophysical data analyzed included side scan sonar, sub-bottom profiler, and magnetometry.

2.0 METHODS

The geophysical methods utilized for this characterization included Side Scan Sonar (Side Scan), Magnetometry, and Seismic Sub-bottom Profiling (Sub-bottom). The Side Scan instrumentation was utilized to image the surface of the harbor bottom; the sub-bottom profiler was used to image the subsurface beneath the harbor bottom; and the magnetometer was used to identify metallic objects (such as anchors, pipelines, cables, moorings, or other debris) on the bottom or in the shallow subsurface (sub-bottom).

2.1 Survey Operations

Field operations for the New Bedford Harbor Marine Geophysical Survey were conducted from August 29 through September 13, 1999. The marine surveys were conducted from survey vessels outfitted with Side Scan Sonar, a Sub-bottom Profiler, and a Magnetometer. Shipboard systems were integrated with a Differential Global Positioning System (DGPS) so that the geophysical data collected from the various instruments could be tagged with position information at regular intervals.

The survey operations were conducted with a joint team of Foster Wheeler and specialty subcontractors onboard the survey vessels. John Milner Associates, Inc. (JMA), a firm with specialties in archaeological consulting, was Foster Wheeler's chief subcontractor for the work. A lower tier subcontractor contracted by JMA, CR Environmental, Inc. (a marine survey and equipment contractor), provided the survey vessels (including a boat captain), the DGPS system with navigation software, the geophysical equipment, and a side scan sonar operator with experience in the collection of side scan data for archeological studies and with the appropriate credentials from the Massachusetts Board of Underwater Archaeological Resources (MBUAR). A second lower tier subcontractor contracted by JMA, Dolan Research, Inc. (specialists in marine cultural resource projects), provided a magnetometer operator with experience in the collection of magnetic data for archaeological studies. Foster Wheeler provided a qualified shipboard geophysicist to oversee the collection of the marine geophysical data, and a shipboard geophysical technician to operate the sub-bottom profiler system. JMA/Dolan Research published the results of the archaeology study under separate cover (see Section 1.0). The analysis of the geophysical survey data from an engineering perspective (this report) is being produced by Foster Wheeler.

2.2 Survey Vessels

The survey was conducted from two survey vessels provided by CR Environmental, Inc. of Falmouth, MA, the *R/V Cyprinodon* and the *R/V Jonzo*. The vessels were insured and in compliance with federal, state, and local regulations. The vessels were captained by a U.S. Coast Guard licensed captain, and the crew had all applicable OSHA and Site Specific health and safety training.

R/V Cyprinodon

The principal survey vessel was the *R/V Cyprinodon*, a 32-foot aluminum workboat. This vessel was well equipped for survey operations, having a large pilothouse for protection of the instrumentation and electronics from the elements, a hydraulic winch and A-frame for ease of deployment of equipment into the water, on-board power, and could accommodate the four to five on-board scientists and boat captain required for the work. The A-frame and mast of the vessel could be lowered for clearance under low bridges, which allowed direct access for the vessel to the Upper Harbor area under the Route I-195 and Coggeshall Street Bridges. This vessel had a draft of approximately 3 to 4 feet, and was utilized for the areas of the harbor with water depths of greater than approximately 3.5 feet.

R/V Jonzo

Because some of the work required survey in areas with water depths of less than 3.5 feet, which could not be accessed by the principal vessel, a second smaller survey vessel, the *R/V Jonzo,* was also used. This 16-foot aluminum jon boat was utilized for sub-bottom profiling and marine magnetometer surveys on the mud flats in the Upper Harbor and in the shallower coves of the Lower Harbor. The vessel was outfitted with a wooden enclosure to protect the survey equipment, a portable generator for power, and a 15 hp outboard motor. The vessel accommodated a crew of two scientists and one captain, and could operate in depths of less than one foot of water.

2.3 Survey Equipment

The marine survey vessels were outfitted with equipment capable of producing accurate and detailed images of the harbor bottom and shallow sub-bottom. A Side Scan Sonar device was utilized to produce picture-like acoustic images of the harbor bottom in order to map bottom features and objects. A magnetometer was used to produce magnetic field maps of the harbor areas for the detection of metallic objects (usually cultural in origin) on the harbor bottom or in the shallow harbor sub-bottom. A sub-bottom profiler was also utilized to gather acoustic information on the shallow sub-bottom conditions of the harbor in order to identify potential buried objects. All three of the geophysical instruments were integrated with a DGPS for accurate location referencing information. The following provides a summary of the equipment used to complete the task.

Side Scan Sonar

The Side Scan Sonar system used included an Edgetech (EG&G) DF-1000 dual frequency in-water Side Scan towfish matched with an Edgetech Digital Control Interface (DCI). The Side Scan towfish was towed off a bow pulpit to minimize wake noise and to accommodate the shallow data collection areas. The DCI board was connected to a TRITON Isis computerized Side Scan Sonar data acquisition and processing system for shipboard data collection and processing. The Isis system processed the dual frequency digital data recorded from the towfish and DCI, and combined the data with navigation inputs for real-time viewing of the Side Scan image in pseudo-map format. The data was printed shipboard on an EPC thermal printer, and stored digitally on 2.3 GB magneto-optic data storage disks for future post-processing and interpretation. The data was recorded and displayed as digital location-corrected pseudo-maps of the acoustic response of the harbor bottom.

Magnetometer

Magnetic data was collected with a Geometrics G-881 Cesium Marine Magnetometer system consisting of a high-sensitivity in-water marine magnetic sensor coupled to a digital data processing computer system running Geometrics MagSea processing software. The MagSea software was utilized to calibrate the system and to record and display the raw digital magnetic data. The G-881 system was designed for shallow water applications, and is easily deployed from small survey vessels. The magnetic sensor was deployed from the stern of the survey vessel far enough behind the vessel to be beyond the effects of the magnetic field generated by the boat's engines and electronics. The depth of the sensor was controlled by attaching the cable leader to a floatation device such that the swim depth of the sensor remained at a constant depth of approximately one to two feet below the water surface. This allowed for the survey to be conducted in both shallow and deep-water conditions without the risk of bottoming out the sensor. The system was set up to output the raw digital magnetic signature values to a computer screen for on-board real-time initial interpretation, and to the project positioning system computer (running HYPAK software) for permanent storage and later post-processing and interpretation. The HYPAK system logged the raw magnetic data, time stamping each reading and tagging it with DGPS navigation positions

obtained from the survey positioning system. Readings were collected at a rate of once per second. The sensor towfish "layback" was entered into the HYPAK system and the correct position of the sensor was calculated and logged.

Sub-bottom Profiler

Sub-bottom data for the project was collected using the X-Star, Swept-frequency, Sub-bottom Profiling System manufactured by Edgetech Systems. The X-Star System consists of a towfish with in-water transducers and hydrophone receivers, which was towed at a fixed distance behind the survey vessel, and a shipboard processing system that received digital data from the towfish. An acoustic pulse was generated by the transducers and acoustic reflections from the harbor sub-bottom were received by the hydrophones. Data was transmitted via cable from the towfish to the shipboard processing system, which consisted of a UNIX based Sparc workstation. The processing system logged the return pulse signals, processing the data into time-based cross sections of the acoustic response of the sub-bottom. Data was displayed as pseudo cross sections of acoustic response with time on a computer screen and printed to an Alden thermal printer in real-time for initial shipboard processing. The data was also logged to a "Jazz" drive and stored on Iomega 1 GB discs for permanent storage and later post-processing. Two different towfish transceivers were used for this project. The SB216S towfish, which operates over a relatively high frequency band, was expected to provide the best resolution vs. depth penetration for the specific archaeological and engineering needs of the project over most of the area surveyed. The SB512 towfish, which operates at a slightly lower frequency band, has greater depth penetration but lower resolution. This towfish was used (in addition to the SB216S) in the areas where the future CDFs were to be constructed, in an attempt to obtain deeper geologic information, which would be used to design of the CDFs.

Positioning System

Horizontal positioning and navigation for the project was accomplished using a Trimble Pathfinder Pro-XR DGPS. The DGPS consisted of a satellite beacon and radio transmitter mounted on the roof of the vessel and the Trimble Pro-XR processing system mounted shipboard. Satellite positioning data was logged at a rate of once per second, and differential corrections were obtained from the nearest Coast Guard Beacon and processed with the data in real-time for sub-meter position accuracy. The DGPS system generated a constant stream of corrected position information which was output to all ship board systems, including the Side Scan System, the Sub-bottom system, the Magnetics system, and the HYPAK navigation system. The HYPAK software was utilized to store the time-tagged position data in both latitude-longitude format and in the project datum (US State Plane – NAD83, Zone - Massachusetts Mainland 2001, NGVD-29, feet). The HYPAK system also provided real-time vessel position status on a helmsman's display for the running of track-lines. An outline of the harbor superimposed with the project proposed track-line locations was entered into the HYPAK system at the start of the field program. These proposed track-lines were then retrieved onto the helmsman's display as the survey was in progress. The position of the vessel, as determined by the DGPS system, was superimposed in real time onto the track-line layout, so that the vessel Captain could "steer-to" navigate to stay on course and run straight and accurate data collection lines.

Bathymetry

Bathymetric data was collected as the survey was in progress using a Raytheon DE-719 MK2 precision survey Fathometer. The bathymetry data was collected to monitor water depth to ensure sensor clearance off the bottom, and to provide accurate reference depth information, which was used in the final processing and interpretation of the geophysical data. The system used a narrow beam 200 kHz in-water transducer, and provided high resolution reliable bottom depth information in both paper printout format

(for shipboard reference) and digital format (logged in HYPAK) for later data processing reference. System accuracy achieved is thought to have been approximately one tenth of a foot, and the system performed accurately in water as shallow as two feet. At the initiation of the survey and as a daily check, a bar-check calibration was performed using a plate suspended beneath the system transducer.

3.0 STUDY AREA DEFINITION AND MEASUREMENT SPACING

Marine geophysical data for this survey was collected from the three portions of New Bedford Harbor which are of interest to the project: the Upper Harbor, the northern half of the Lower Harbor, and a section of the Outer Harbor. Maps of the survey areas (see Figures 8, 9, and 10) with ship's track-lines show the extent of the survey. Coverage was obtained over the areas of interest as follows:

1. The Upper Harbor from about 200 feet north of the Wood Street Bridge south to the Coggeshall Street Bridge;
2. The Northern Half of the Lower Harbor from the Coggeshall Street Bridge south to the Popes Island Bridge (Huttlestone Ave.); and
3. The innermost portion of the Outer Harbor, from the hurricane barrier out to approximately the David Street Pier (on the New Bedford side) and Fort Phoenix Beach - west end (on the Fairhaven side).

Prior to mobilization, a review of the information currently available for the harbor and the requirements of the various programs that are to use the data generated by this program was conducted. This review indicated that the appropriate track-line spacing for the survey was 50-feet (during the survey of the harbor, the survey vessel collected data along track-lines that were approximately 50-feet apart). The survey direction was primarily north-south, the prevailing direction of elongation of the harbor. For data quality control purposes, crosstie lines were collected at approximately 500-foot intervals down the length of the harbor segments. The following number of lines and line-miles were surveyed in each of the harbor segments:

- Upper Harbor: 61 survey lines (north-south), with six cross-tie lines, for a total nautical mileage of approximately 43 nautical miles;
- Lower Harbor: 69 survey lines (north-south), with six cross-tie lines, for a composite total nautical mileage of approximately 38 nautical miles; and
- Outside the hurricane barrier: 46 survey lines (roughly northeast by southwest), with five crosstie lines, for a composite total nautical line mileage of approximately 22 nautical miles.

A total of approximately 103 nautical miles of data was collected from these three portions of New Bedford Harbor. Line spacings ranged from approximately 30 feet in some of the smaller embayments, to approximately 50 feet in the larger open areas.

4.0 SURVEY PROCEDURES

Sequencing of the work required consideration of the tide cycles. In several locations, the survey had to be accomplished in pieces, as an outgoing tide prohibited an entire area from being surveyed at one time. This was particularly true in the shallower portions of the Lower Harbor (mostly near the Fairhaven shoreline), and in the upper reaches and shallow embayments of the Upper Harbor. For areas where this occurred, the data was later pieced together in post-processing.

4.1 Preliminary Method Testing and Early Termination Procedures

At the inception of the marine geophysical survey at each section of the harbor surveyed (Upper, Lower, Outer), an initial survey line was run with each of the instruments being used for the program (Side Scan, Sub-bottom, Magnetometer). The line was a minimum of 500 feet long, and the purpose of this initial line was three-fold:

- To ensure that the equipment was operating as expected under the specific Site conditions;
- To ensure that the anticipated equipment response (meeting the project data quality objectives) was being achieved under the specific Site conditions; and
- To provide initial information on the general geophysical conditions at the specific Site location so that the field geophysicists could obtain a preliminary idea of what the geophysical data would look like prior to conducting the survey.

The initial survey line was collected over a feature with a generally known response on all of the field instruments. The feature used for this pre-survey check-line was selected by the field geophysicists at the inception of the survey in a given area. In the Outer Harbor, the channel, which passes through the hurricane barrier, was utilized, where the predicted response from each of the field instruments was obtained as the vessel passed through the opening in the breakwater. In the upper portion of the Lower Harbor, the moorings for boats in the marina on the Fairhaven side of the harbor were used, and the predicted response from each of the field instruments was obtained as the vessel passed through the boat mooring area. In the Upper Harbor, the passage under the Coggeshall Street Bridge was utilized for the Side Scan Sonar, and the electric utility lines passing under the northern portion of the harbor were used to test the magnetometer and sub-bottom profiler. In both cases, the predicted responses were obtained.

Based upon the results of the test lines run in each Harbor section surveyed, the field geophysicists determined that the information obtained from all instruments was acceptable, and the full survey could commence in those areas.

4.2 Instrument Calibration and Quality Control

Because the marine geophysical program for New Bedford Harbor encompassed several objectives, Geophysical Data Quality Objectives (GDQOs) were developed to ensure that the geophysical data collected was of sufficient quality and quantity to meet the investigation objectives.

The data collected for this survey was compared to standard parameters to ensure the data quality objectives established for the project were met. These parameters were:

- Precision: a measure of the agreement between repetitive measurements of the same property;

- Accuracy: a measure of the agreement of a measurement with a pre-defined (or accepted) value (geophysical instruments are "calibrated" for accuracy at the specific manufacturer's laboratory under controlled test conditions);
- Representativeness: describes evidence demonstrating that placement of the data acquisition line and selection of the proper instrumentation will result in data representative of the area to be measured;
- Completeness: the amount of valid data acquired compared to the amount of valid data expected; and
- Comparability: describes the degree of confidence in comparing one data set with another (i.e., 2 Side Scan surveys over the same area at two different time periods).

An evaluation of all the parameters applicable to the instruments used for this survey were made both at the inception of the fieldwork, and periodically throughout the completion of the field activities. The following activities and instrument checks were conducted as part of the overall project QA/QC.

Magnetometer

In order to ensure optimal accuracy and performance, the magnetometry equipment was tested daily prior to operation. Results of tests performed were recorded in field logbooks. The daily test included moving the magnetic sensor back and forth past a metallic object (i.e., the A-frame mast) on the stern of the vessel prior to deploying the sensor. The resulting magnetic signature was analyzed to see that the response from the test was consistent with that expected and consistent with the previous days tests. Repeatability and precision were assessed by rerunning at least one magnetic data collection line for each day of surveying.

No changes to the calibration of the sensor were made, as it was calibrated prior to leaving the factory, and the manufacturer does not recommend field modifications to be made to the calibration. However, the overall system was calibrated each day to ensure that the magnetometer was reading from the same baseline, and that an unacceptable level of instrument drift was not occurring over the period of the survey. Caution was exercised to avoid excessive noise from electrical static or spherics caused by electromagnetic radiation. At the beginning of each day of surveying, the sensor was deployed and magnetic measurements were taken and compared to background readings from surveys of previous days to ensure that the magnetometer was properly positioned away from the survey vessel and was not receiving excessive interference from the electromagnetic field generated by the survey vessel.

The field geophysicists made continual assessment of the GDQO parameters during the conduct of the field survey. The magnetic data collected consistently met the GDQO parameters of precision, completeness, and comparability. The accuracy of the system was set at the factory and could not be changed, however the particular sensor used (Cesium Magnetometer) was chosen because it was the most accurate available. Representativeness was assessed, in part, by comparing initial rough maps of the magnetic intensity observed to background regional magnetic maps produced by the USGS. The comparison indicated that the data collected was also representative of the area being surveyed. Based upon the results of the daily equipment tests, and the continual assessment of the GDQO parameters, the field geophysicists determined that the GDQOs were met for the magnetic data collected.

Side Scan Sonar

In order to ensure optimal accuracy and performance, the Side Scan Sonar equipment was tested daily prior to operation. Results of tests performed were recorded in field logbooks. The daily test included "rubbing" each of the two transducers (one on each side of the towfish) on the stern of the vessel prior to deploying the towfish. The resulting acoustic signature was analyzed to see that the response from the test was constant with that expected, and that it was consistent with the previous days tests. Repeatability and precision were assessed by rerunning at least one Side Scan data collection line for each day of surveying.

No changes to the calibration of the sensor were made, as it was calibrated prior to leaving the factory, and the manufacturer does not recommend field modifications to be made to the calibration. However, functional checks were made to ensure the computer hardware was functioning properly, including correctly identifying the acoustic reflection from the harbor bottom. Measurements were recorded at least once per day over a portion of an existing data acquisition line to provide information on the precision and repeatability of the measurement process.

The field geophysicists made continual assessment of the GDQO parameters during the field survey. The Side Scan Sonar data collected consistently met the GDQO parameters of precision, completeness, and comparability. The accuracy of the system was set at the factory and could not be changed; however, the particular sensor used (the DF 1000) was chosen because of its high degree of accuracy. Representativeness was assessed, in part, by comparing objects identified from the records with known objects (a partially submerged sunken vessel at Herman Mellville Shipyard, the riprap at the toe of the bridge abutment in the Upper Harbor, the gates in the Hurricane Barrier). The comparison indicated that the data collected was representative of the area being surveyed. In some areas of the harbor, it was determined that the water was too shallow to collect meaningful Side Scan Data (Side Scan requires at least two to three feet of water to produce a useable image). In most of these areas however, the data coverage was not compromised, as the wide beam of the sonar from the deeper-water traverses covered most of the areas of interest. Based upon the results of the daily equipment tests, and the continual assessment of the GDQO parameters, the field geophysicists determined that the GDQOs were met for the Side Scan Sonar data collected.

Sub-bottom Profiler

The Sub-bottom Profiler equipment was tested daily prior to operation and the results of tests performed were recorded in field logbooks. The daily test included the "pinging" of the sonar transducer on the deck of the survey vessel to ensure that the acoustic signal observed was consistent with that expected from a steel surface in air, and that each day the response was similar to those collected on each of the previous days. Repeatability and precision were assessed by rerunning at least one Sub-bottom data collection line for each day of surveying.

No changes to the calibration of the sensor were made, as it was calibrated prior to leaving the factory, and the manufacturer does not recommend field modifications to be made to the calibration. However, functional checks were made to ensure the computer hardware was functioning properly, including correctly identifying the acoustic reflection from the harbor bottom. Measurements were recorded at least once per day over a portion of an existing data acquisition line to provide information on the precision and repeatability of the measurement process. At the initiation of surveying each day, a test line would be run using several different instrument output frequencies and power settings to ensure that the most advantageous frequency and power were being used. Settings were adjusted until the best image of the sub-bottom was produced.

The field geophysicists made continual assessment of the GDQO parameters throughout the field survey. The Side Scan Sonar data collected consistently met the GDQO parameters of precision, completeness, and comparability. The accuracy of the system was set at the factory and could not be changed, however the particular system used (the Edgetech XSTAR) was chosen because of its high degree of accuracy. Representativeness was assessed, in part, by comparing objects identified from the records with known or assumed objects (buried boulders in the area of a boulder field observed on the Side Scan data). The comparison indicated that the data collected was representative of the area being surveyed. Based upon the results of the daily equipment tests, and the continual assessment of the GDQO parameters, the field geophysicists determined that the GDQOs were met for the Sub-bottom data collected for the purpose of identifying large objects or hazards in the shallow subsurface (upper three to five feet of sediment).

Problems were encountered however, when attempting to assess conditions deeper than approximately three to five feet beneath large portions of the survey area. This was due to the large amount of biogenic gas trapped in the organic sediments of the harbor bottom. Gases in sediment act as a perfect reflector of acoustic energy and mask any information from layers below the gas pockets. Where the concentration of the biogenic gases was sufficiently high, sub-bottom signals could not penetrate, or the penetration resulted in very weak returns. Based upon the data collected, it appears that the west (New Bedford) side of the Upper and Lower Harbors have high enough concentrations of biogenic gases to impede the interpretation of the deeper sub-bottom signals. On the eastern portions of the Harbor (the Fairhaven side), the sediments contained less "gas", and the deeper signals were easier to interpret. As a result of these observations, it was determined that additional work, using other equipment and methods, would be needed if information was required on the deep sediment and bedrock characteristics along the western portions of the harbor. A second marine geophysical program (Uniboom and Seismic Refraction) was subsequently carried out, and the results published under separate cover ("Report of Marine Geophysical Surveys: Uniboom and Seismic Refraction," Foster Wheeler, February, 2000).

Global Positioning System (GPS)

No calibration modifications were made to the instrument electronics or antennas as they were calibrated at the factory and the manufacturer does not recommend field calibration of the equipment. Functional checks were made to ensure the computer hardware was functioning properly, including correctly identifying the location of the boat within the survey area. Measurements were recorded at the beginning and end of each survey day at a known survey point (a surveyed position on the boat dock) in order to ensure the precision and repeatability of the measurement process. Continual checks were made to ensure that sufficient satellites were being received to obtain differential accuracy at all times. Surveying was halted and a survey line re-run if it was determined that satellite lock was insufficient to apply differential corrections. This occurred occasionally during the survey period, usually in the afternoon when several of the satellites in the region tended to be low on the horizon. Portions of the data collected while the DGPS system was not in differential mode were processed out of the data sets in post-processing. Based upon the daily data repeatability tests and the continual monitoring of the satellite lock, it was determined that the DGPS system performed within the parameters prescribed by the GDQOs for the project.

4.3 Field Data Collection

Geophysical data was collected with all three instrument systems (Side Scan Sonar, Sub-bottom Profiler, and Magnetometer) running concurrently when the larger vessel, the *R/V Cyprinodon* was utilized. All of the areas in the Outer and Lower Harbor that could be accessed with that vessel were conducted first. When the water depth in the survey area was not deep enough to support the vessel without hitting the harbor bottom, the data gaps were filled in using the smaller *R/V Jonzo*. Because the *Jonzo* could only carry one piece of equipment at a time, the areas surveyed by that vessel were covered twice, once with the Magnetometer and once with the Sub-bottom Profiler. Side Scan Sonar surveying in excessively

shallow areas was not carried out, as the water depths were insufficient to achieve a useable signal (Side Scan equipment requires at least two to three feet of water to produce a useable image).

The field data collection occurred between August 29 and September 13, 1999. All collection occurred during daylight hours, and the vessels were stored either at public marinas in New Bedford Harbor at night, or in the case of the Upper Harbor, on a mooring. All operational personnel met at the dock each morning, and after a daily safety briefing and daily equipment calibrations, and functional checks, set underway to conduct survey operations. Operations were continuous during the day, except for minor periods of occasional equipment malfunction or loss of DGPS satellite differential coverage. Over the 12-day survey period, over 100 nautical miles of data was collected in the three harbor areas of interest in water depths that ranged from less than one foot to greater than 25 feet.

4.4 Data Processing

Initial data processing and interpretation was carried out as the survey was in progress to ensure that good quality data was being collected and that data quality objectives were being met. The initial shipboard data processing and interpretation varied by instrument:

- Side Scan Sonar data was processed using the TRITON Isis system into pseudo-map images along the data path. The initially processed data appeared as strip images of the harbor bottom displayed on a computer screen and printed on a thermal recorder. The Side Scan operator would monitor the data collection at all times to ensure that the image was as clear as possible, and to make initial interpretations of the data in real-time. Targets (features of the bottom appearing as anomalous from the rest of the data) were "captured" digitally by the operator using the computerized target capture feature of the Isis system, and were cataloged and stored for later post-processing and enhancement. A list of the targets identified in the field was recorded into the field logbook. The Side Scan data was also stored digitally for later post-processing and more intensive interpretation.

- Magnetic data was initially processed in the field by the Edgetech MagSea system. Uncorrected magnetic data was then displayed on a computer screen in cross-sectional form so that the magnetometer operator could make observations concerning the data stream as it appeared on the screen. The magnetometer operator noted and cataloged any significant raw magnetic anomalies (deviations of the magnetic signal from background) identified as the survey was in progress. The magnetic data was also stored digitally for later post-processing and more intensive interpretation.

- The Sub-bottom data was automatically initially processed in the field by the Edgetech XSTAR system. The initially processed data was displayed in real-time on the systems computer monitor as pseudo cross sections of the acoustic response of the sub-bottom. Paper records are also produced shipboard. The Sub-bottom system operator constantly monitored the XSTAR system to ensure that the initial data processing parameters that the system constantly updates remains within proper ranges, and to conduct initial interpretations of the data. Initial interpretations consisted of the identification of significant targets in the sub-bottom. The targets appear as anomalies on the acoustic records, and the system operator noted the targets identified on the field printouts of the records. The Sub-bottom data was also stored digitally for later post-processing and more intensive interpretation.

The initial interpretations of the data made in the field were utilized by the field team to continually assess the appropriateness of the data collected, and make minor modifications to the field program in order to

ensure the highest possible data quality. Both the initial field interpretations and the raw field data were brought into the office for further post-processing and interpretation upon completion of the survey.

Complete data processing and interpretation was carried out by the team of Foster Wheeler geophysicists and subcontracted archaeologists. The geophysical data required extensive computer reduction prior to interpretation. The basic processes for reduction of the digitally recorded data are summarized in the sections below.

Magnetics

The magnetic data collected in the field was stored on the navigation system computer in a HYPAK file. The data consisted of the x and y positions of the magnetic sensor, the total field magnetic reading (once per second), and the time that each reading was collected. Because the magnetic field of the earth (which is the parameter measured) varies with time and location, a series of corrections must be made to the raw field data before it can be displayed in map form and contoured. The following steps were involved in the processing of the magnetic data:

- Data files for each survey area were checked for proper geometry and recording interval with internally developed software. Coordinate transformations, if necessary, were performed, and position outliers were removed from the data sets.
- The data was merged by running the position data and the magnetometer raw data through software that allows for the merging of magnetic data with GPS positional data. The software assigns an X-Y coordinate location to each digital magnetic data value.
- A file of magnetic (diurnal) corrections was constructed using data from a magnetic base station that was operating during the field program, and data from a U.S. Geological Survey Magnetic Recording Station downloaded from the Internet for the period of the survey. The corrections file was time-tagged for later merging with the raw data file from the survey.
- The position-corrected raw data was then merged with the file of magnetic corrections. This was accomplished by matching up the time–tag for each element of the two data sets. The result of the merging of the raw data and corrections was the creation of a file containing the corrected magnetic measurement data for the survey.
- The corrected data set (x, y position, and corrected magnetic reading) was then input into Geosoft's Oasis Montaj data presentation software. Montaj creates a planimetric map of the magnetic readings, grids the data set, and produces a color-coded contour map of the magnetic intensity readings of the survey areas for interpretation.
- Anomalies within the data set were then identified using the Montaj software's anomaly auto-picking feature. An experienced geophysicist analyzed each anomaly identified by the software and made any adjustments required utilizing experience to enhance the interpretations. The interpreter also analyzed the planimetric projection of the data set to ensure that no anomalies were overlooked by the Geosoft auto-picking routine.
- Once the interpreter was satisfied that all anomalies were identified, a target list was generated consisting of x and y positions in the project datum. This target list was output as a data table for inclusion in this report, and as a DXF file for the plotting of a Target Location Plan on the project base map of the harbor.

Side Scan Sonar

The Side Scan data collected in the field was stored on the TRITON Isis system computer for post-processing. The data was merged with the HYPAK navigation data in real time as the data was collected, so that position-corrected strip images of the bottom were also created in real-time. These strip images are gray tone (or colorized) representations of the strength of the return acoustic signal from the bottom as the survey was in progress. The Side Scan data files were further processed in the office to enhance the image quality, and mosaic images were created by digitally pasting together the strip images into a pseudo-map of the entire harbor bottom. The following steps were involved in the further processing and interpretation of the Side Scan data:

- All of the Side Scan data files were played back using the TRITON Isis system in the office by an experienced geophysicist. The images were "cleaned up" by playing back the data using optimal imaging parameters to create as accurate an image as possible.
- Targets were identified through visual assessment by an experienced geophysicist of the replayed, enhanced strip images. The target images were then "captured" using the target analysis software on the Isis system, and output to an image enhancement program for final presentation and hard-copy printing.
- A "Side Scan mosaic" was then created by taking all of the Side Scan data from each area and merging it using the mosaic-generating program within the Isis system. One mosaic was generated for each of the three areas surveyed. The mosaicing was accomplished by merging the strip image data with the navigation positioning data, overlaying all of the position-referenced strips of the Side Scan data out in corrected real position, and pasting the image into a single mosaic.
- The resulting position-corrected Side Scan Mosaic for each area was then output as a "TIF" file, and was overlain on the project standard survey maps of the harbor edge, thus generating an acoustic map image of the harbor bottom features referenced to the shoreline.
- Finally, an output file of the locations of all of the targets identified from the Side Scan data interpretation was created for inclusion in the text of this report. A "DXF" file of the target locations was also generated, and was overlain, along with the magnetics data, on the base map for the project.

Sub-bottom Profiler

The Sub-bottom data collected in the field was stored on the Edgetech XSTAR system computer for post-processing. The data was merged with the HYPAK navigation data in real-time as the data was collected, so that position-corrected strip images of the sub-bottom features were also created in real-time. These strip images are gray tone (or colorized) representations of the strength of the return acoustic signal from the sub-bottom as the survey was in progress. The Sub-bottom data files were further processed in the office to enhance the image quality. The following steps were involved in the further processing and interpretation of the Sub-bottom data:

- The XSTAR position data was cross-referenced with the HYPAK track-line data to ensure that the position information tagged to all of the data strips was correct.
- The XSTAR images were "cleaned up" by playing back the data using optimal imaging parameters to create as accurate an image as possible.

- Targets were identified on the records visually by an experienced geophysicist. The locations of the targets were saved to a data file where the x and y positions were logged.
- The resultant Sub-bottom target file was output to a spreadsheet for inclusion in this report, and for plotting by the project CADD system on the project summary target maps.

The final geophysical survey data was stored on a digital storage medium. Data and interpretations were backed-up on disk and CD (Iomega ZIP, JAZZ drive, and Compact Disk).

4.5 Interpretation Techniques

Preliminary analysis and interpretation of the geophysical survey information was completed each day in the on-site processing center to aid in planning remaining work or modifying the survey program in specific areas. The objective of the data analysis and interpretation phase was to characterize the responses from the geophysical data in terms of their most probable sources (i.e., bottom object, buried object, pipeline, cable, bedrock outcrop, shell bed, variation in bottom hardness, vegetation, etc.). An integrated approach to the analysis and interpretation phase was implemented for this project, in which targets and features detected by magnetic, Side Scan, and sub-bottom methods were collectively interpreted. This strategy allowed targets and features detected by separate instruments to be more accurately characterized in terms of depth and probable source. The magnetic, Side Scan, and Sub-bottom data was also analyzed and interpreted in concert with the historic structure pattern, and lithologic and geotechnical sampling data existent for the harbor.

Experienced geophysicists identified target and feature responses within the data and generated color–coded maps and target anomaly lists depicting geophysical anomalies. The software used for the processing, analysis, and interpretation of the magnetic data was a combination of internally developed software and Oasis Montage, a geophysical data analysis program developed by Geosoft, Incorporated of Canada. Montage allows intensive mathematical and statistical analysis of geophysical data. Both the Side Scan and the Sub-bottom data were analyzed on their respective systems (Isis and X-STAR), which were manufactured for full data processing and enhancement as well as data collection. The Side Scan data was interpreted from the graphic images produced by the Isis system. The Sub-bottom data was interpreted from the graphic time-domain cross-sections produced during post-processing of the data on the X-STAR system. In order to improve target and feature recognition, the geophysical data was also intensively analyzed mathematically; filtering and data enhancement operations were conducted on the data until the best images were obtained. Representative symbols of the targets or features of interest were transcribed onto a summary plan map of the Site.

5.0 RESULTS

The following sections describe the results of the marine Side Scan Sonar, Sub-bottom Profiler, and Magnetics field survey of the areas of interest in the Upper, Lower, and Outer Harbor portions of New Bedford Harbor. This survey was conducted as part of the New Bedford Harbor Superfund Project – Operable Unit #1 (OU#1).

5.1 Summary of Geophysical Features

Analysis of the Side Scan, Magnetics, and Sub-bottom data collected during this phase of the geophysical work conducted at New Bedford Harbor was completed by Foster Wheeler geophysicists and the results are summarized on the Geophysical Target Summary Plan Maps presented as Figures 1, 2, and 3 in the figures section of this report. These plans were generated in order to provide easy and rapid reference information on all of the targets identified as a result of the analysis of the Side Scan, Magnetics, and Sub-bottom data analyzed. The targets appear on the plan maps in correct coordinate position as determined by the DGPS in the field during the survey.

The targets identified from the data sources fall into two primary categories:

- Those objects or features which appear to be of cultural origin (manmade); and
- Those objects or features, which are natural.

The "natural" objects are thought to consist primarily of large boulders, either resting on the harbor bottom, or buried in the shallow sub-bottom. In addition, at several locations the data appears to indicate that the bedrock surface beneath the harbor bottom may be elevated in the subsurface to a position that puts it within the conceivable range of the potential future dredging operations.

The "cultural" objects identified were of several different types. Linear features were noted which are thought to consist mostly of pipelines and cables. Individual targets are thought to generally represent stand-alone features such as mooring blocks, anchors, and miscellaneous dropped objects. Groups of targets clustered together are thought to generally represent structures or the remnants of structures such as existing or remnant piers, pilings, and bulkheads, modern vessels debris, or engineering structures such as submerged water intakes or waste outfalls. The following bullets provide a list of the kinds of cultural features or objects apparently identified from the data:

- Raised pipelines and cables (sitting above the harbor bottom);
- Bottom pipelines and cables (laying on the bottom of the harbor);
- Buried cables and pipelines (buried in the harbor sub-bottom);
- Mooring blocks and mooring balls;
- Chain and cable either attached to moorings or laying on the harbor bottom;
- Piers and pilings from existing wharves or docks;
- The remnants of piers or pilings from old wharves or docks which have been destroyed;
- The intact or semi-intact hulls of sunken vessels, boats, and/or barges;
- The debris and remnants of modern vessels, boats, or barges which have broken apart or been partially buried in sediment;
- The remnants of a section of railroad tracks, (apparently formerly spanning a section of the harbor, potentially destroyed by storm, and now laying on the harbor bottom); and

- General debris (objects either lost over-board, washed off of the shoreline during storms, or set adrift and sunk).

The Geophysical Target Summary Plan Maps (Figures 1 through 3) present the data interpreted from all three instruments on one plan. At locations where objects identified as either Side Scan or Sub-bottom targets line up with magnetic targets, there is a high likelihood that the object is of a cultural nature and is metallic or contains at least some metallic parts. A significant exception to this assumption is areas where shallow bedrock may be present, or where the bedrock appears to be relatively close to the surface of the harbor bottom. In these areas, such as noted in the southeast portion of the Outer Harbor survey area, a broad magnetic "high" (Figure 9) is present coincident with near harbor bottom surface anomalies on the sub-bottom records. The other areas with elevated magnetic readings, in the Upper and Lower Harbor, are not as pronounced, but might also be due to shallow (as compared to the surrounding area) bedrock. The Upper Harbor contains two areas where the magnetic data suggests bedrock may be relatively shallow (orange colored area on Figure 7): a small are to the north in the vicinity of magnetic target 39; and a large area in the southern portion of the Upper Harbor (Figure 7). There are two regions (orange colored area on Figure 8) of potentially shallow bedrock in the Lower Harbor, both are on the Fairhaven side of the harbor. One is east of Pope Island, and the other is northeast of the proposed CDF-D (see Figure 8).

The following sections describe the results interpreted from each of the three geophysical instruments used during the course of the survey.

5.2 Side Scan Sonar

Composite images of the survey areas for each of the Upper, Lower, and Outer Harbor areas of interest are presented as Side Scan "mosaics" on Figures 4, 5, and 6 in the figures section of this report. Figure 4 shows the Upper Harbor Area of Interest, Figure 5 the Lower Harbor Area of Interest, and Figure 6 is the Outer Harbor Area of Interest. These mosaic images depict the acoustic response of the harbor bottom surface to the output signal generated by the Side Scan instruments transducer. The mosaics are generated by digitally overlaying data strip images of each of the lines of Side Scan data collected in the field on a base map of the survey area and correcting the images to real position using the navigation data collected during the survey. The Side Scan mosaics represent pseudo plan maps of the harbor bottom acoustic response. The mosaics resemble acoustic "photographs" of the bottom, and features and objects such as pipelines, mooring blocks, or debris can be visually identified in the data.

Because the objects and features of interest to this project are relatively small compared with harbor plan maps, and are difficult to pick out in any detail from the mosaic maps, blown-up images of all of the relevant targets identified from the Side Scan data are included in Appendix A. The target blow-ups are all tagged with anomaly numbers that match the target numbers displayed on the Figures 1, 2, and 3. These blow-ups indicate in some detail the nature of many of the objects identified from the Side Scan data. Notable examples include:

- Target 30: a suspended cable or pipe;
- Target 49: possible modern vessel debris;
- Targets 56 and 59: obvious pipelines or cables;
- Target 60: pair of pipelines elevated just off the harbor bottom which appear to have suffered anchor drag damage (the two pipelines have apparently been spread apart, as if one of them had been dragged by an anchor, and there is some evidence on the Side Scan record – a telltale shadow, probably the result of a thermal plume - that suggests one of the pipelines

may be leaking a material that has different acoustic properties (e.g. temperature, density, turbidity) than the surrounding harbor water);

- Target 62: pier with possible modern vessel debris adjacent;
- Target 63: a submerged section of railway tracks (a startling image which appears to corroborate anecdotal evidence from Town records and rumors from long-time residents that a section of railway track that once spanned the harbor south of the Coggeshall Street Bridge - was destroyed by a mid-century hurricane and may have been left in the harbor. The apparent pile of rock near the track section may be the remains of the old railway abutment or span support which was also destroyed);
- Target 66: possible mooring block or other large rectangular object on the harbor bottom; and
- Target 83: possible rock outcropping in the Outer Harbor area, thought to be indicative of the presence of shallow bedrock.

It should be noted that not every object identified from the data was captured as a detailed image and included in Appendix A. Many of the objects noted were apparent rocks or boulders sitting on the harbor bottom which look very similar to all of the other rocks or boulders noted; only representative images of rocks and boulders were included in the detailed target printouts. A summary table of all of the targets identified from the Side Scan data is presented as Table 5-1. The table presents the anomaly number (which matches the target numbers presented on the Geophysical Target Summary Plan Maps in Figures 1, 2, and 3), the x and y location of the object, and a brief description of the nature of the object as interpreted by a geophysicist.

5.3 Magnetics

Contour maps of the magnetic data collected as part of this survey program are presented as Figures 7, 8, and 9 in the figures section of this report. Figure 7 depicts the magnetic contour map of the Upper Harbor area of interest, Figure 8 represents the magnetic data form the Lower Harbor area of interest, and Figure 9 shows the magnetic contour map of the data from the Outer Harbor area of interest. The magnetic maps display the data collected from the areas of interest as color coded magnetic intensity plans: magnetic highs are displayed as oranges, reds, and pinks; while the magnetic lows are depicted as blues, greens, and blacks.

Specific anomalies, which are thought to represent magnetic targets, are identified by triangular target symbols. The targets were picked by experienced geophysicists utilizing the Oasis Montaj data enhancement and interpretation software program. Individual targets were generally identified by picking anomalies that displayed significant and localized shifts from the background data. In particular, anomalies with either localized extreme magnetic highs, extreme magnetic lows, or coupled highs with lows adjacent to one another were interpreted as being indicative of a magnetic target. In addition to displaying the targets on the magnetic contour maps, the target files were translated onto Figures 1, 2, and 3. The magnetic targets are identified by triangular symbols. Where these magnetic targets are coincident with either Side Scan or Sub-bottom targets, it is reasonable to assume that the identified object is metallic or has some metallic parts.

In addition to the numerous individual targets identified from the data and displayed on the magnetic and summary maps of the areas of interest, several larger features of interest can be interpreted from the data. The most obvious of these are the three linear anomalies that cross the northern portion of the Upper Harbor area of interest with a roughly east-west trend. These anomalies are interpreted as representing the magnetic signature of the submerged power lines that run across the harbor in this area.

TABLE 5-1
Interpreted Target from Side Scan Data
Upper, Lower, and Outer New Bedford Harbor Areas of Interest

Target #	Northing	Easting	Characteristic
1	2696592	815585	Debris
2	2696640	815904	Cable/Chain
3	2696602	816325	SunkenBuoy
4	2696618	816430	Pile Coal
5	2695880	816842	Debris
6	2695849	816856	Debris
7	2695945	816863	Debris
8	2696192	817181	Debris
9	2695972	817181	Debris
10	2695703	817699	Cable/Chain
11	2695558	817549	Debris
12	2695017	815151	Debris
13	2697169	814286	Debris
14	2697245	814284	Debris
15	2697066	814287	Modern Vessel Debris
16	2694152	814497	Debris
17	2698861	814637	Rock
18	2697754	814575	Debris
19	2697118	814621	Piling
20	2696278	814447	Cable/Chain
21	2694941	814607	Cable/Chain
22	2694820	814608	Debris
23	2694238	814359	Cable/Chain
24	2694802	814603	Debris
25	2694865	814585	Cable/Chain
26	2695245	814811	Debris
27	2696426	814846	Pipe
28	2696456	814748	Debris
29	2696720	814728	Debris
30	2698610	814977	Suspended Cable
31	2698891	814875	Cable/Chain
32	2699370	814771	Modern Vessel Debris
33	2698654	815038	Pipe
34	2698125	815172	Cable/Chain
35	2696001	815001	Debris
37	2695019	815161	Debris
38	2695951	815095	Debris
39	2697743	815320	Debris
40	2696743	815315	Rock
41	2695510	815721	Debris
42	2696136	815952	Rock
43	2695256	816349	Debris
44	2695471	814841	Rock

Target #	Northing	Easting	Characteristic
45	2695978	814836	Debris
46	2698671	814968	Pipe
47	2698885	814986	Rock
48	2699227	815019	Debris
49	2695943	814983	Modern Vessel Debris
50	2698691	814961	Pipe
51	2695060	814991	Unknown
52	2696257	814443	Chain
53	2695681	815012	Debris
54	2695668	815337	Debris
55	2695657	815444	Debris
56	2695539	815672	Pipe
57	2695232	816419	Debris
58	2695511	817590	Rock
59	2696652	816812	Cable/Chain
60	2698232	815221	Pipe
61	2699297	815472	Debris
62	2699380	814811	Debris
63	2698873	814602	Railway Tracks
64	2704167	814999	Rock
65	2700709	815182	Rock
66	2700325	815232	Debris
67	2704303	815331	Debris
68	2700451	815480	Rock
69	2687038	817501	RockField
70	2688120	818647	Debris
71	2688554	818745	Debris
72	2688024	819061	Rock
73	2687716	818944	Debris
74	2687723	818961	Rock
75	2687544	818784	Rock
76	2686562	817691	Debris
77	2686788	818232	Debris
78	2686308	818395	Rock
79	2686292	818369	Rock
80	2685989	818751	Rock
81	2685757	818468	Debris
82	2685966	818508	Rockoutcrop
83	2685979	818713	Rock
84	2685720	818436	Rockoutcrop?
85	2685995	818762	Rock
86	2685999	818790	Rock
87	2685767	818501	Rockoutcrop?

Note: Target postions are shown on Summary Maps - Figure 1, 2 and 3.
Detailed images of **bold text** targets are shown in Appendex A.

Another feature of interest is in the northern portion of the Lower Harbor. Here, near the eastern shoreline adjacent to the Fairhaven side of the harbor, a set of linear anomalies (first crossing from west to east and seen as blue circular anomalies, then turning to the south at the eastern harbor shoreline where the anomaly is detected as linear magnetic highs of orange) can be identified. These anomalies line up with a set of pipelines identified from the Side Scan data, and clearly visible on the Side Scan Mosaic in Figure 5.

In the Outer Harbor, the magnetic data is significantly more "noisy" than the data from the other harbor segments. It is thought that this is due to the fact that the bedrock is closer to the harbor bottom surface here than elsewhere in the study areas. In two locations, broad bands of magnetic highs noted in the data appear to indicate the presence of bedrock at or just below the harbor bottom surface. The first such area is located in the southeast portion of the area, and is characterized by a curving broad band of magnetic highs delineated by pink colorization on the contour plan (see Figure 9). This area also coincides with an area identified from the Side Scan data as having potential submerged bedrock outcrops. The second area is located near the western corner of the Outer Harbor contour map, and is also a curved set of anomalies that appear as magnetic highs (pink shading). This area is coincident with Side Scan and Sub-bottom anomalies that indicate there are a significant number of rocks and boulders at or just under the surface of the harbor bottom, a condition that often indicates the close presence of bedrock.

A summary table of all of the targets identified from the Magnetic data is presented as Table 5-2. The table presents the anomaly number (which matches the target numbers presented on the Geophysical Target Summary Plan Maps in Figures 1, 2, and 3), the x and y location of the object, and a brief description of the nature of the object as interpreted by a geophysicist.

5.4 Sub-bottom Profiler

Targets interpreted from the Sub-bottom Profiler data are displayed on the Figures 1, 2, and 3. The Sub-bottom targets are indicated by diamond-shaped symbols, which denote the location of targets in the harbor sub-bottom as interpreted from the Sub-bottom data. The target location parameters were identified from the merged data set of Sub-bottom data and navigation data. Sections of the XSTAR Sub-bottom data are included in Appendix B of this report. The data sections in Appendix B represent time and pseudo-depth sections of segments of the processed XSTAR records; the geophysicist-interpreted features are noted directly on the records. A table of the interpreted targets is included as Table 5-3.

The targets identified from the records appear as parabolic features in the near subsurface beneath the harbor bottom reflector. They are generally individual anomalies within the data sections, with the exception of the areas where the bedrock surface appears to rise to just below the harbor bottom. Individual anomalies in the sub-bottom probably represent large boulders buried in the sediment. An example of the interpretation of a group of individual targets can be seen in Sub-bottom target numbers 1 and 2 (see Appendix B). Sub-bottom targets 3, 5, and 10 (see Appendix B) are examples of where the interpretations indicate that the bedrock may be at or near the harbor bottom surface. Most of the individual targets identified from the Sub-bottom records are located in the Lower Harbor area of interest. Most of the areas where it appears that the bedrock is shallow are located in the Outer Harbor (with a few minor exceptions, including two areas in the Upper Harbor and two relatively small areas in the Lower Harbor), and are coincident with the areas where the Side Scan and Magnetic data seem to indicate that the bedrock is shallow or outcropping (see Sections 5.1 and 5.2).

TABLE 5-2A
Interpreted Targets from Magnetic Data
Upper Harbor Area of Interest
New Bedford Harbor Superfund Site - OU#1

Target #	Easting	Northing
1	815744.2	2700581.53
2	815076.34	2700636.36
3	815436.13	2700697.82
4	815024.75	2700730.95
5	815093.53	2700739.55
6	815394.86	2700814.77
7	815632.17	2700964.39
8	815599.42	2701058.55
9	815238.3	2701146.26
10	815095.58	2701206.45
11	815040.55	2701221.93
12	816346.92	2701285.71
13	815028.51	2701319.96
14	815886.59	2701340.6
15	815049.15	2701436.9
16	815141.1	2701546.42
17	816444.93	2701571.2
18	815044.81	2701604.89
19	814815.56	2701797.1
20	815958.37	2701868.47
21	815254.6	2701888.66
22	815600.17	2701901.44
23	815500.46	2702155.02
24	814631.56	2702215.01
25	814622.96	2702297.56
26	815533.72	2702390.4
27	815240.78	2702592.8
28	815257.44	2702738.35
29	815845.82	2702781.85
30	815431.39	2702994.2
31	815873.96	2703027.82
32	815188.37	2703224.83
33	815182.78	2703749
34	815377.44	2704718.73
35	815538.78	2704891.61
36	815299.33	2704915.94
37	815150.81	2705436.68
38	815593.71	2706092.86
39	815520.73	2706229.88
40	815905.95	2706450.15
41	815592.23	2706462.96
42	815679.3	2706468.08
43	816100.58	2706553.88
44	815771.53	2706727.47
45	815684.46	2706736.43
46	816105.7	2706798.48
47	815975.12	2706818.39
48	815662.69	2706978.47
49	816163.35	2707137.27
50	815758.72	2707171.85
51	815676.77	2707325.53
52	816018.66	2707348.58

Note: Target positions are shown on Summary Map - Figure 1.

TABLE 5-2B
Interpreted Targets from Magnetic Data
Middle Harbor Area of Interest
New Bedford Harbor Superfund Site - OU#1

Target #	Easting	Northing
53	814599.09	2694750.65
54	814942.46	2694931.63
55	816127.96	2695268.01
56	816276.39	2695345.67
57	817182.58	2695431.52
58	817476.65	2695621.50
59	817536.29	2695621.50
60	816584.70	2695639.53
61	817690.63	2695648.50
62	816122.41	2695660.46
63	816654.06	2695721.35
64	816906.22	2695733.19
65	817657.34	2695752.51
66	817421.16	2695975.12
67	815084.59	2695977.79
68	817390.64	2696016.72
69	814883.45	2696022.17
70	817136.49	2696049.37
71	815984.93	2696157.20
72	814738.93	2696349.06
73	814912.33	2696444.74
74	815604.08	2696601.90
75	815048.27	2696672.16
76	815913.42	2696692.04
77	815764.87	2696775.81
78	814882.90	2696910.03
79	816200.45	2696936.67
80	816421.01	2696969.95
81	814582.82	2697082.92
82	814729.87	2697114.81
83	815243.12	2697170.28
84	814509.30	2697256.26
85	815280.77	2697281.21
86	815364.00	2697299.24
87	815233.60	2697300.63
88	814635.59	2697617.66
89	815197.66	2697717.27
90	815362.73	2697735.29
91	815350.25	2697862.87
92	814707.72	2697935.47
93	814603.19	2698189.01
94	814901.40	2698338.44
95	814515.76	2698425.81
96	815015.15	2698646.30
97	814790.43	2698786.36
98	814586.51	2698830.73
99	814941.63	2698926.42
100	814714.13	2699110.86

Note: Target positions are shown on Summary Map - Figure 2.

TABLE 5-2C
Interpreted Targets from Magnetic Data
Outer Harbor Area of Interest
New Bedford Harbor Superfund Site - OU#1

Target #	Easting	Northing
101	818464.10	2685766.81
102	818120.56	2685910.61
103	818320.02	2685929.22
104	817885.20	2686191.09
105	817752.23	2686199.07
106	818258.86	2686225.65
107	817515.53	2686244.27
108	818432.92	2686278.20
109	817776.79	2686285.60
110	819268.86	2686318.05
111	817814.02	2686356.05
112	819638.73	2686425.17
113	817790.08	2686430.50
114	817655.78	2686439.80
115	817347.80	2686466.39
116	817768.81	2686519.56
117	817650.46	2686636.54
118	817557.38	2686649.83
119	817635.84	2686701.67
120	817542.75	2686758.83
121	819496.27	2686762.74
122	817072.54	2686785.42
123	818245.62	2686839.53
124	818220.35	2686983.09
125	817834.73	2686987.08
126	817410.76	2687064.11
127	818262.40	2687106.08
128	817667.40	2687284.77
129	818411.31	2687538.12
130	818675.30	2687572.33
131	818616.63	2688144.13

Note: Target positions are shown on Summary Map - Figure 3.

TABLE 5-3
Interpreted Targets from Sub-bottom Data
Upper, Lower, and Outer New Bedford Harbor Areas of Interest

Target #	Geodetic		NAD83 (ft)		Pseudo Depth
	Latitude	Longitude	Northing	Easting	(meters)
1	41 38.481	70 55.209	2694872.5	814663.8	1 - 2
2	41 38.528	70 54.208	2695189.4	819222.0	1
3	41 38.531	70 54.880	2695186.4	816160.5	outcropping
4	41 39.190	70 55.156	2699180.0	814876.0	1
5	41 38.532	70 54.842	2695193.7	816333.6	outcropping
6	41 38.618	70 54.903	2695714.0	816052.1	<1
7	41 38.658	70 54.835	2695959.1	816360.2	1 - 2
8	41 38.740	70 54.803	2696458.1	816502.6	<1
9	41 39.553	70 54.929	2701391.6	815894.8	1
10	41 37.283	70 54.490	2687619.4	817989.8	outcropping

Note: Target positions are shown on Summary Maps - Figures 1, 2, and 3.

An analysis of the Sub-bottom data was also carried out in an attempt to determine if the data quality was sufficient at depth to enable the mapping of the bedrock surface over the extent of the surveyed area. While the bedrock surface was identifiable on many of the Sub-bottom Profiler records, the presence of biogenic gas in some of the harbor sediments impeded signal penetration, and therefore data interpretation was hampered over some of the more critical portions of the areas of interest. In general, data collected from the eastern sides of the harbor segments, nearer to Fairhaven, appears to indicate that the sediments there contain less biogenic gases, and therefore exhibit significantly better signal depth penetration than areas further to the west on the New Bedford side of the harbor. Interpretations of the data records from the eastern side of the harbor would support the mapping of the bedrock surface using Sub-bottom data, however, the biogenic gases prevalent along the western (New Bedford) side of the harbor preclude the data form being used for that purpose there. One of the areas where there was interest from various project stakeholders in obtaining bedrock data was the portion of the Lower Harbor adjacent to the New Bedford shore, where CDF-D is to be built. Analysis of the data transects collected with both the XSTAR SB216S towfish and the more powerful SB512 towfish in the area of eventual CDF-D indicate that the presence of biogenic gases in that region make the realistic interpretation of a bedrock surface in that area from the Sub-bottom data unlikely. This information was passed on to USACE and Foster Wheeler engineers as soon as it became apparent, while the filed program was in progress. As a result, a second subsequent two-phase investigation was undertaken utilizing Seismic Reflection and Seismic Refraction geophysical techniques, which yielded much better bedrock surface results. The first phase (Phase I) of this program is described in detail in the report entitled "Report of Geophysical Surveys: Uniboom and Seismic Refraction," Foster Wheeler, February 2000, submitted under separate cover. The second phase (Phase II) incorporated the data from first phase with the second phase data and is described in detail in the report entitled "Draft Report of Marine Geophysical Surveys: Phase I Uniboom & Seismic Refraction, and Phase II Seismic Refraction," Foster Wheeler, April 2001, submitted under separate cover, which supercedes the Phase I report.

6.0 CONCLUSIONS

Foster Wheeler conducted a focused multi-phase geophysical survey of portions of the Upper, Lower, and Outer Harbor at New Bedford Harbor, Massachusetts. The survey was conducted in an attempt to identify hazards on the harbor bottom, or in the harbor sub-bottom, which might effect future dredging operations, or operations related to the construction of the future CDFs intended for the Site.

Three distinctly different, yet mutually beneficial geophysical survey techniques were utilized: Side Scan Sonar, Magnetometry, and Sub-bottom Profiling. The results of the processing and interpretation of the data collected by these three methods are included in this report as Figures 4 through 9, and in Appendix A and Appendix B. Targets were identified from each of the data sets generated. Plotting of the targets on summary maps of the harbor segments (Figures 1 through 3) indicate that many of the targets identified individually from the various methods actually agree in location with targets identified from the other geophysical methods. This agreement between data types lends confidence to the interpretations. It is thought that at locations where sharp, localized Magnetic anomalies are coincident with either sharp, localized Side Scan or Sub-bottom anomalies, that the object identified is either metallic, or contains significant metallic parts. In general, objects or features that are identified by such coincident localized Side Scan or Sub-bottom and sharp, localized Magnetic anomalies are interpreted as being cultural in nature (i.e. – man made).

An important exception to the above noted assertion is the case where a broad, wide, more gradual set of magnetic anomalies is coincident with extremely large anomalies on the Sub-bottom and/or Side Scan records. At these locations (two noted from the Outer Harbor data set, two areas noted from the Upper Harbor data set, and two relatively small areas from the Lower Harbor data set – see Figure 3 and Sections 5.1 and 5.2), the data interpretations indicate the likely presence of shallow bedrock (at or just below the harbor bottom).

Figures 1, 2, and 3 summarize the numerous features identified (objects interpreted from sharp localized anomalies and natural obstructions identified from broader geophysical features in the data), which represent a hazard to future dredging and/or CDF construction operations scheduled for the harbor areas of interest. It is anticipated that the plans and information presented within this report will be utilized by various project stakeholders in the design of future operations at the Site. Several of the targets identified (such as the potential section of former railway, the several large partially exposed pipelines, or the areas of potential shallow bedrock), may represent significant and difficult issues for future dredging or other project operations, and may require further investigation to determine exactly how these features may impact future operations. Additional analyses, which could be conducted, include further processing and interpretation of the existing geophysical information, collection of additional focused geophysical data, and more direct means of investigation including video, ROV, or direct probing.

Finally, it should be noted that the interpretations rendered in this report are not necessarily exclusive, but are rather the best-fit interpretations of all of the available information using current-day software and practices to render the results. The interpretations may be improved as additional information and data becomes available by incorporating the new information into the input parameters for the simulations and re-running the models.

7.0 LIMITATIONS

The following limitations apply to all geophysical surveys conducted by Foster Wheeler Environmental Corporation; it's subsidiaries and subcontractors. Every attempt has been made to conduct this survey in such a fashion so as to maximize the quality of the data collected and the interpretations rendered. However, a geophysical investigation is an indirect method of subsurface exploration whereby subsurface characteristics are inferred or interpreted from measurements collected at the ground or water surface. Many variables may affect these measurements. Due to the indirect, interpretive nature of geophysics, findings are generally considered precursory and subject to verification by more direct methods of investigation such as test borings or test pits. The following limitations are considered when evaluating geophysical data:

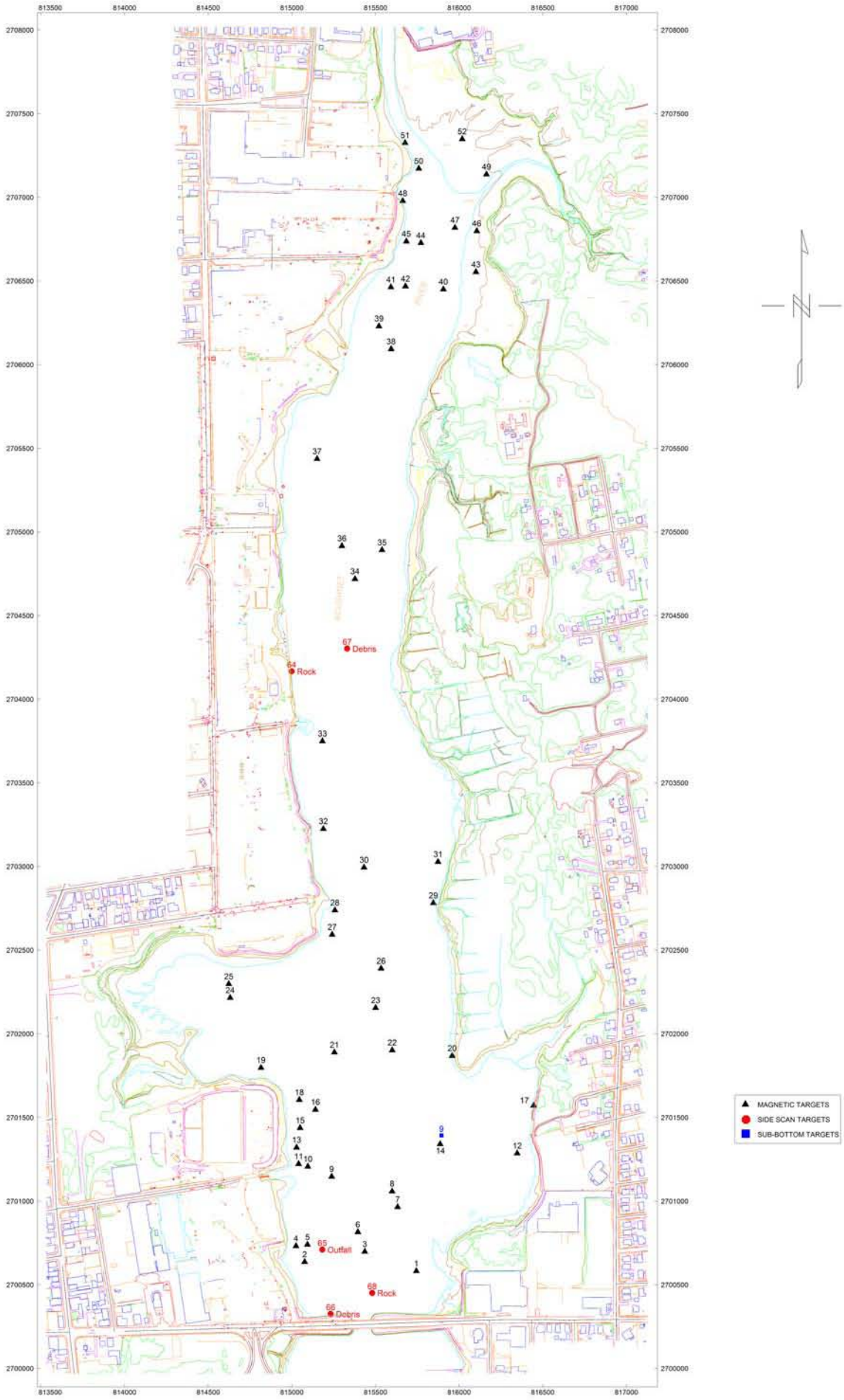
1. Subsurface features can be interpreted from the appropriate geophysical methods only insofar as they produce a discernible geophysical signature. They must have adequate homogeneity, size, and appropriate physical or chemical properties sufficient to contrast with the surrounding medium and be within reasonable proximity to the sensors. Additionally, their signature must be distinguishable from and not masked by background noise or interference.

2. Lithologic data inferred on the basis of geophysical data may not be identical to geologic or hydrogeologic data. Lithologies are generally interpreted from some geophysical signature (e.g., velocity differences) that may be the result of many factors (including density, susceptibility, angle to the sensors, amount of weathering, etc.). Lithology divisions based upon seismic velocity for example may not necessarily be identical to lithology changes identified by drilling. The discrepancy is generally related to formation density and/or compaction (i.e., a dense till may have a higher density than a weathered bedrock, and the difference can be difficult to resolve with seismic data).

3. Complex geological configurations may be impossible to resolve with surface geophysical methods. The resolution of geophysical data is limited by the spatial geometry of sensors, strength of signal, and distance of the object or layer of interest from the energy source and the sensor array used. Resulting interpretations are rendered by modeling geophysical response to known or presumed geometric relationships. The complexity of the relationships that can be modeled is limited by the resolution allowed by the method and geometry of equipment layout used, and the limitations of the software used.

4. Foster Wheeler is not responsible for data quality in areas having excessive "background noise" which affect the specific physical parameters of the subsurface that are being measured by a particular geophysical technique. Examples of background noise include: heavy traffic on a nearby roadway which induces vibrational energy into the ground that in turn interferes with seismic data collection; heavy machinery (i.e., boat, sand-blaster, or torch) operation adjacent to or in the water near a marine seismic survey line; or underground utilities (such as electric lines, tunnels, sewers, etc.), which can interfere with seismic instrumentation.

No guarantee or warranty (other than that stipulated in the contract under which this work was promulgated), expressly stated or implied, is given concerning the data and interpretations rendered in this report. All information is presented as "for information only". Foster Wheeler Environmental Corporation, it's parent company or any subsidiary, is not liable for any losses resulting from the misuse, misrepresentation, or misinterpretation of any information presented in this report by any person or entity.



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US State Plane 1983 Zone - Massachusetts Mainland 2001

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Map File Name: Figure 1.map
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6/11/2001

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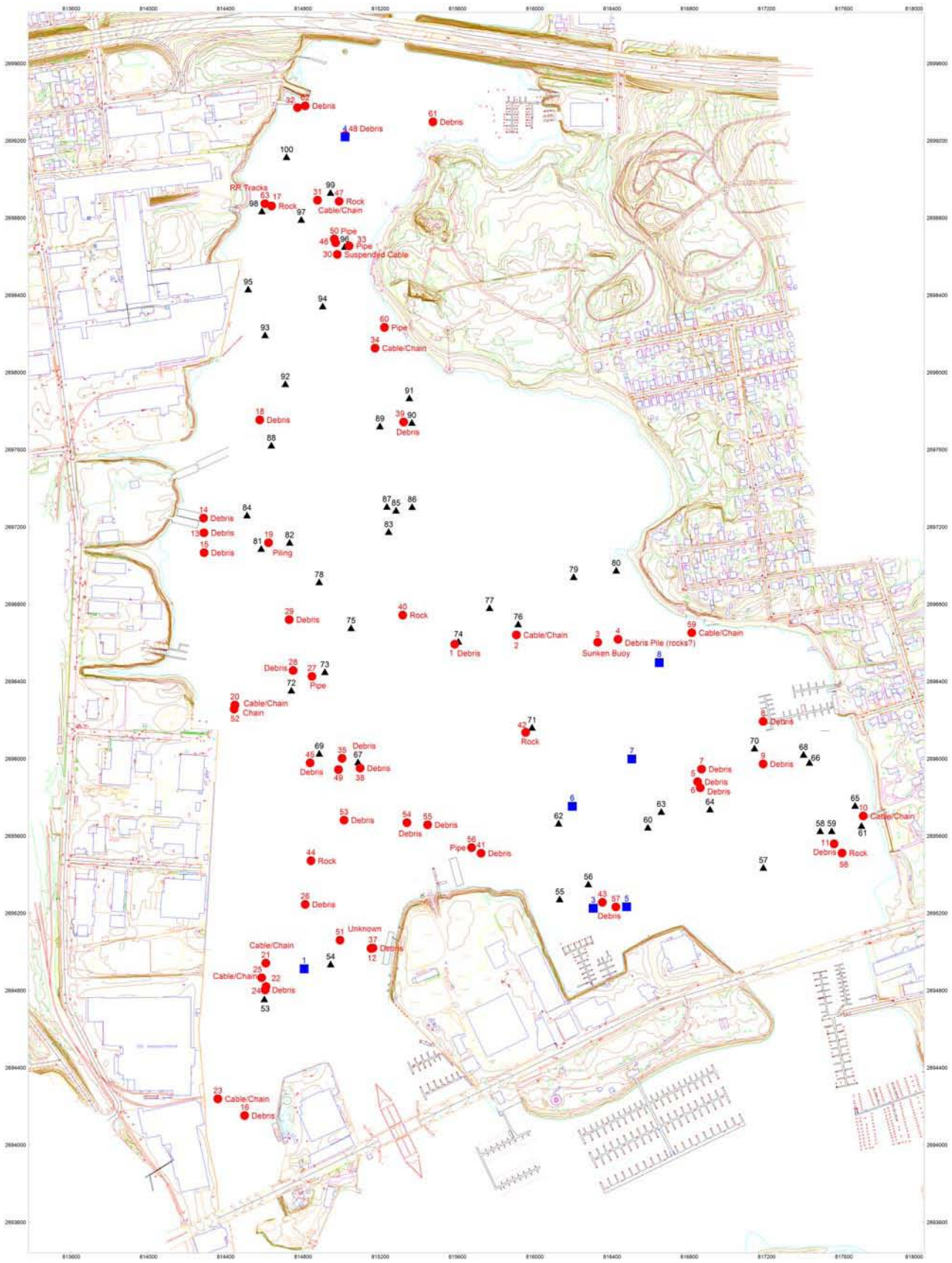
US Army Corps of Engineers
New England District

FIGURE 1

New Bedford Harbor Superfund Site
New Bedford, Massachusetts
UPPER HARBOR AREA OF INTEREST

GEOPHYSICAL TARGET
SUMMARY PLAN MAP

FWENC Geophysics



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(US State Plane 1983 Zone - Massachusetts Mainland 2001)

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8/11/2003

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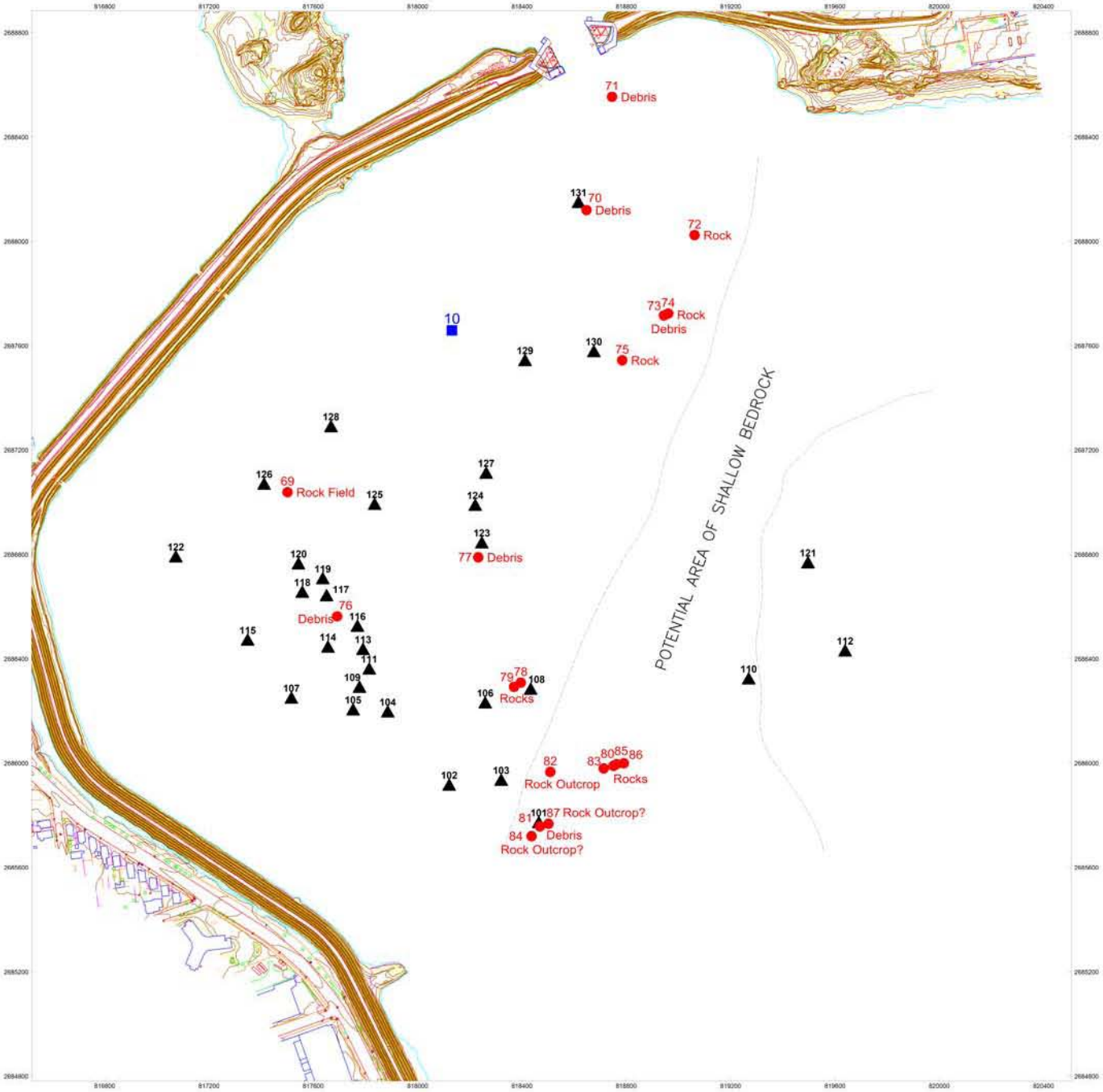
US Army Corps of Engineers
New England District

FIGURE 2

New Bedford Harbor Superfund Site
New Bedford, Massachusetts
OUTER HARBOR AREA OF INTEREST

GEOPHYSICAL TARGET SUMMARY PLAN MAP

FW/ENC Geophysics



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6/11/2007

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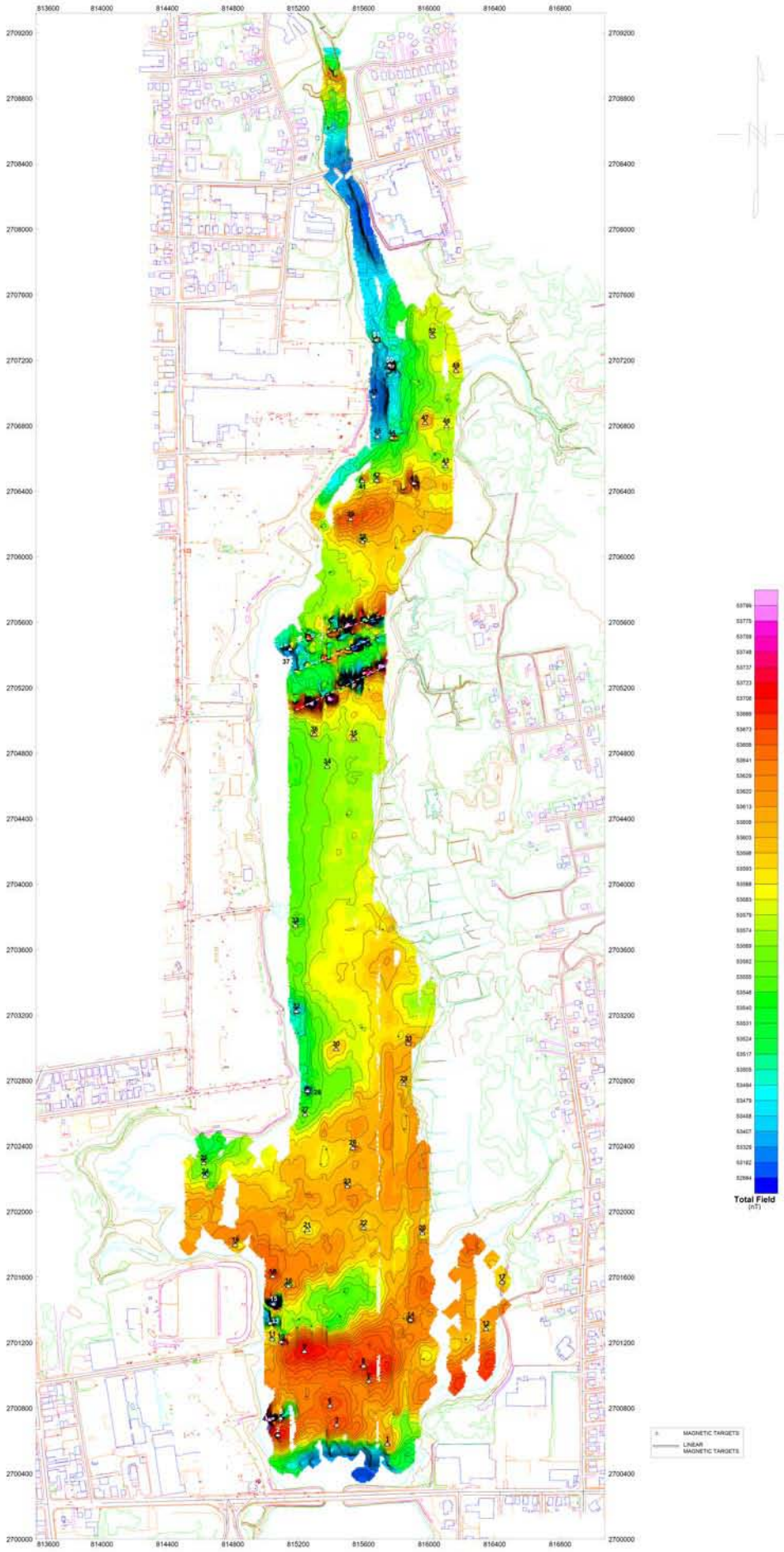
US Army Corps of Engineers New England District

FIGURE 3

New Bedford Harbor Superfund Site
New Bedford, Massachusetts
OUTER HARBOR AREA OF INTEREST

GEOPHYSICAL TARGET SUMMARY PLAN MAP

FWENC Geophysics



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Scale 1" = 300'

US State Plane 1983 Zone - Massachusetts Mainland 2001

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6/11/2001

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FIGURE 7

New Bedford Harbor Superfund Site
New Bedford, Massachusetts
UPPER HARBOR AREA OF INTEREST

PLAN MAP OF MAGNETICS DATA
Total Magnetic Field
Diurnally Corrected

FWENC Geophysics

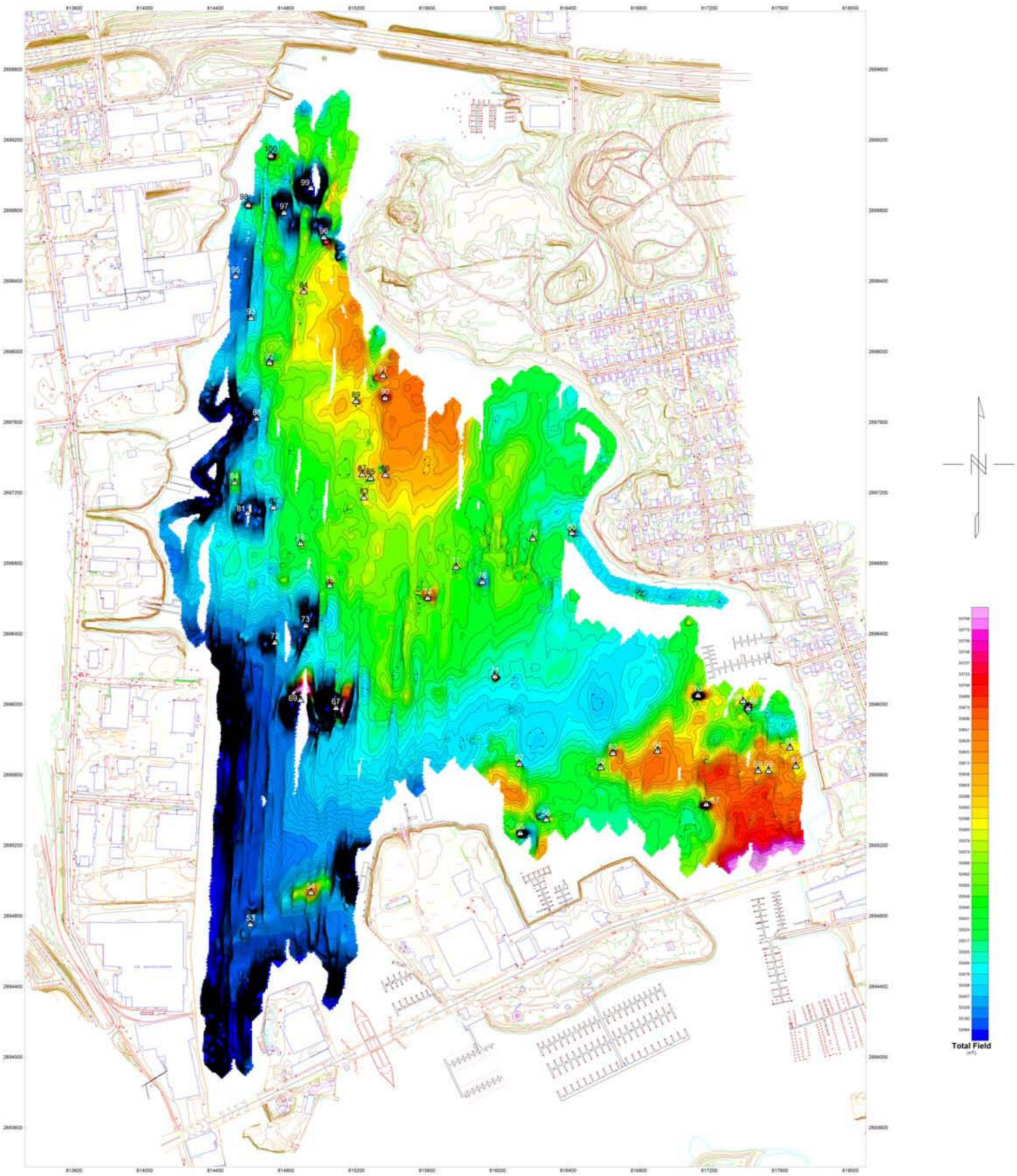

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FIGURE 8

New Bedford Harbor Superfund Site
New Bedford, Massachusetts
MIDDLE HARBOR AREA OF INTEREST

PLAN MAP OF MAGNETICS DATA
Total Magnetic Field
Diurnally Corrected

FWENC Geophysics

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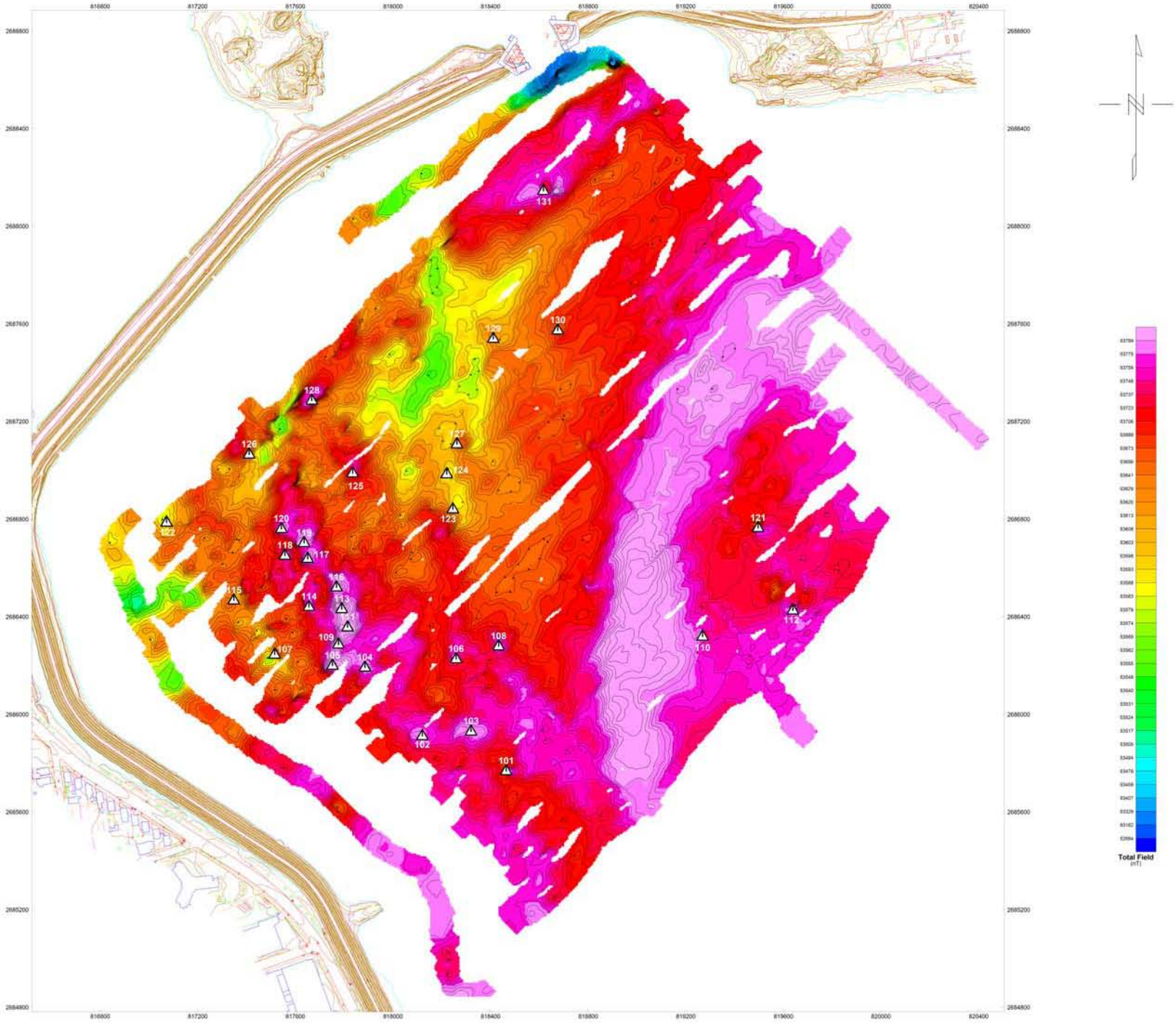

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6/11/2001

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FIGURE 9

New Bedford Harbor Superfund Site
New Bedford, Massachusetts
OUTER HARBOR AREA OF INTEREST

PLAN MAP OF MAGNETICS DATA
Total Magnetic Field
Diurnally Corrected

FWENC Geophysics

This map was created in Geosoft's Oasis Montaj V5.07
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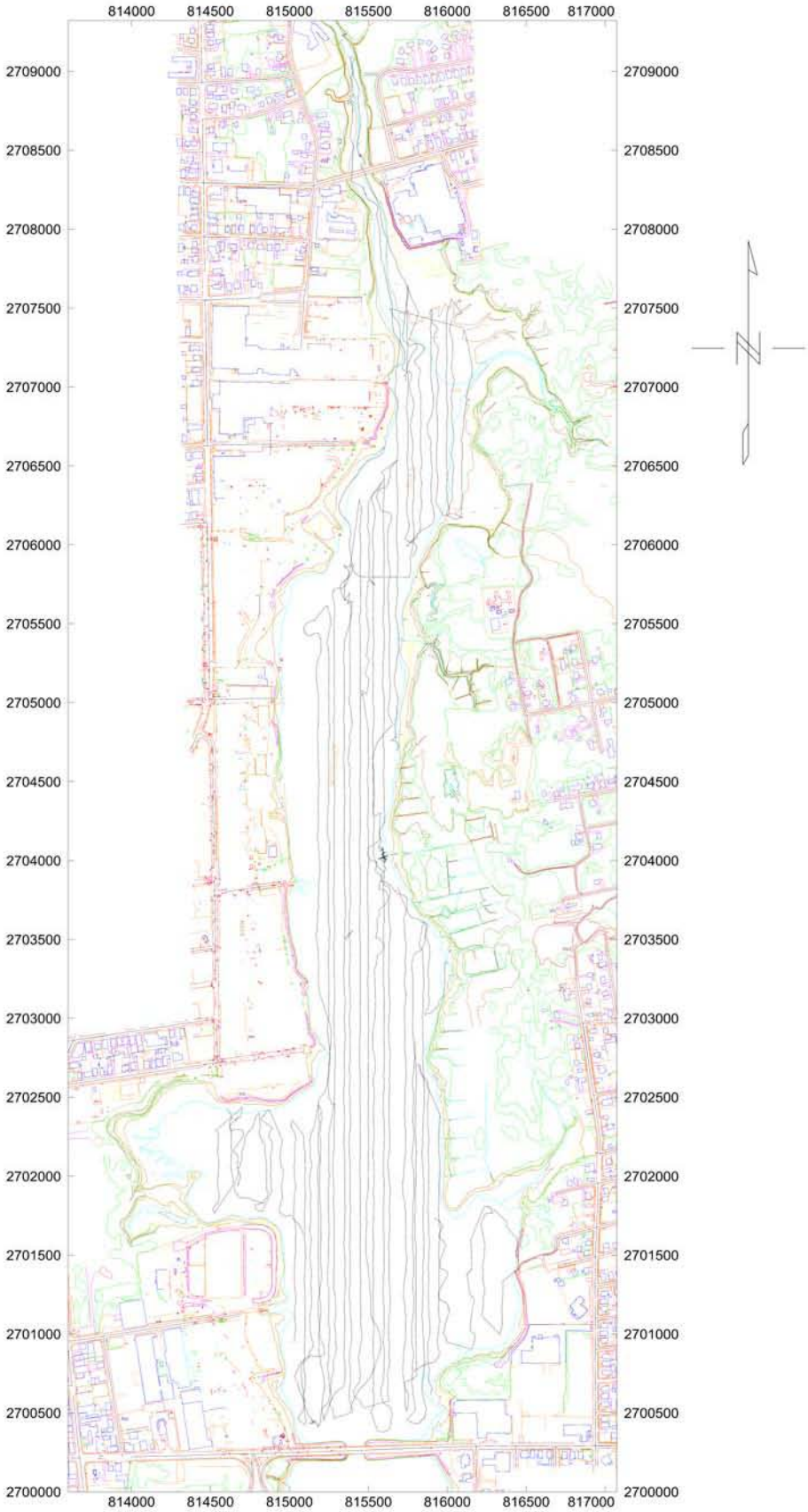

Scale 1:7500

250 0 250 500 750

feet

Scale 1" = 625'

US State Plane 1983 Zone - Massachusetts Mainland 2001

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New England District

FIGURE 10

New Bedford Harbor Superfund Site
New Bedford, Massachusetts
UPPER HARBOR AREA OF INTEREST

TRACK-LINE PLOT PLAN MAP

FWENC Geophysics

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Map File Name: Figure 11.map
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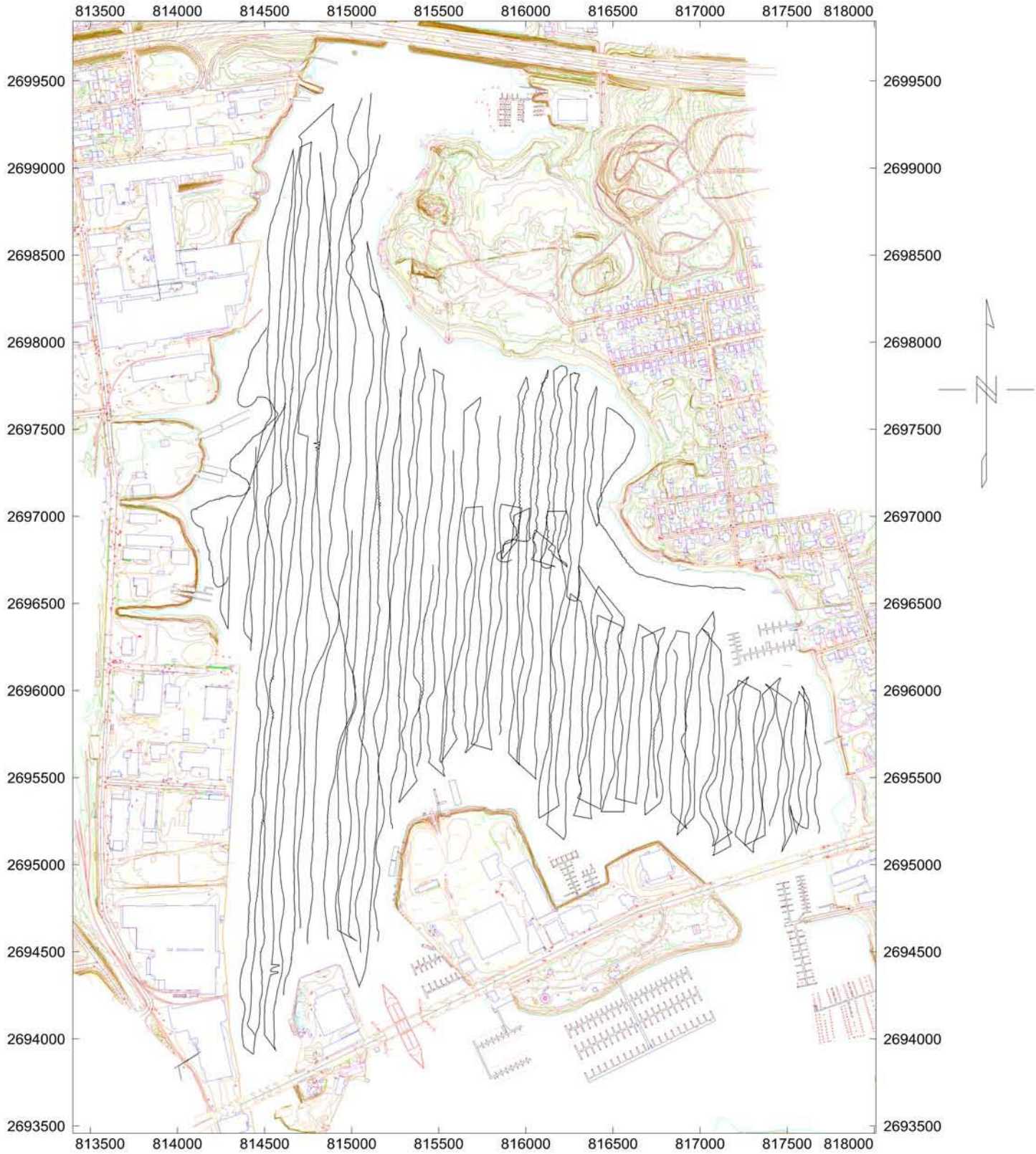

Scale 1:7200

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feet

Scale 1" = 600'

US State Plane 1983 Zone - Massachusetts Mainland 2001

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New England District

FIGURE 11

New Bedford Harbor Superfund Site
New Bedford, Massachusetts
LOWER HARBOR AREA OF INTEREST

TRACK-LINE PLOT PLAN MAP

FWENC Geophysics

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Map File Name: Figure 12.map
Path: HQ_FILER1\Groups\Geophysics\2000-17-0119 Side Scan Report\Figures
6/11/2001

Scale 1:6000

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feet

Scale 1" = 500'

US State Plane 1983 Zone - Massachusetts Mainland 2001

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New England District

FIGURE 12

New Bedford Harbor Superfund Site
New Bedford, Massachusetts
OUTER HARBOR AREA OF INTEREST

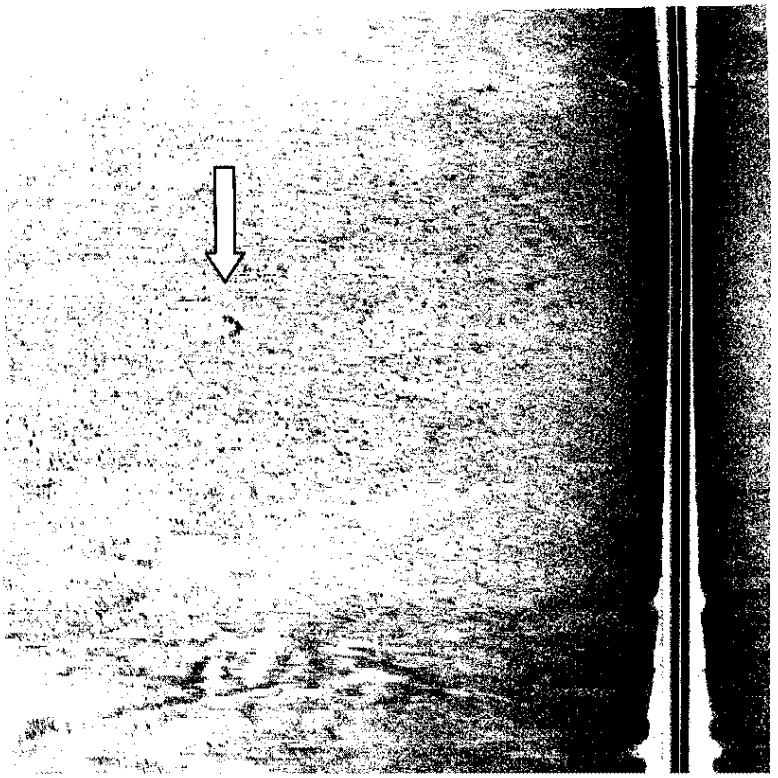
TRACK-LINE PLOT PLAN MAP

FWENC Geophysics

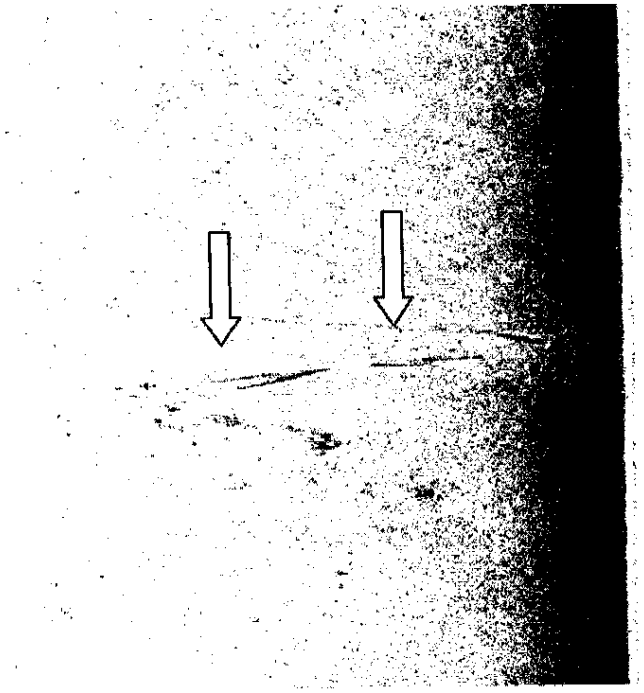
APPENDIX A

Detailed Images of Selected Side Scan Targets

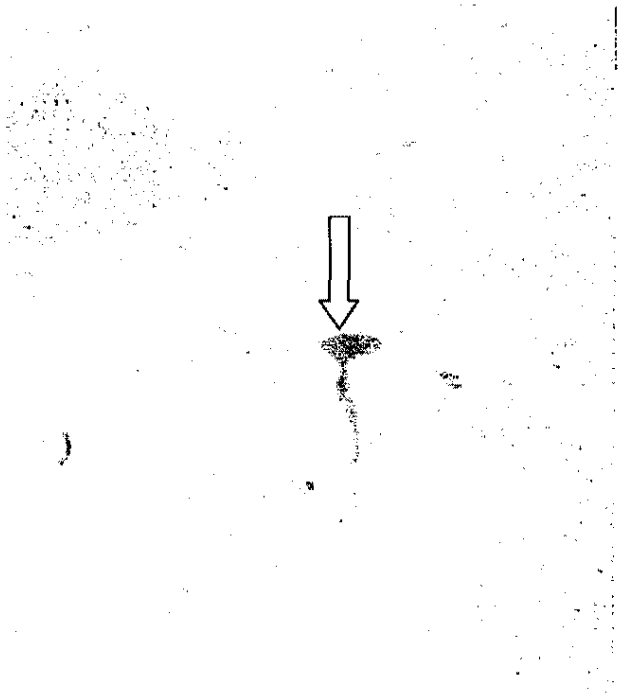
Target 1. Debris – Possible small rock.



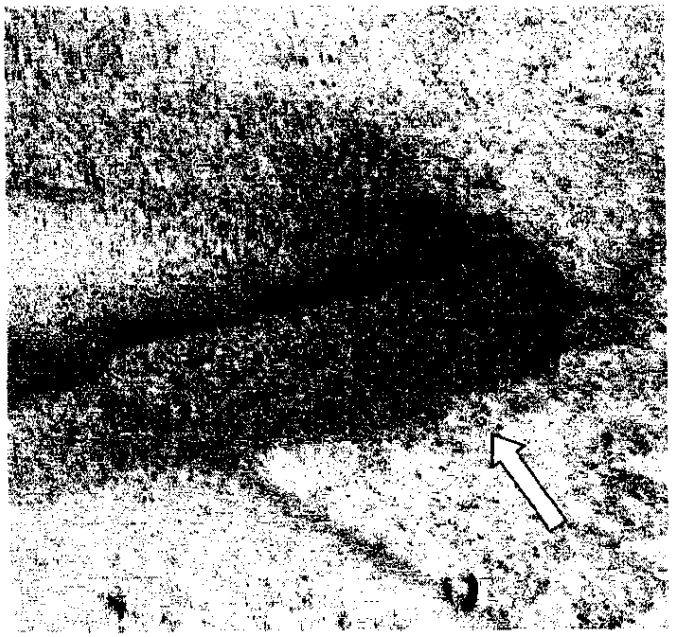
Target 2. Cable/Chain



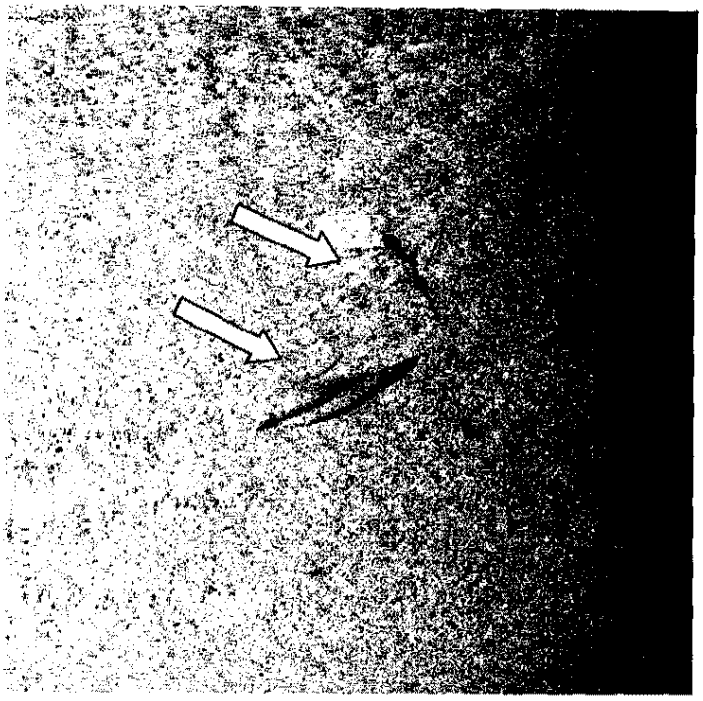
Target 3. Sunken Buoy – Possible buoy with an attached cable or rope.



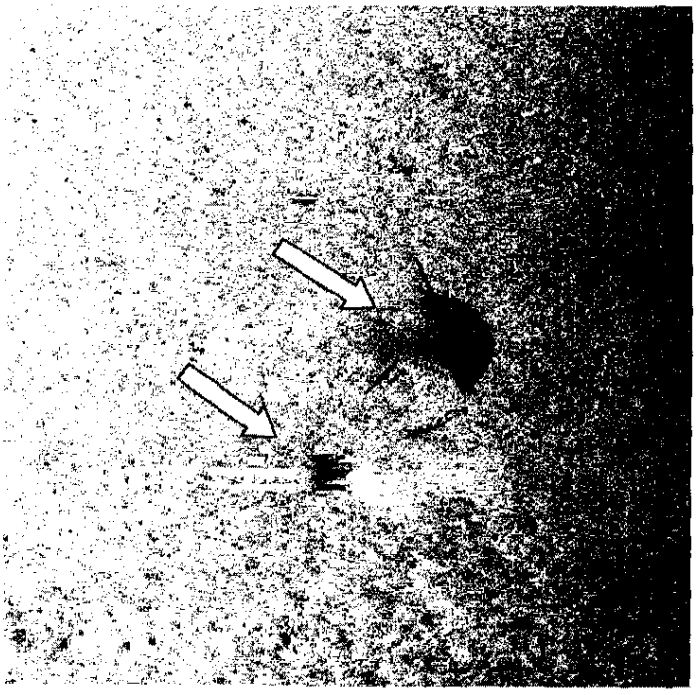
Target 4. Pile of Rocks - Large (< 30m) deposit of rocks (possibly gravel).



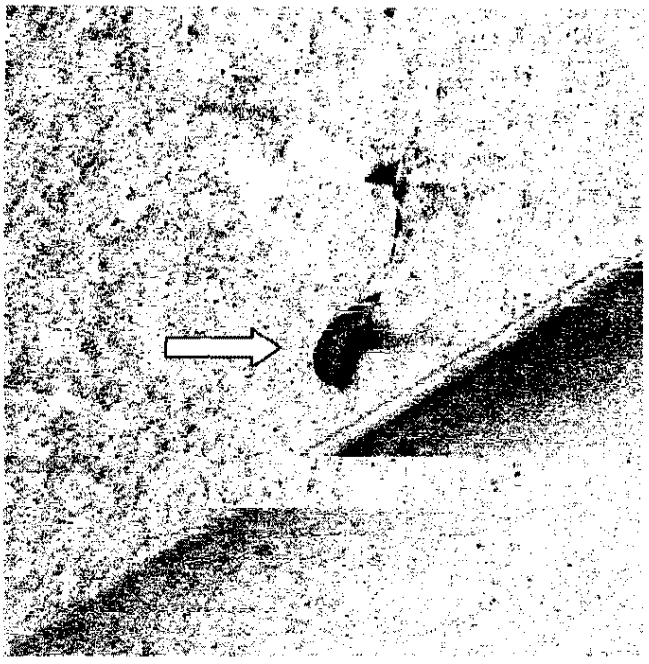
Target 5. Debris - Both objects are approximately 10m in length.



Target 6. Debris – Two unidentified objects. The larger object is approximately 9m in length.

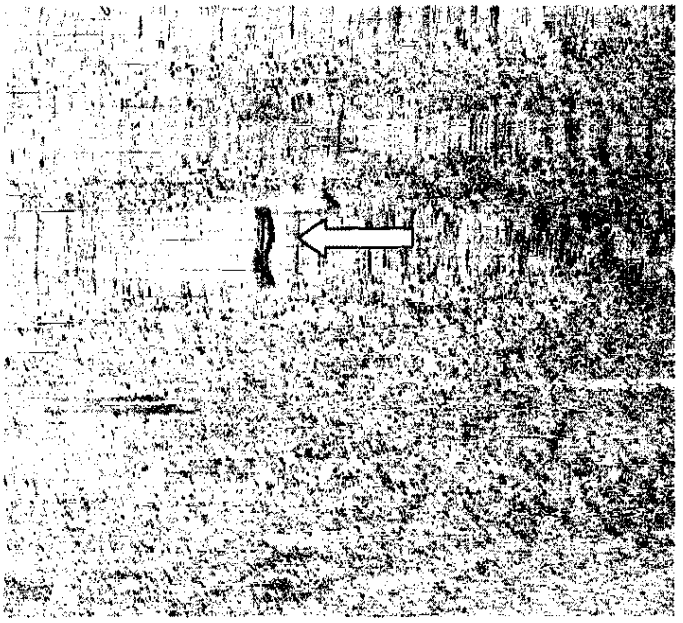


Target 7. Debris – Unidentified object (approximately 6m in length) possibly connected to a second smaller object.



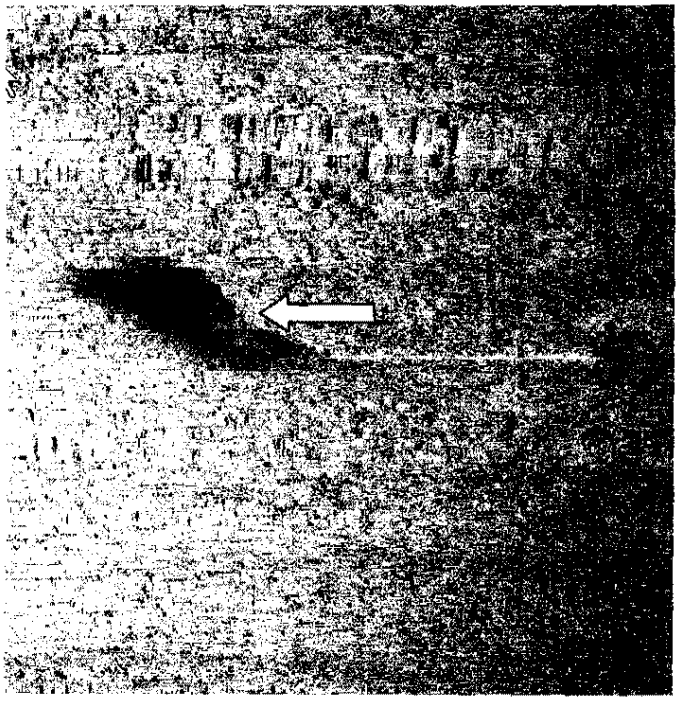
Target 8. Debris – Possible modern vessel debris or old piles from a pier. These objects do not substantially protrude above the harbor bottom.

Target 9. Debris - Linear shaped debris approximately 3m in length (slightly above the harbor bottom).

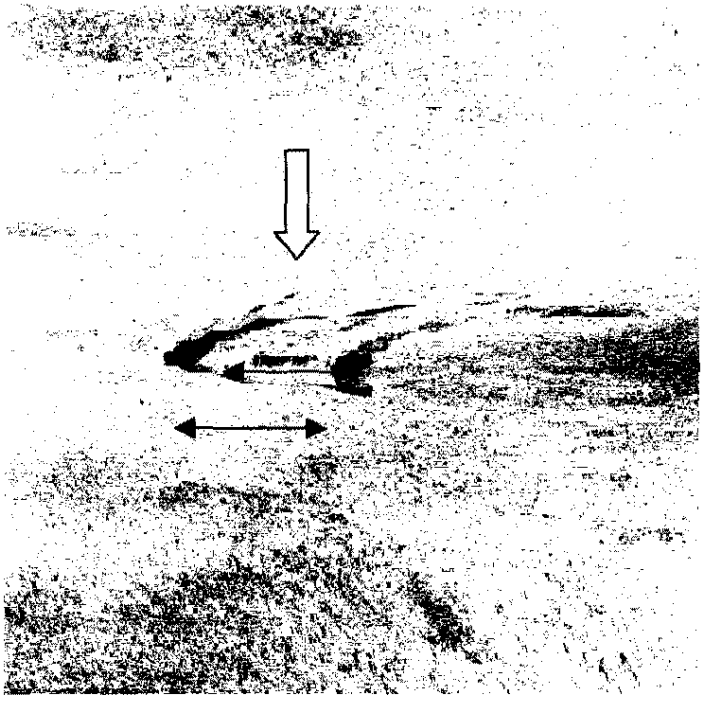


Target 10. Cable/Chain – Cable or chain and a small object to the lower right (possibly debris or mooring block).

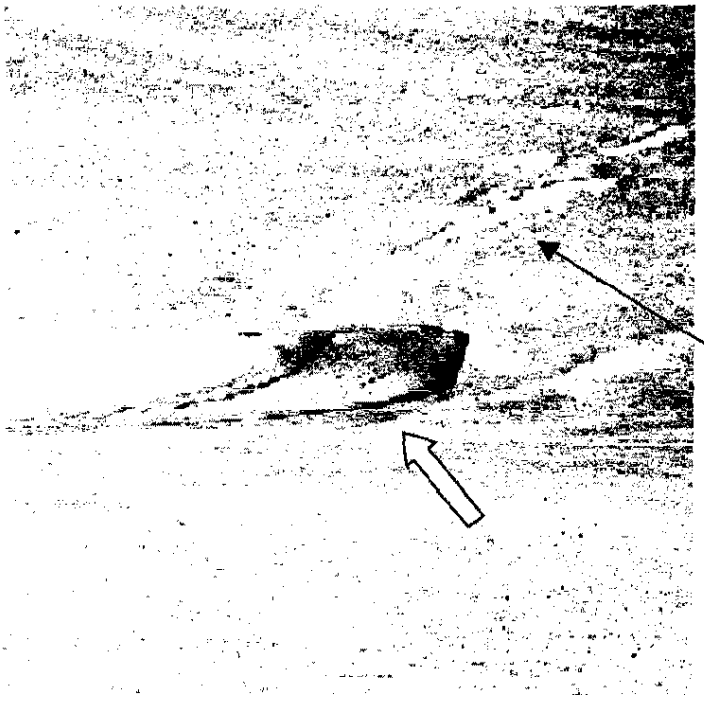
Target 11. Debris – Large object approximately 16m in length (unknown type).



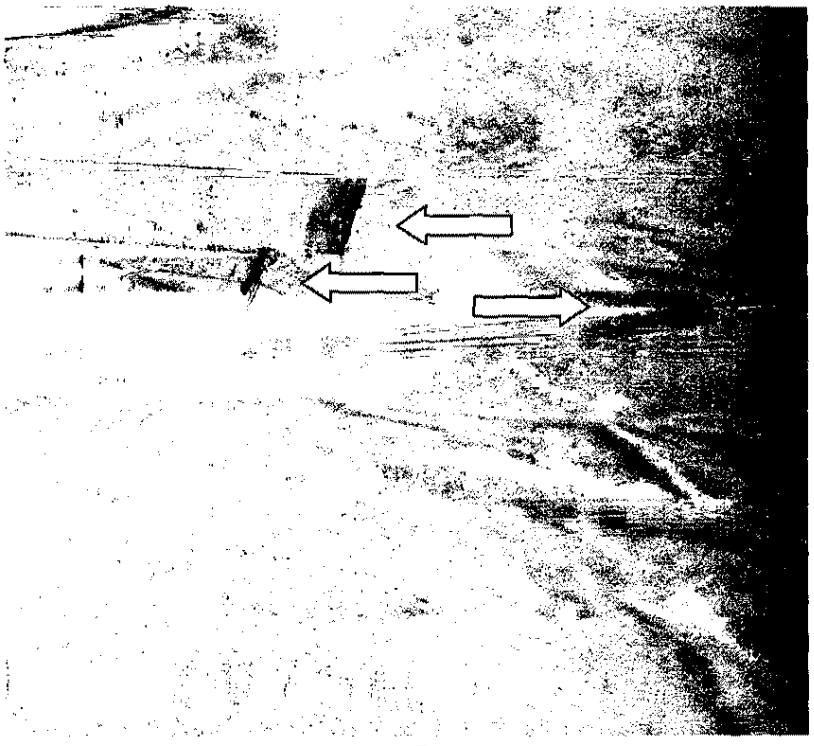
Target 12. Debris – Large ,approximately 5m, object (unknown type).



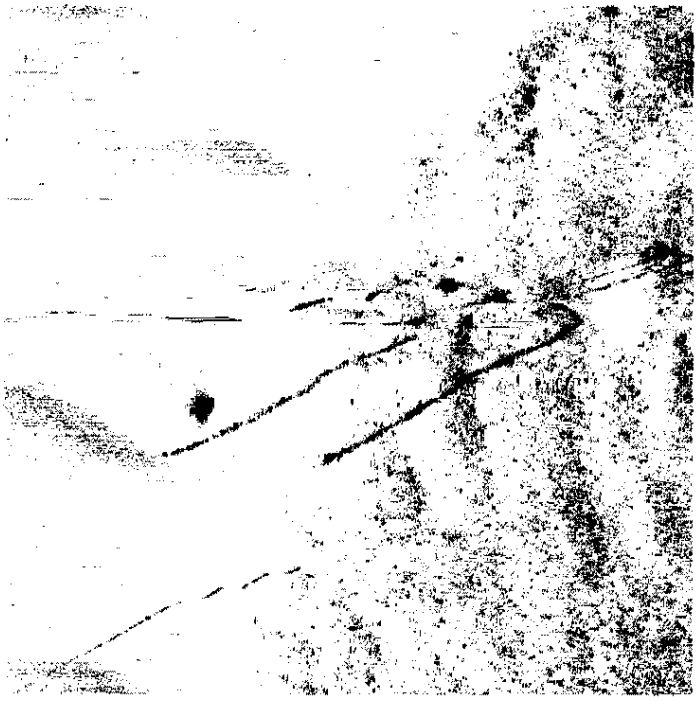
Target 13. Debris – Unidentified object protruding from the harbor bottom. To the right are large drag scars (potentially anchor scars). Associated with target 14.



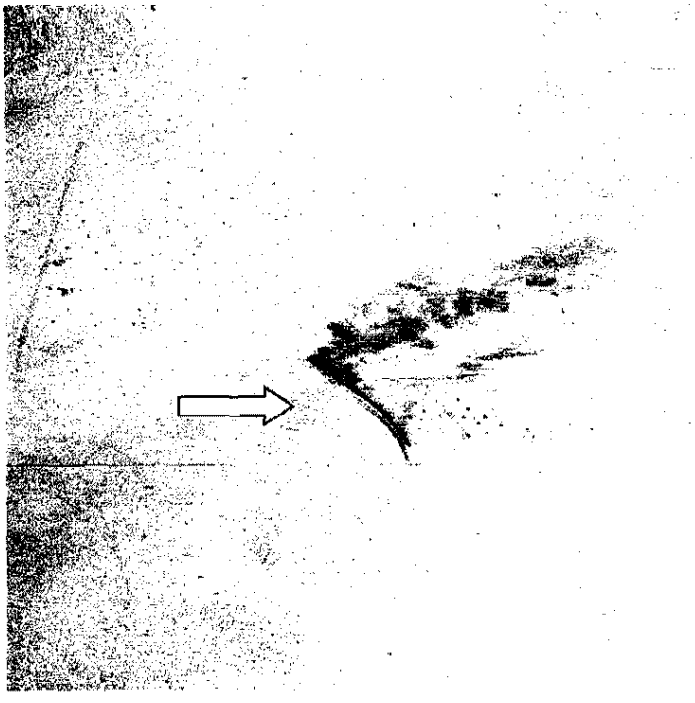
Target 14. Debris – Three large objects possibly debris from nearby pier or old bulkhead structure. Associated with target 13.



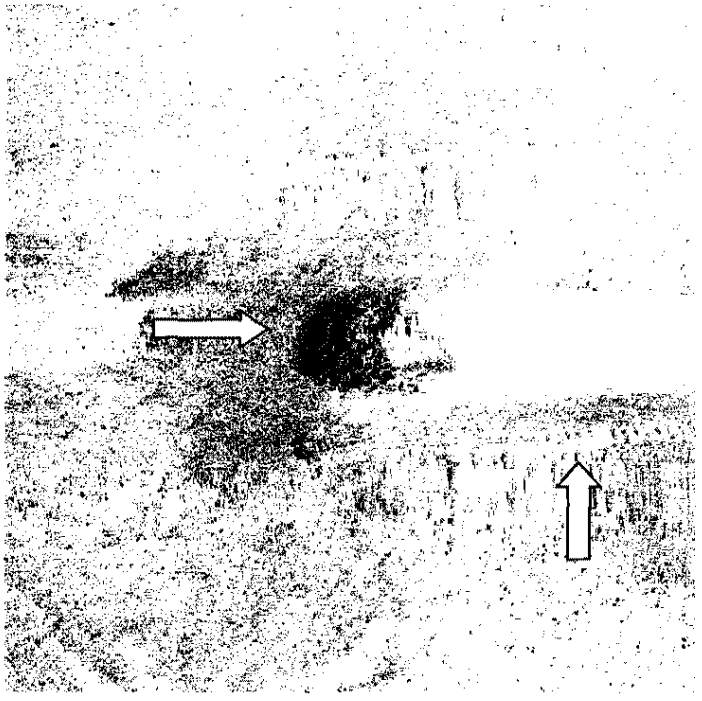
Target 15. Possible Modern Vessel Debris – Collection of debris approximately 15m in length that is possibly related to a modern vessel.



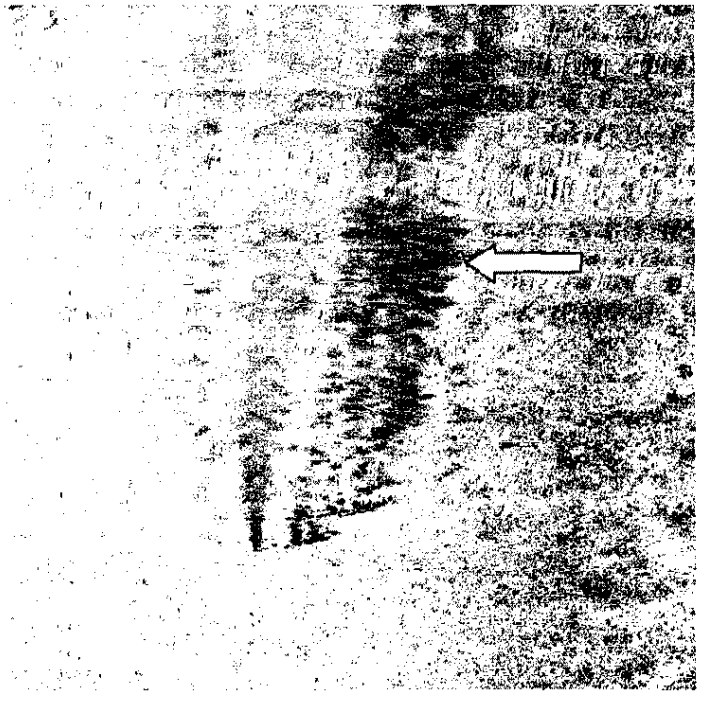
Target 16. Debris – Large object of approximately 15m in length.



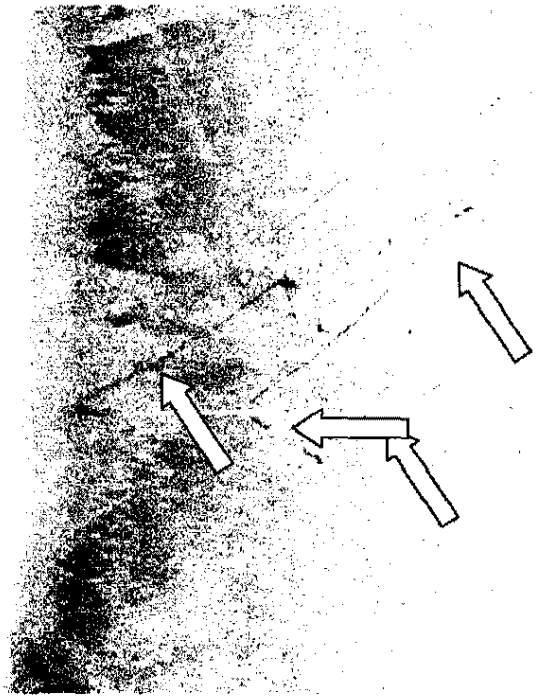
Target 17. Rock Pile – Large rock pile with a faint image of a length of railway track below refer to Target 63 for close-up of railway track).



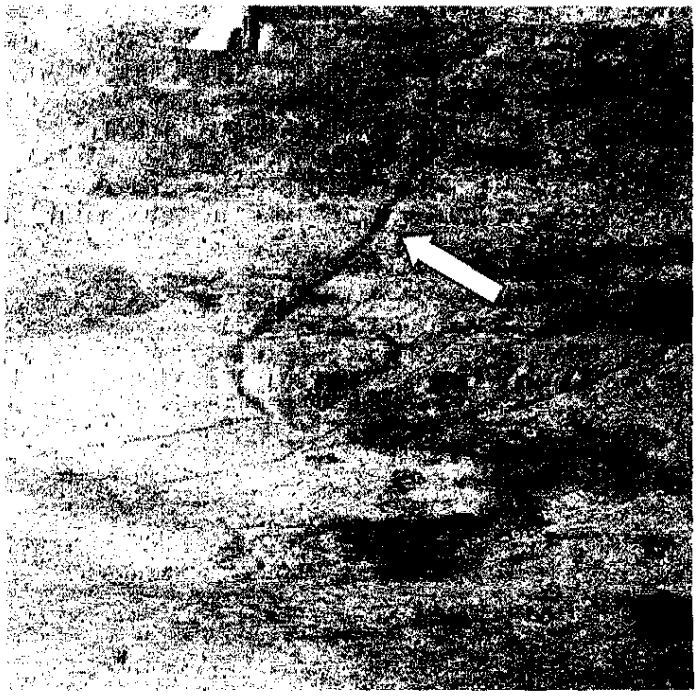
Target 18. Debris – Object protruding from the harbor bottom. Possible scour noted associated with target.



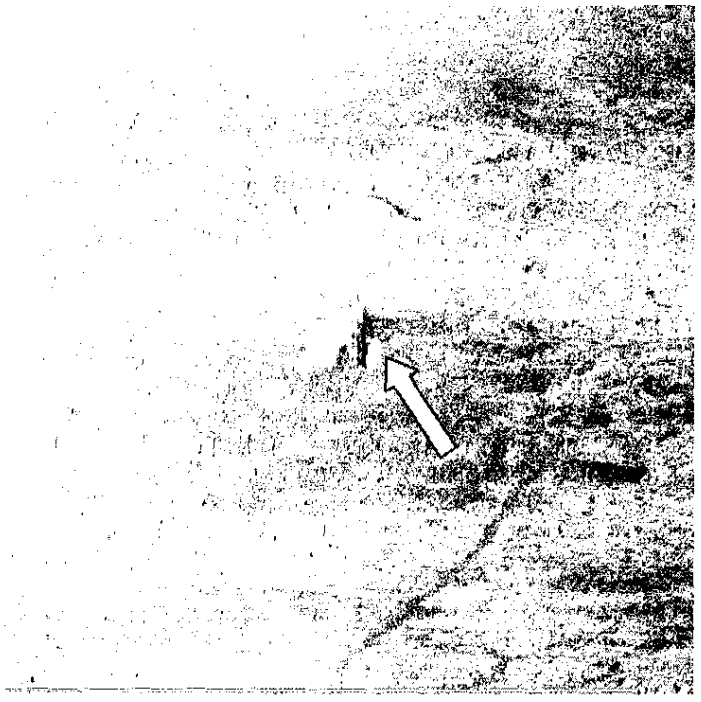
Target 20. Cable/Chain - Multiple cables/chains, possibly attached to mooring blocks at the lower end of linear anomalies.



Target 21. Cable/Chain – Long length of cable/chain on harbor bottom.



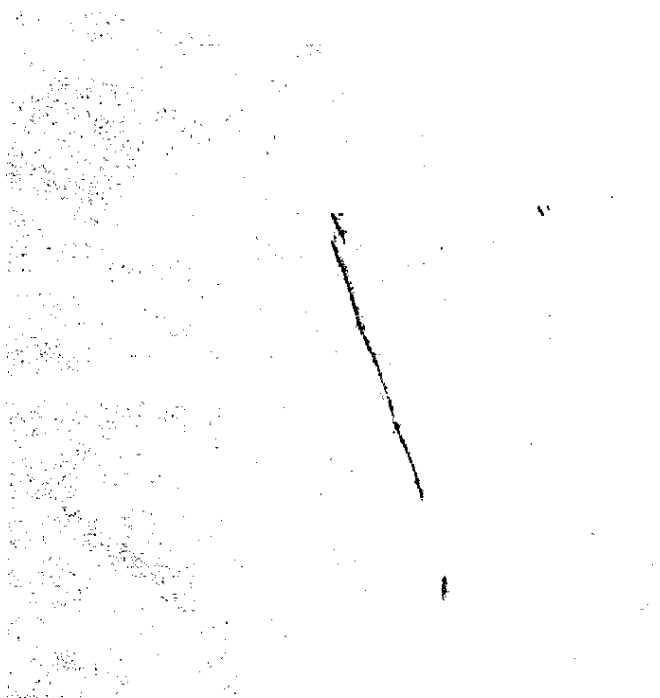
Target 22. Debris – Small single object approximately 4m in length protruding from the harbor floor.



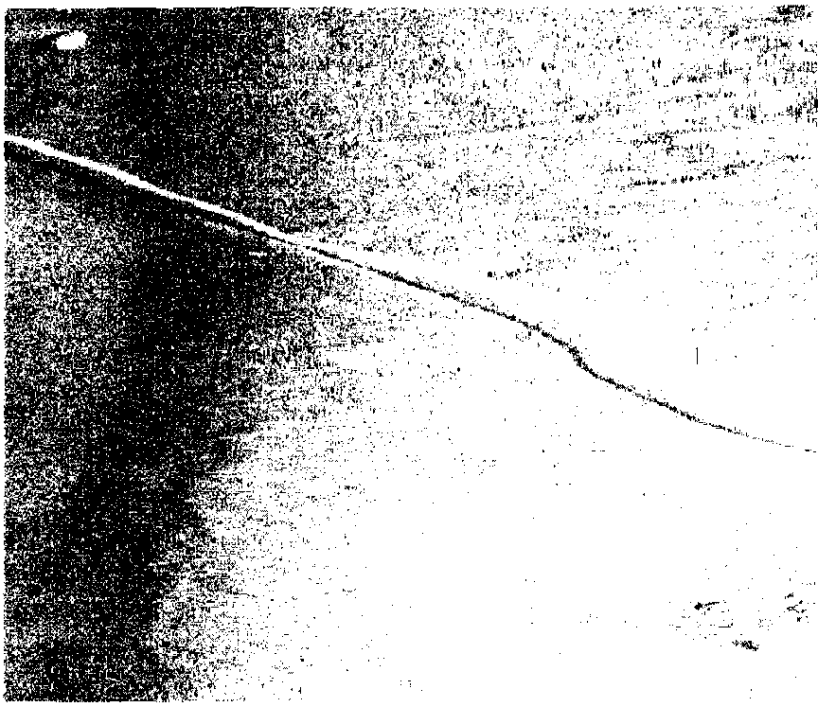
Target 23. Cable/Chain and Multiple Linear Debris– Possible former pier structure (pilings) in the lower right of image with associated debris.

Target 24. Debris – Unidentified debris approximately 3m in size. Also, drag scar crosses center to upper right of image.

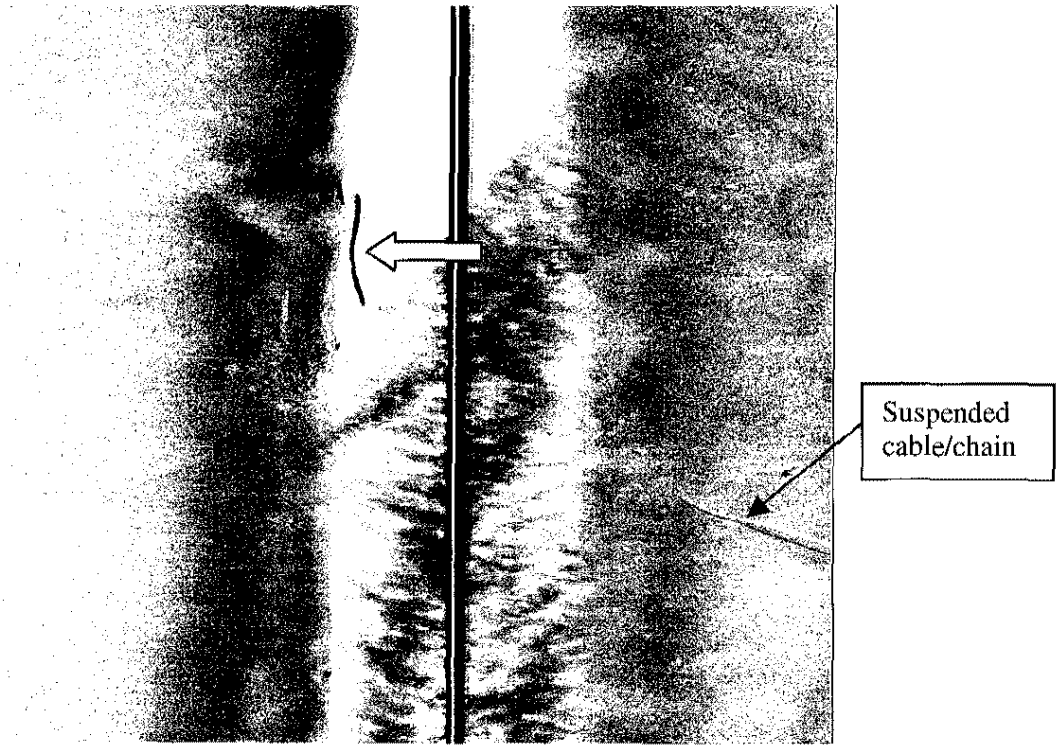
Target 27. Piece of Pipe – Length of pipe-like object is approximately 20m.



Target 30. Suspended Cable or Pipe – Cable, chain, or pipe suspended above harbor bottom (showing a characteristic shadow).



Target 31. Cable/Chain – Suspended cable or chain in lower right of image. Low unidentified object approximately 20 meters long protruding from the harbor bottom. The large vertical line through the image is the position of the towfish. The white and gray mottled pattern on either side of the tow fish is the water column, with the gray showing turbulence.



Target 32. Possible Modern Vessel Debris/Pier – Collection of debris possibly related to an old pier structure or modern sunken barge approximately 20 x 12 m in size.

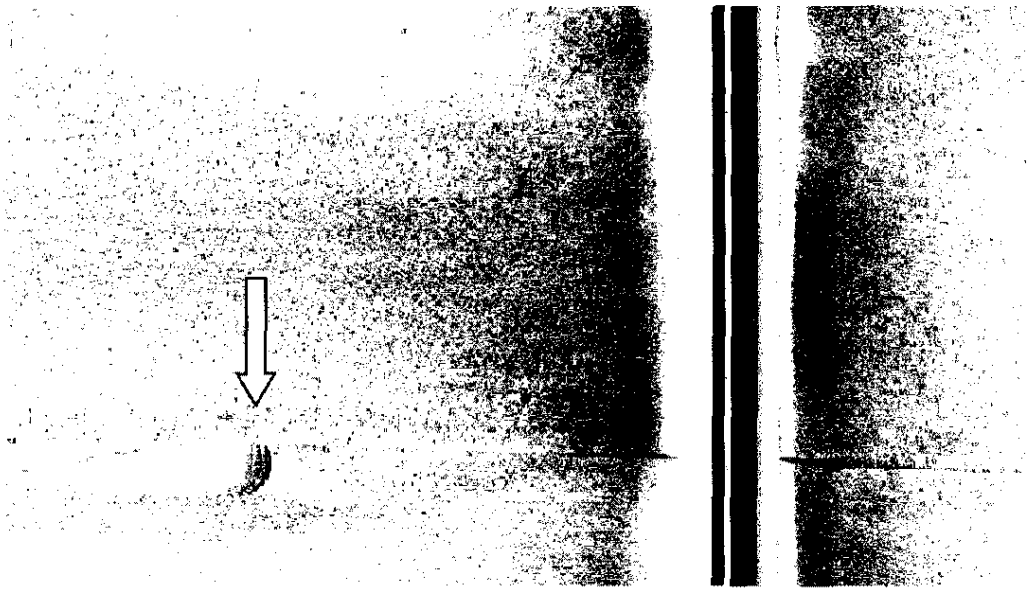
Target 34. Cable/Chain – Possibly a large chain or cable.

Target 35. Debris – Collection of debris varying in size from 2 -10m.

Target 37. Debris – Possible modern vessel debris up to 15m in length.

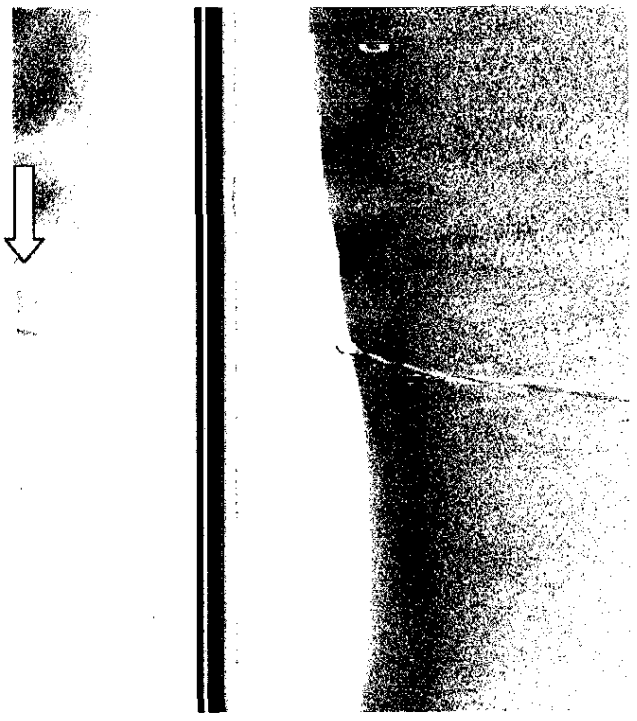
Target 38. Debris – Possible modern vessel debris (7 x 2m).

Target 41. Debris – An isolated protruding object approximately 4m in length.

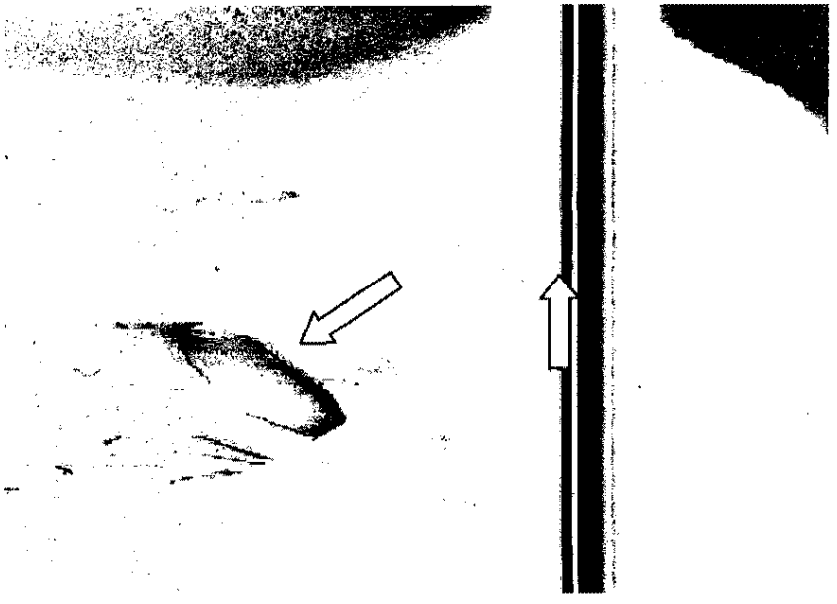


Target 45. Debris – Flat lying unidentified debris approximately 6m in length.

Target 46. Pipe – Possible pipeline on the harbor bottom.

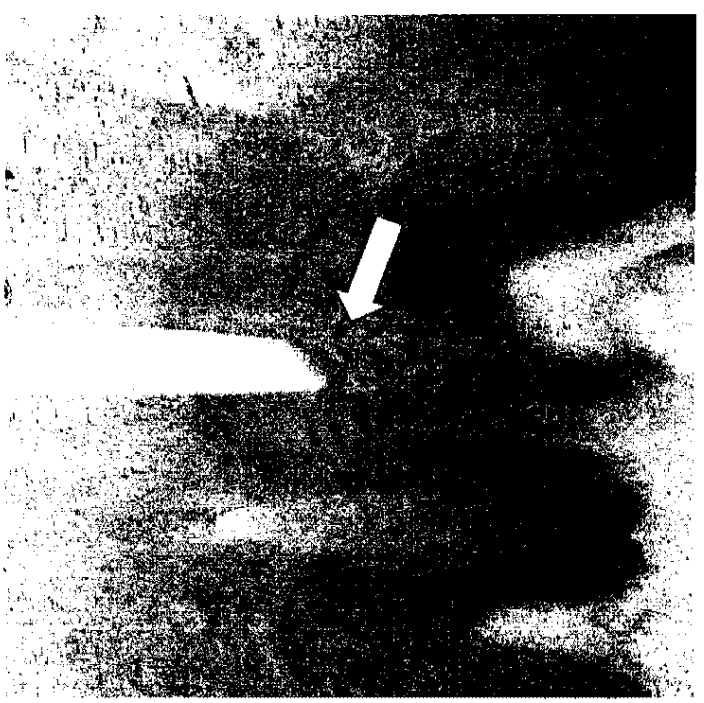


Target 49. Possible Modern Vessel Debris – Small, modern vessel-like object approximately 9m in length.

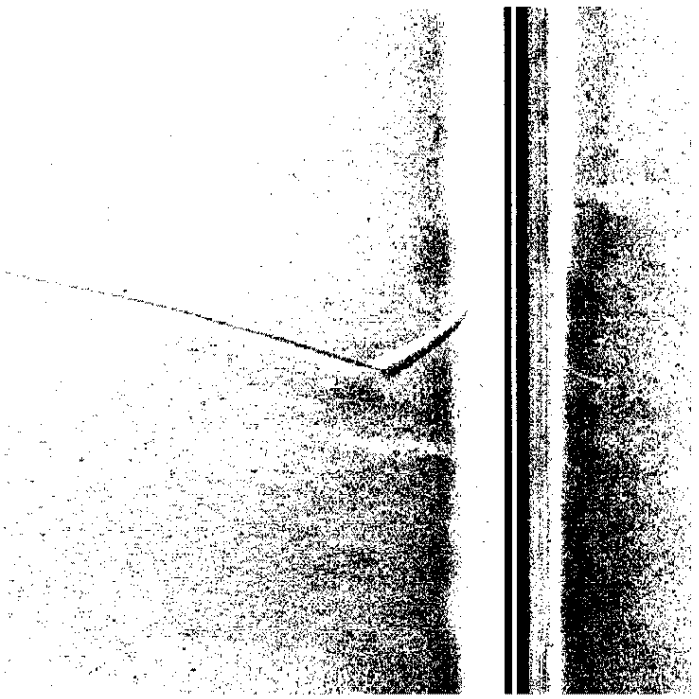


Target 54. Debris – Flat lying debris and possible cable/chain.

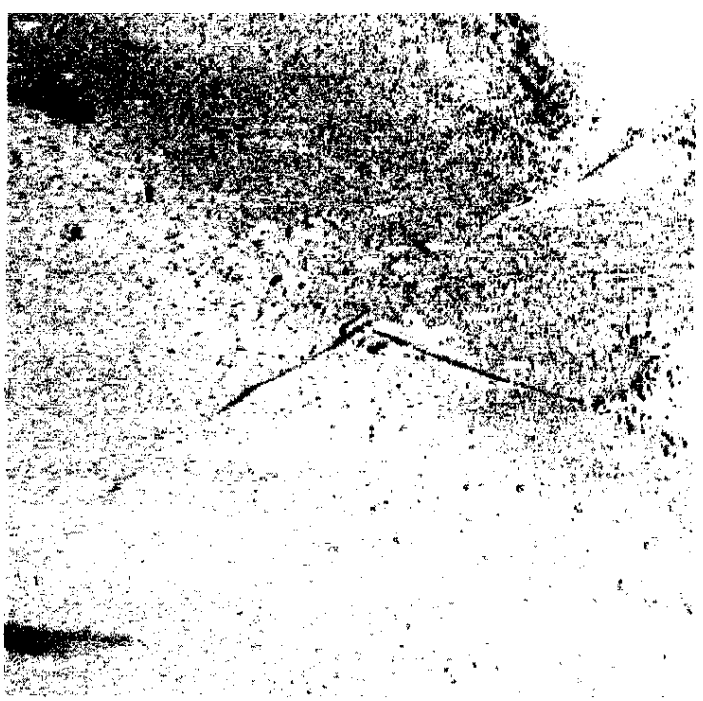
Target 55. Debris – Small (~1m) unidentified object protruding into the water column.



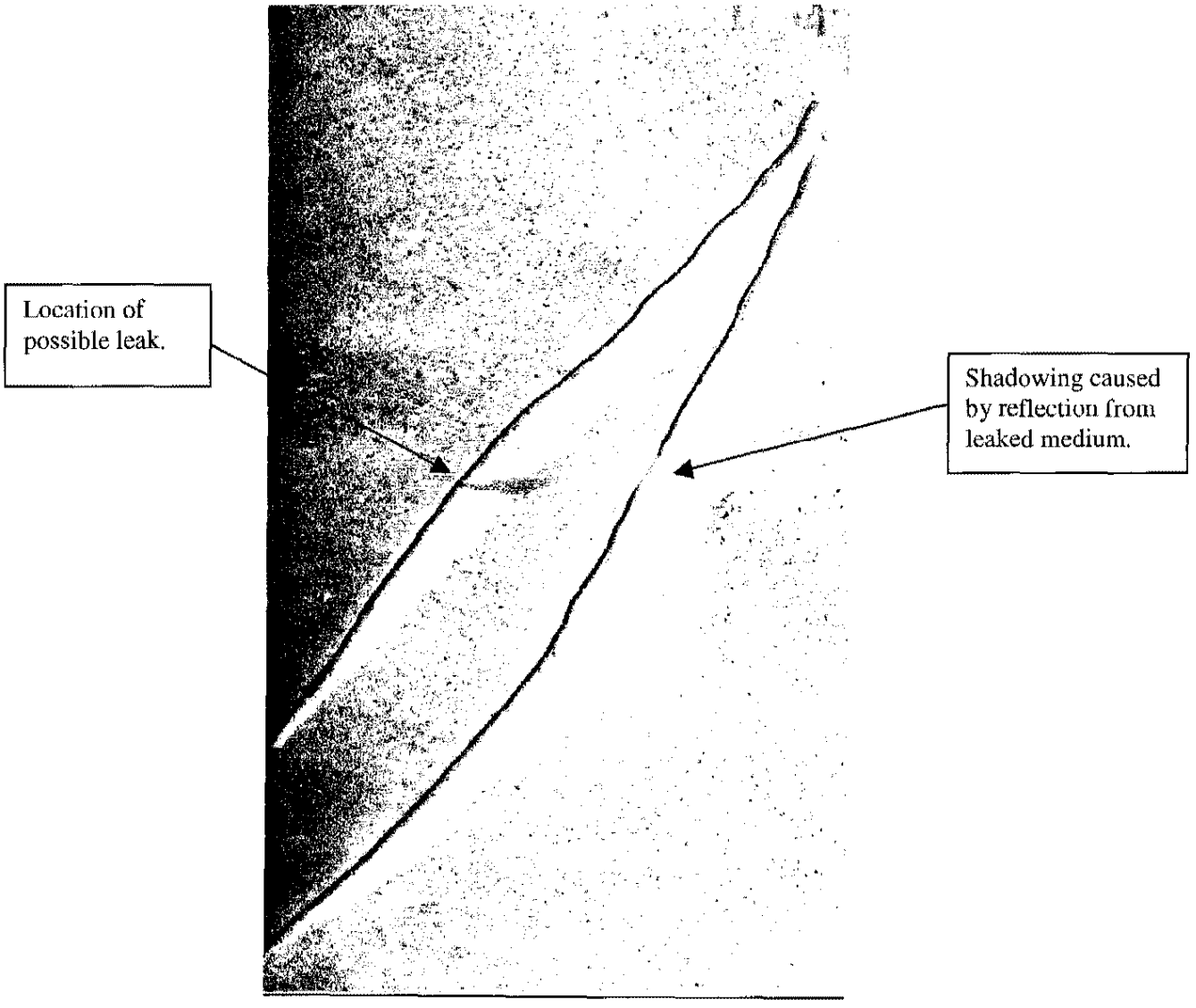
Target 56. Debris – Possible suspended pipe or cable with a bend indicating possible anchor drag.



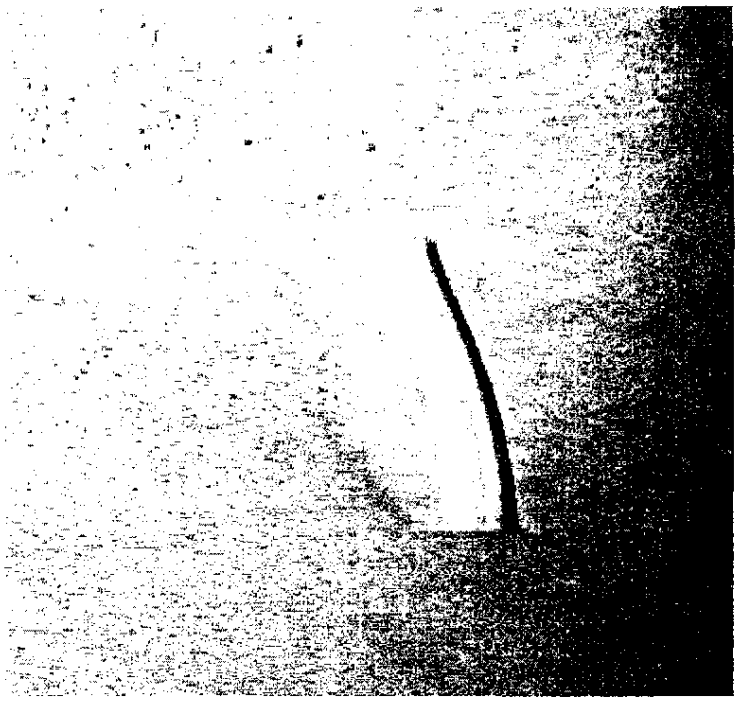
Target 59. Cable or Pipe – Pipe or cable with a characteristic bend indicating that an anchor could have dragged it.



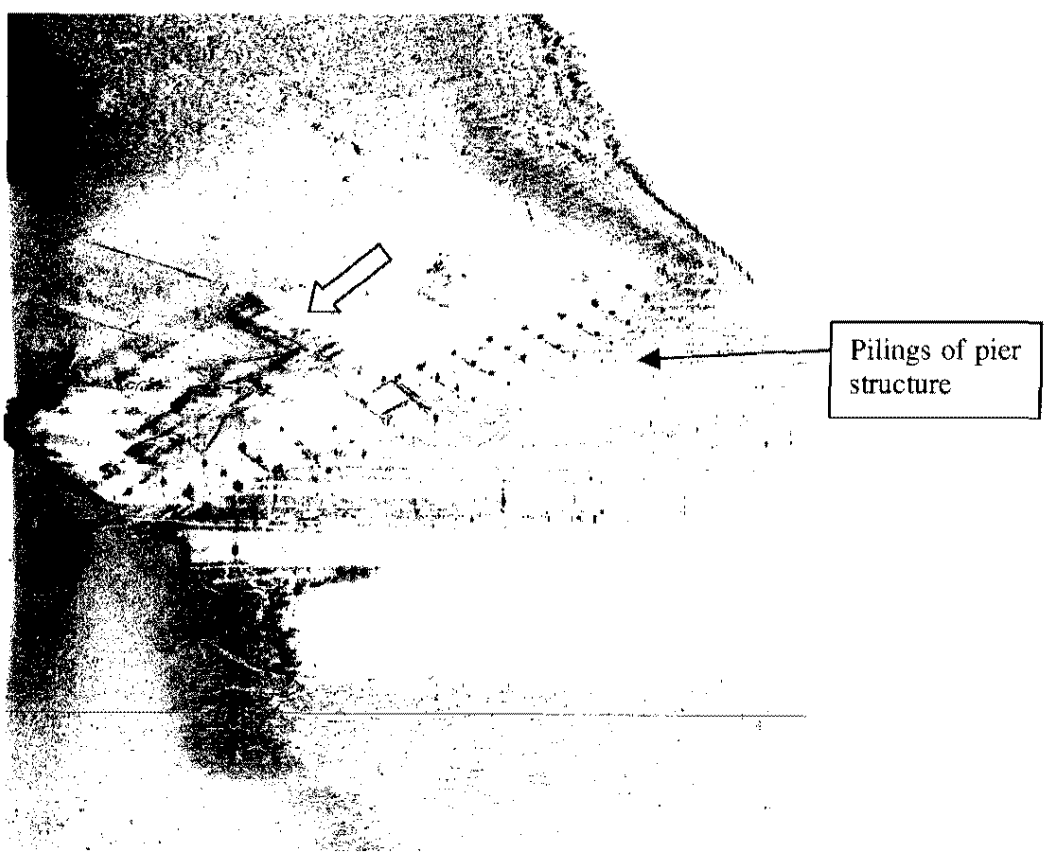
Target 60. Pipeline – Two large pipes sitting just above the harbor bottom. A streak on the left of the image is a possible leak showing a characteristic shadow from the leaking medium in the water column.



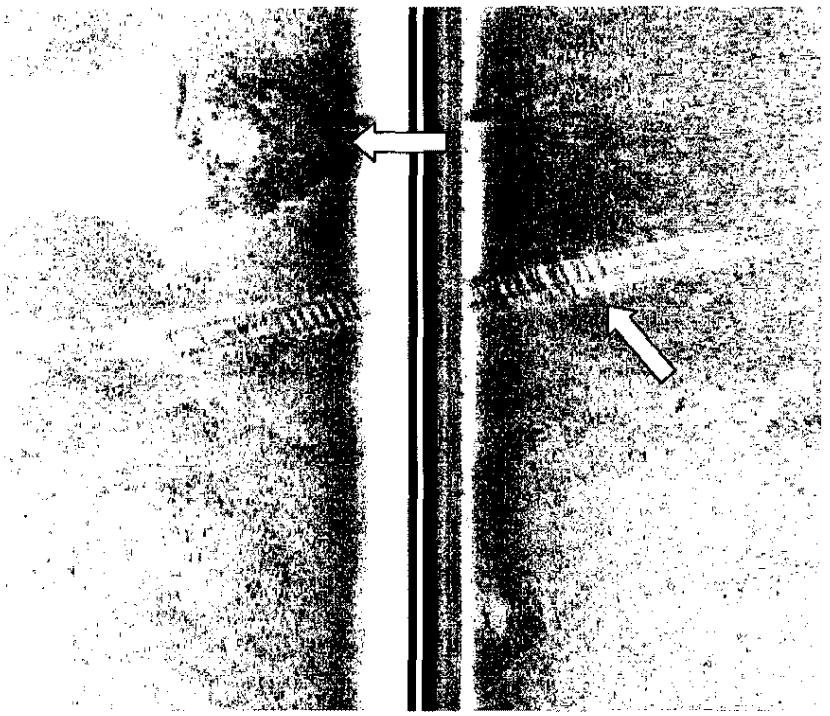
Target 61. Debris – Large 17m linear object protruding above the harbor bottom.



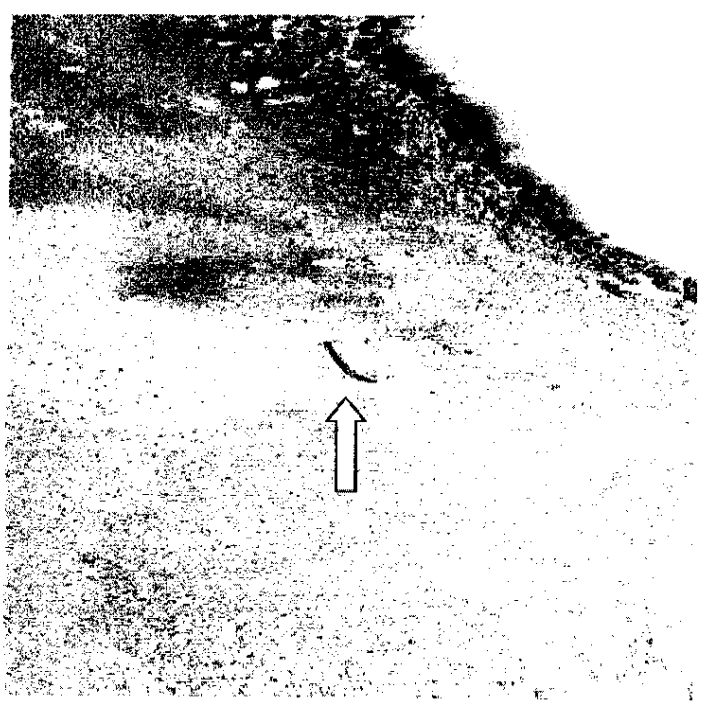
Target 62. Pier and debris – Debris (possible modern vessel debris) adjacent to pier structure.



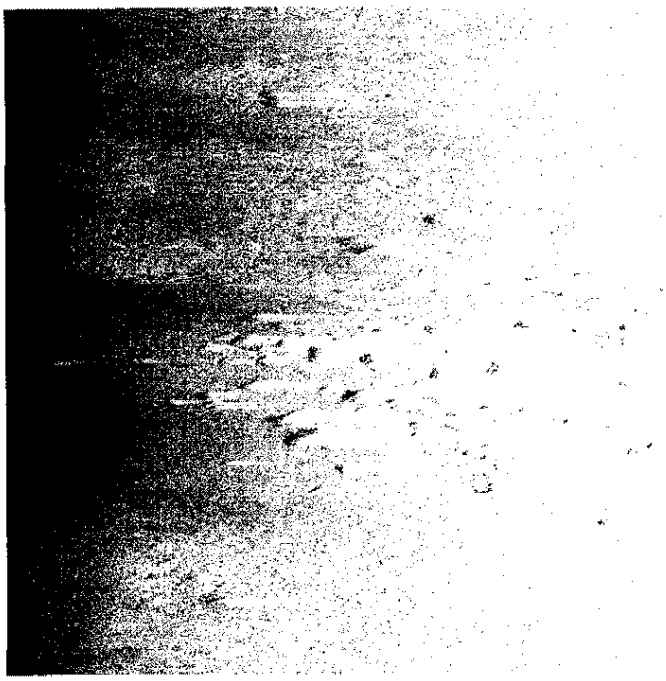
Target 63. Railway Tracks – An 18m-long section of railway track adjacent to rock pile. (See also target 17).



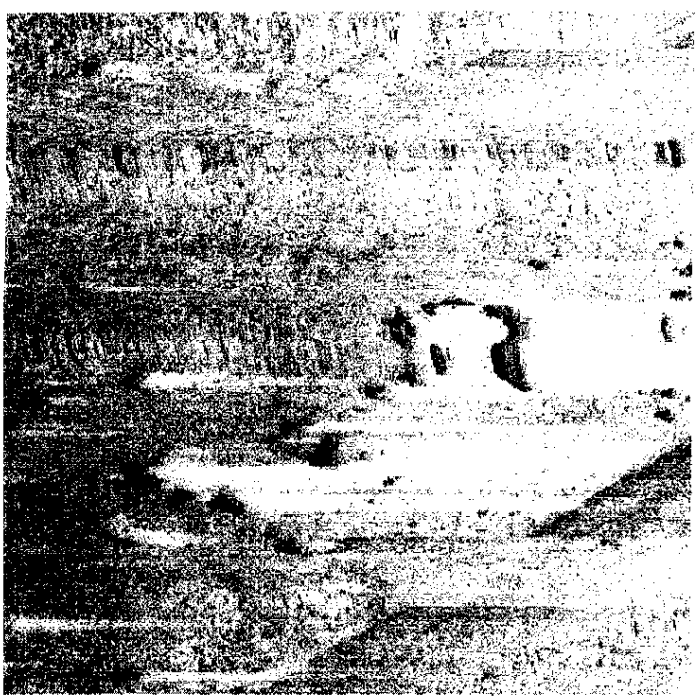
Target 66. Debris – Possible mooring block or other large rectangular object.



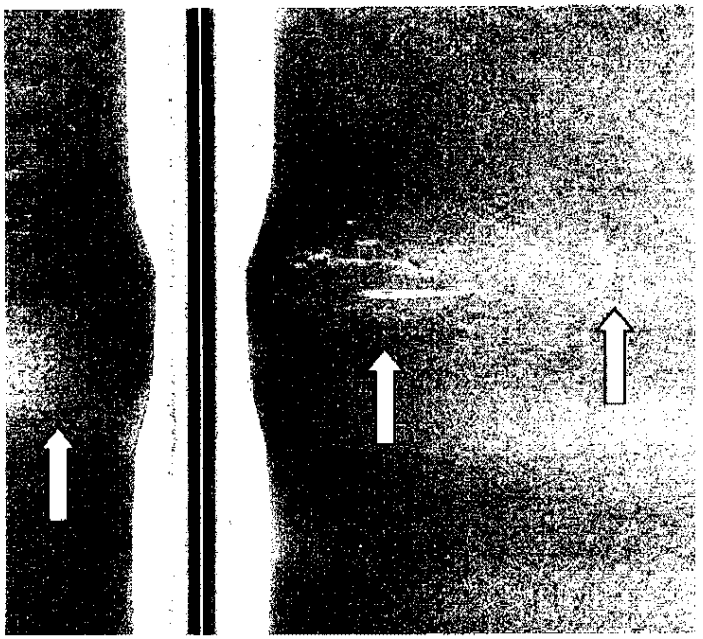
Target 69. Rock Field - Collection of large rocks.



Target 76. Debris – Collection of unidentifiable debris.

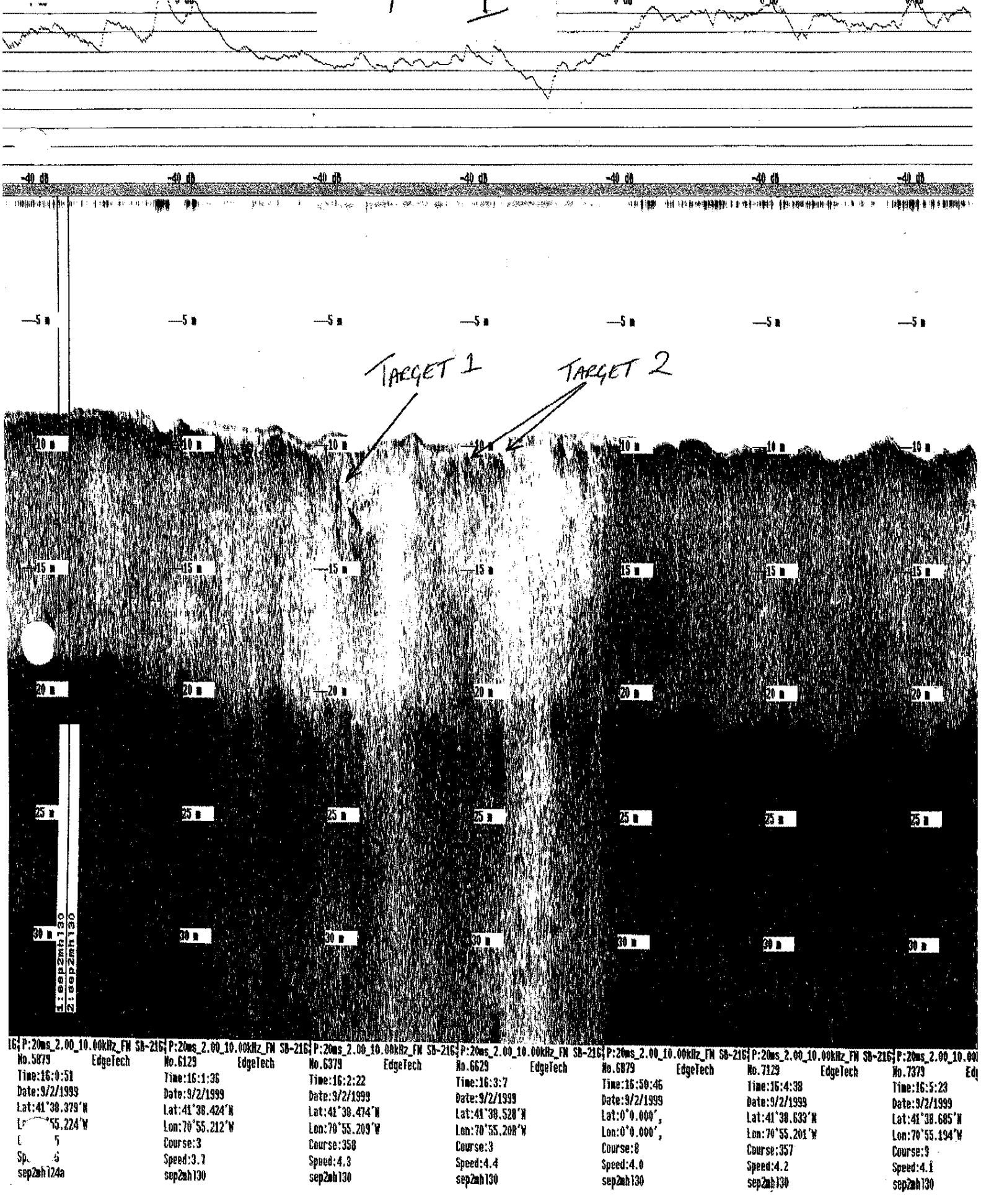


Target 83. Rock Outcrop – The decrease in the water column suggests a rocky mound or outcrop rising above the sea floor.

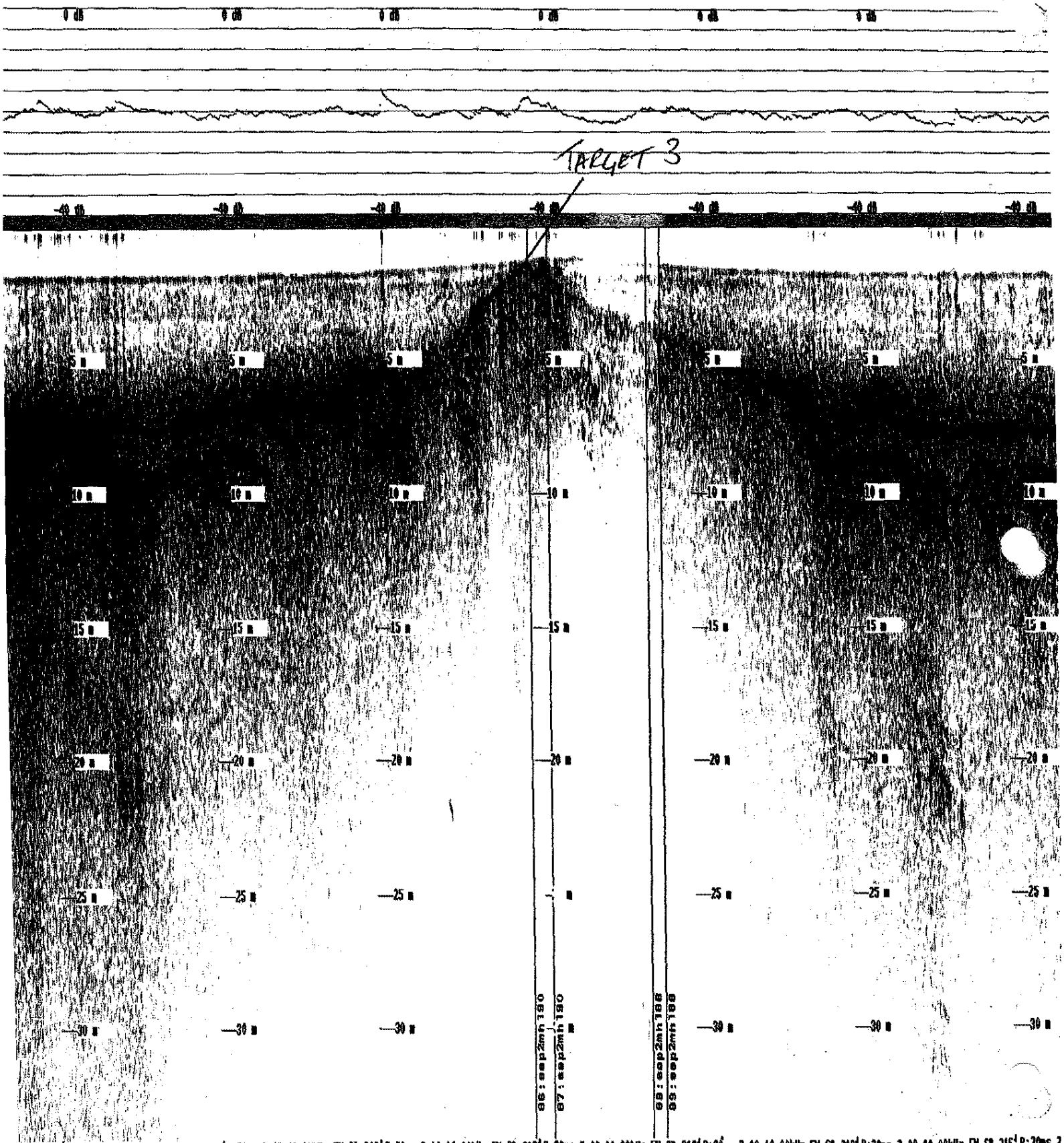


APPENDIX B

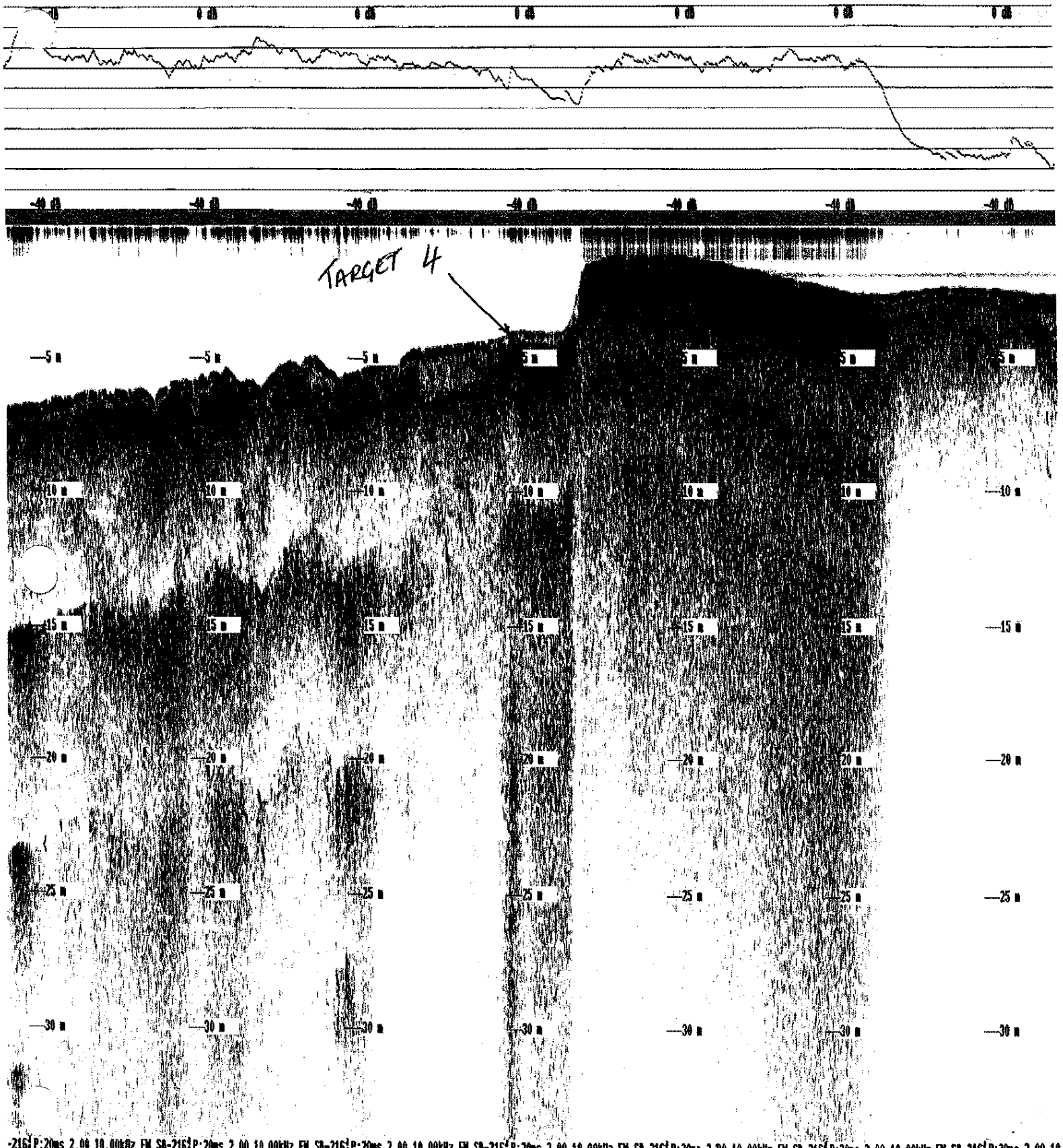
Sub-Bottom Targets Data Records

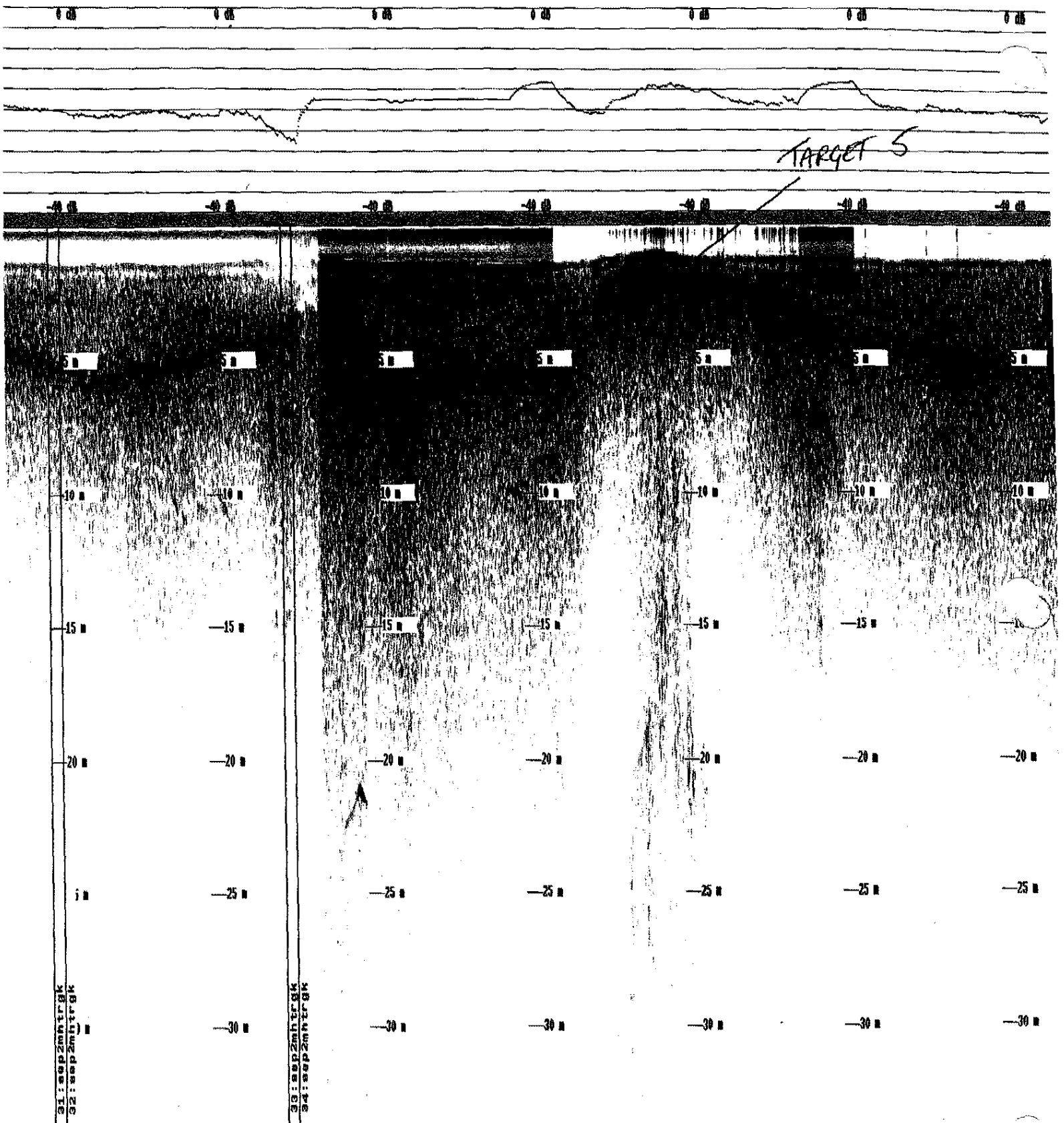


-40 dB
-5 m
10 m
15 m
20 m
25 m
30 m
TARGET 1
TARGET 2
1: sep2mh130
2: sep2mh130
P:20ms_2.00_10.00kHz_FM SB-216
No.5879 EdgeTech
Time:16:0:51
Date:9/2/1999
Lat:41°38.379'N
Lon:70°55.224'W
Course:3
Speed:3.7
sep2mh124a
P:20ms_2.00_10.00kHz_FM SB-216
No.6129 EdgeTech
Time:16:1:36
Date:9/2/1999
Lat:41°38.424'N
Lon:70°55.212'W
Course:3
Speed:3.7
sep2mh130
P:20ms_2.00_10.00kHz_FM SB-216
No.6379 EdgeTech
Time:16:2:22
Date:9/2/1999
Lat:41°38.474'N
Lon:70°55.209'W
Course:358
Speed:4.3
sep2mh130
P:20ms_2.00_10.00kHz_FM SB-216
No.6629 EdgeTech
Time:16:3:7
Date:9/2/1999
Lat:41°38.528'N
Lon:70°55.208'W
Course:3
Speed:4.4
sep2mh130
P:20ms_2.00_10.00kHz_FM SB-216
No.6879 EdgeTech
Time:16:50:46
Date:9/2/1999
Lat:0°0.000',
Lon:0°0.000',
Course:8
Speed:4.0
sep2mh130
P:20ms_2.00_10.00kHz_FM SB-216
No.7129 EdgeTech
Time:16:4:38
Date:9/2/1999
Lat:41°38.633'N
Lon:70°55.201'W
Course:357
Speed:4.2
sep2mh130
P:20ms_2.00_10.00
No.7379
Time:16:5:23
Date:9/2/1999
Lat:41°38.685'N
Lon:70°55.194'W
Course:9
Speed:4.1
sep2mh130



SB-216 P:20ms_2.00_10.00kHz_FM	SB-216 P:20ms_2.00_10.00kHz_FM	SB-216 P:20ms_2.00_10.00kHz_FM	SB-216 P:20ms_2.00_10.00kHz_FM	SB-216 P:20ms_2.00_10.00kHz_FM	SB-216 P:20ms_2.00_10.00kHz_FM	SB-216 P:20ms_2.
No.33141 EdgeTech	No.33391 EdgeTech	No.33641 EdgeTech	No.33891 EdgeTech	No.34141 EdgeTech	No.34391 EdgeTech	No.34641
Time:19:34:8	Time:19:34:53	Time:19:35:39	Time:19:36:24	Time:19:37:9	Time:19:37:55	Time:19:3
Date:9/2/1999	Date:9/2/1999	Date:9/2/1999	Date:9/2/1999	Date:9/2/1999	Date:9/2/1999	Date:9/2/
Lat:41°38.684'N	Lat:41°38.632'N	Lat:41°38.579'N	Lat:41°38.531'N	Lat:41°38.567'N	Lat:41°38.619'N	Lat:41°38
Lon:70°54.866'W	Lon:70°54.869'W	Lon:70°54.875'W	Lon:70°54.880'W	Lon:70°54.900'W	Lon:70°54.887'W	Lon:70°54


TARGET 4
-216 P:20ms_2.00_10.00kHz_FM SB-216 P:20ms_2.00_10.00kHz_FM SB-216 P:20ms_2.00_10.00kHz_FM SB-216 P:20ms_2.00_10.00kHz_FM SB-216 P:20ms_2.00_10.00kHz_FM SB-216 P:20ms_2.00_10.00kHz_FM SB-216 P:20ms_2.00_10
No.54391 EdgeTech
Time:20:38:40
Date:9/2/1999
Lat:41°39.139'N
Lon:70°55.149'W
Course:3
No.54641 EdgeTech
Time:20:39:25
Date:9/2/1999
Lat:41°39.190'N
Lon:70°55.132'W
Course:21
No.54891 EdgeTech
Time:20:40:11
Date:9/2/1999
Lat:41°39.216'N
Lon:70°55.106'W
No.55141 EdgeTech
Time:20:40:56
Date:9/2/1999
Lat:41°39.190'N
Lon:70°55.156'W
No.55391 EdgeTech
Time:20:41:42
Date:9/2/1999
Lat:41°39.158'N
Lon:70°55.190'W
No.55641 EdgeTech
Time:20:42:27
Date:9/2/1999
Lat:41°39.118'N
Lon:70°55.186'W
No.55891
Time:20:43:12
Date:9/2/1999
Lat:41°39.069'N
Lon:70°55.195'W



SB-216 P:20ms_2.00_10.00kHz_FM EdgeTech
No.21042
Time:22:12:26
Date:9/2/1999
Lat:41°38.596'N
Lon:70°54.943'W
Course:118
Speed:3.7
sep2mhtrgk

SB-216 P:20ms_2.00_10.00kHz_FM EdgeTech
No.21292
Time:22:13:12
Date:9/2/1999
Lat:41°38.568'N
Lon:70°54.893'W
Course:134
Speed:3.6
sep2mhtrgk

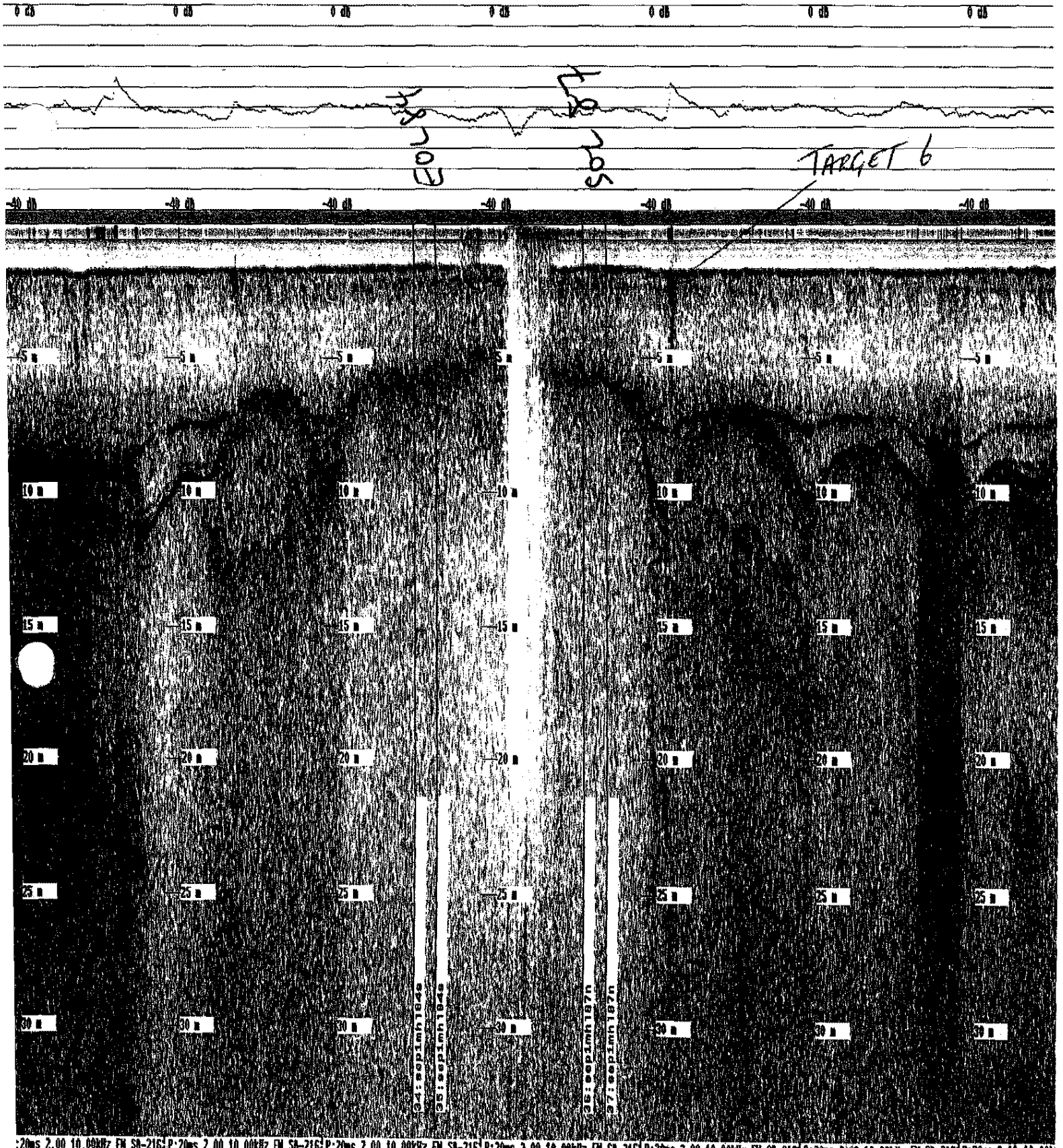
SB-216 P:20ms_2.00_10.00kHz_FM EdgeTech
No.21542
Time:22:13:58
Date:9/2/1999
Lat:41°38.555'N
Lon:70°54.844'W
Course:74
Speed:3.7
sep2mhtrgk

SB-216 P:20ms_2.00_10.00kHz_FM EdgeTech
No.21792
Time:22:14:43
Date:9/2/1999
Lat:41°38.541'N
Lon:70°54.796'W
Course:176
Speed:3.3
sep2mhtrgk

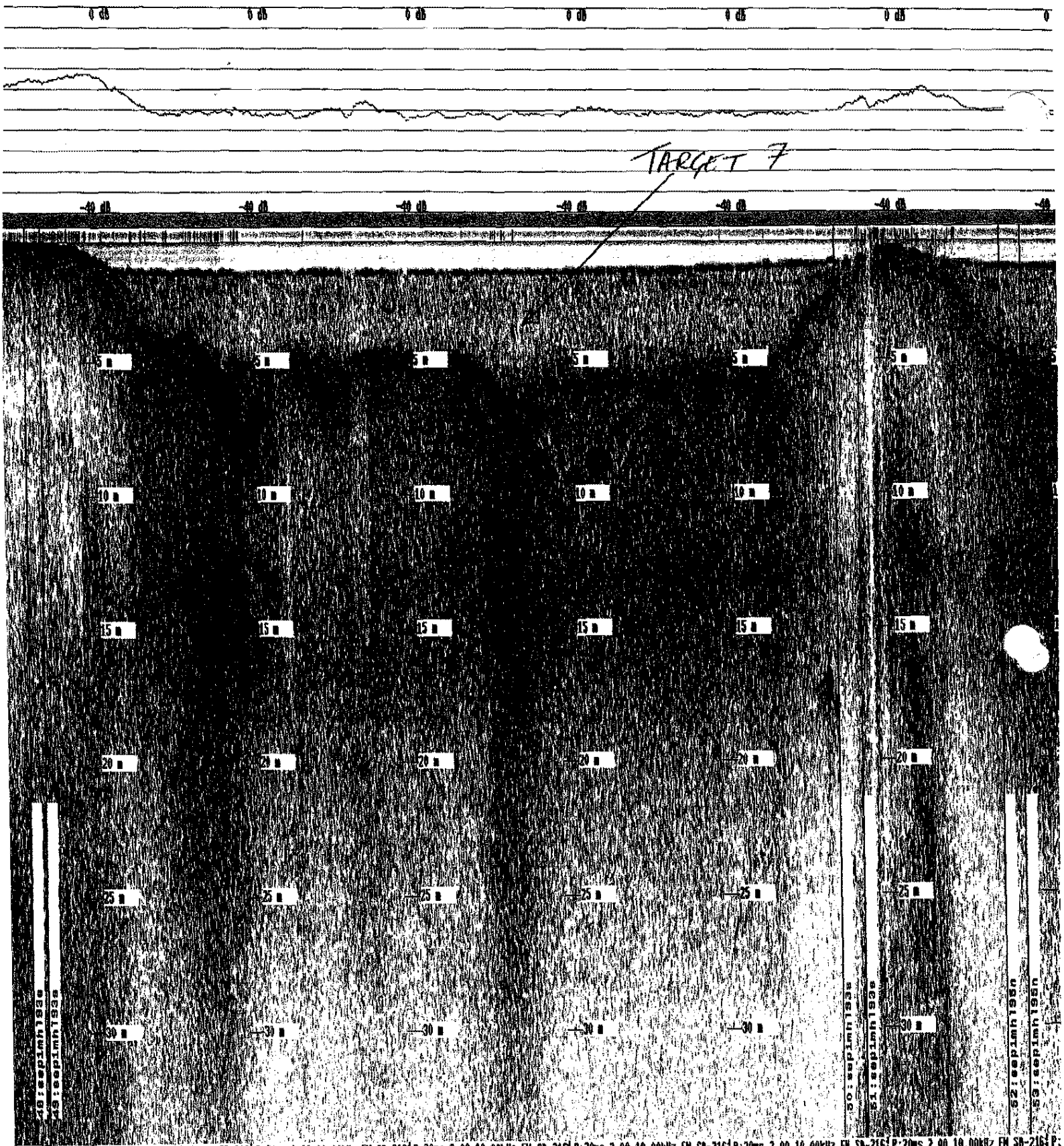
SB-216 P:20ms_2.00_10.00kHz_FM EdgeTech
No.22042
Time:22:15:29
Date:9/2/1999
Lat:41°38.532'N
Lon:70°54.842'W
Course:301
Speed:3.7
sep2mhtrgk

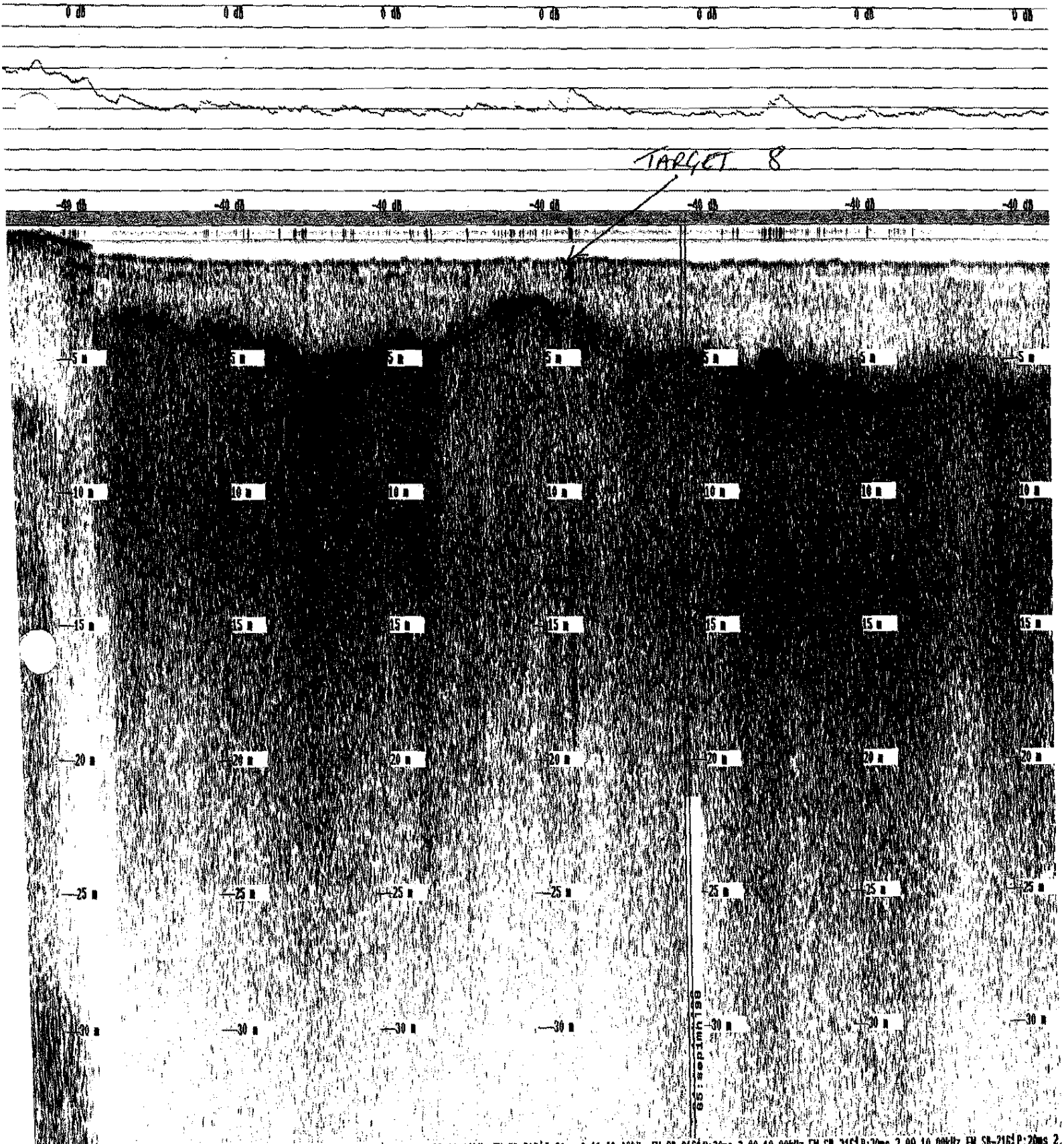
SB-216 P:20ms_2.00_10.00kHz_FM EdgeTech
No.22292
Time:22:16:14
Date:9/2/1999
Lat:41°38.560'N
Lon:70°54.892'W
Course:311
Speed:3.8
sep2mhtrgk

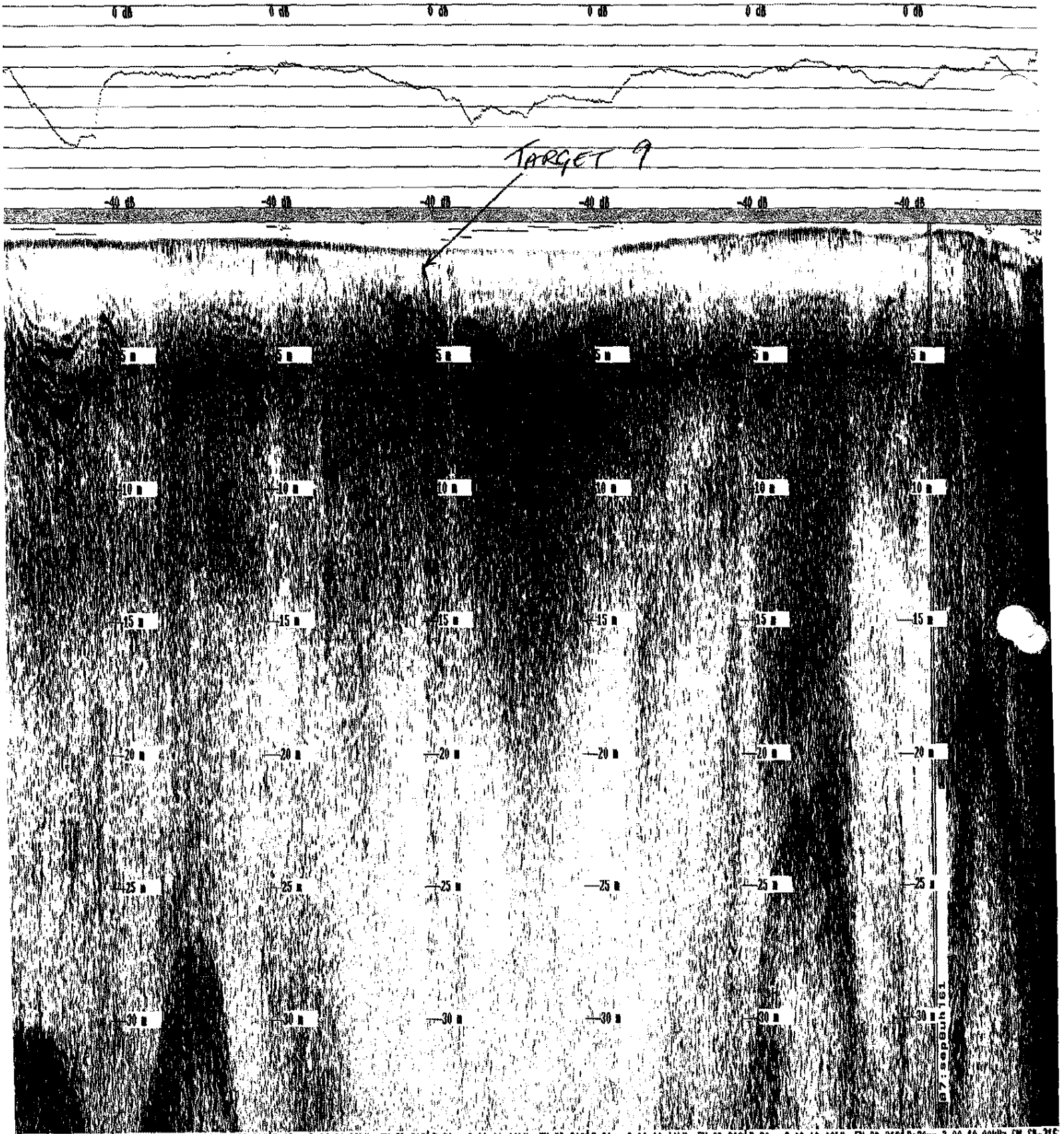
SB-216 P:20ms_2.00_10.00kHz_FM
No.
Time:22:17:0
Date:9/2/199
Lat:41°38.59
Lon:70°54.94
Course:328
Speed:3.7
sep2mhtrgk



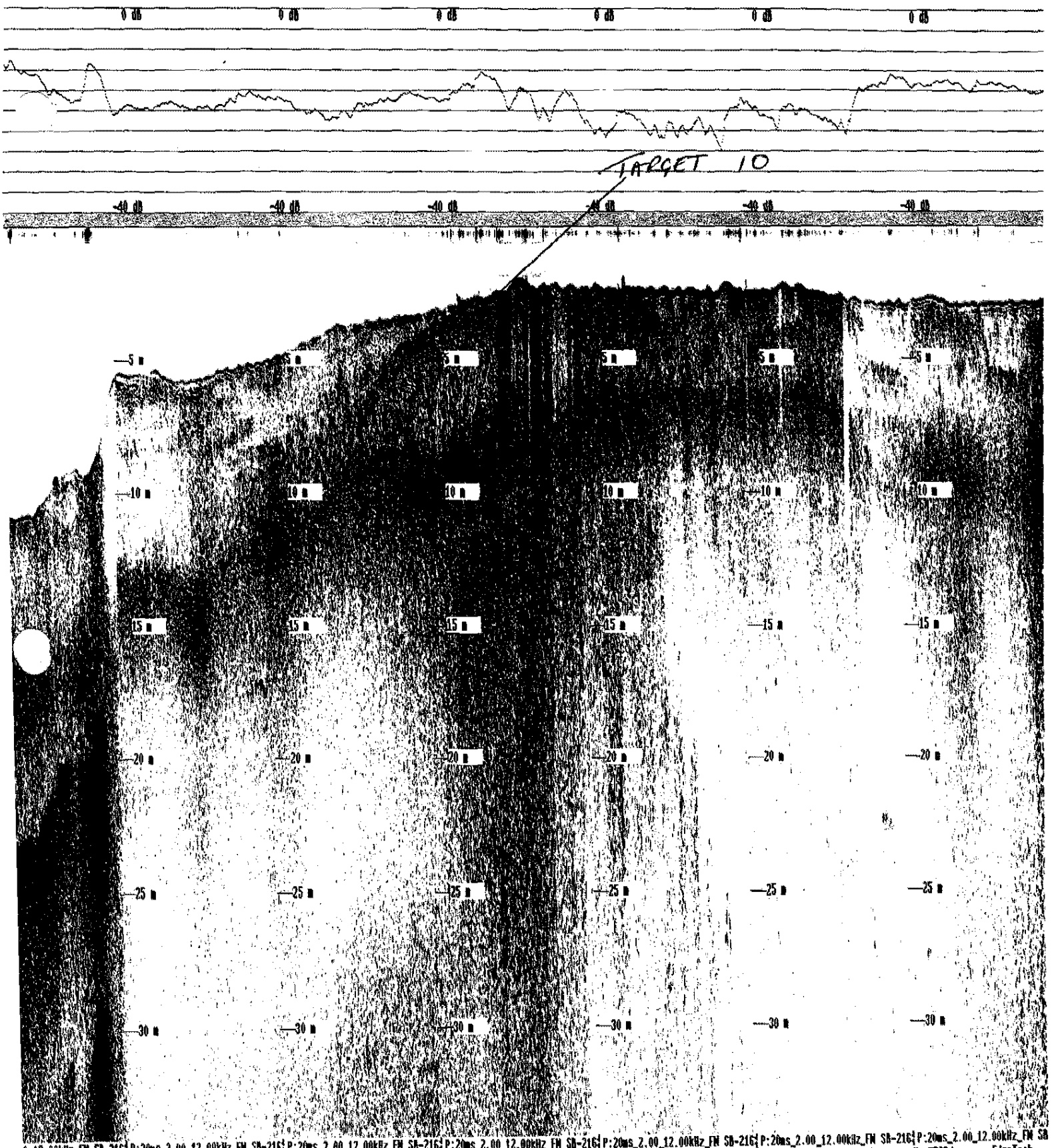
:20ms_2.00_10.00kHz_FM SB-216	P:20ms_2.00_10.00kHz_FM SB-216	P:20ms_2.00_10.00kHz_FM SB-216	P:20ms_2.00_10.00kHz_FM SB-216	P:20ms_2.00_10.00kHz_FM SB-216	P:20ms_2.00_10.00kHz_FM SB-216	P:20ms_2.00_10.00k
.27104 EdgeTech	No.27354 EdgeTech	No.27604 EdgeTech	No.27854 EdgeTech	No.28104 EdgeTech	No.28354 EdgeTech	No.28604 Edg
ne:20:1:25	Time:20:2:11	Time:20:2:56	Time:20:3:41	Time:20:4:26	Time:20:5:12	Time:20:5:58
1999	Date:9/1/1999	Date:9/1/1999	Date:9/1/1999	Date:9/1/1999	Date:9/1/1999	Date:9/1/1999
712'N	Lat:41°38.663'N	Lat:41°38.616'N	Lat:41°38.574'N	Lat:41°38.608'N	Lat:41°38.663'N	Lat:41°38.718'N
:70 54.917'W	Lon:70°54.922'W	Lon:70°54.922'W	Lon:70°54.918'W	Lon:70°54.903'W	Lon:70°54.899'W	Lon:70°54.896'W
urse:179	Course:186	Course:180	Course:114	Course:354	Course:5	Course:355
ed:4.0	Speed:3.9	Speed:3.8	Speed:2.8	Speed:4.2	Speed:4.3	Speed:4.3
1mh184s	sep1mh184s	sep1mh184s	sep1mh184s	sep1mh187n	sep1mh187n	sep1mh187n


TARGET 7
0 dB
-40 dB
5 m
10 m
15 m
20 m
25 m
30 m
90kHz_FN SB-216 P:20ms_2.00_10.00kHz_FN SB-216
EdgeTech
No.32854
Time:20:18:49
Date:9/1/1999
Lat:41°38.770'N
Lon:70°54.822'W
Course:199
Speed:3.8
sepimh193s
No.33104
Time:20:19:35
Date:9/1/1999
Lat:41°38.720'N
Lon:70°54.830'W
Course:179
Speed:3.9
No.33354
Time:20:20:20
Date:9/1/1999
Lat:41°38.671'N
Lon:70°54.831'W
Course:184
Speed:4.0
No.33604
Time:20:21:5
Date:9/1/1999
Lat:41°38.621'N
Lon:70°54.836'W
Course:180
Speed:4.1
No.33854
Time:20:21:51
Date:9/1/1999
Lat:41°38.570'N
Lon:70°54.841'W
Course:185
Speed:4.1
No.34104
Time:20:22:35
Date:9/1/1999
Lat:41°38.525'N
Lon:70°54.838'W
Course:118
Speed:2.7


TARGET 8
0 dB
-40 dB
5 m
10 m
15 m
20 m
25 m
30 m
SB-216 P:20ms_2.00_10.00kHz_FM EdgeTech
No.41687
Time:20:48:30
Date:9/1/1999
Lat:41°38.778'N
Lon:70°54.731'W
Course:140
Speed:1.5
septmh193a
No.41936
Time:20:49:49
Date:9/1/1999
Lat:41°38.736'N
Lon:70°54.798'W
Course:254
Speed:2.7
septmh193a
No.42186
Time:20:50:38
Date:9/1/1999
Lat:41°38.735'N
Lon:70°54.850'W
Course:351
Speed:3.0
septmh193a
No.42436
Time:20:51:24
Date:9/1/1999
Lat:41°38.749'N
Lon:70°54.807'W
Course:102
Speed:3.6
septmh197
No.42686
Time:20:52:0
Date:9/1/1999
Lat:41°38.714'N
Lon:70°54.793'W
Course:199
Speed:3.6
septmh198
No.42936
Time:20:52:54
Date:9/1/1999
Lat:41°38.669'N
Lon:70°54.789'W
Course:193
Speed:3.6
septmh198
No.43186
Time:20:53
Date:9/1/1
Lat:41°38.
Lon:70°54.
Course:180
Speed:3.7
septmh198



10.00kHz_FN SB-216	P:20ms_2.00_10.00kHz_FN SB-216	P:20ms_2.00_10.00kHz_FN SB-216	P:20ms_2.00_10.00kHz_FN SB-216	P:20ms_2.00_10.00kHz_FN SB-216	P:20ms_2.00_10.00kHz_FN SB-216
EdgeTech	No.33465	No.33715	No.33965	No.34215	No.34465	No.34715
EdgeTech	EdgeTech	EdgeTech	EdgeTech	EdgeTech	EdgeTech	Edge
	Time:12:20:58	Time:12:21:44	Time:12:22:30	Time:12:23:15	Time:12:24:1	Time:12:24:46
	Date:9/8/1999	Date:9/8/1999	Date:9/8/1999	Date:9/8/1999	Date:9/8/1999	Date:9/8/1999
1'N	Lat:41°39.654'N	Lat:41°39.603'N	Lat:41°39.553'N	Lat:41°39.504'N	Lat:41°39.453'N	Lat:41°39.403'N
1'W	Lon:70°54.931'W	Lon:70°54.930'W	Lon:70°54.929'W	Lon:70°54.934'W	Lon:70°54.933'W	Lon:70°54.931'W
	Course:184	Course:184	Course:180	Course:183	Course:184	Course:186
	Speed:3.9	Speed:3.9	Speed:4.0	Speed:3.9	Speed:4.1	Speed:4.0
	sep8uh161	sep8uh161	sep8uh161	sep8uh161	sep8uh161	sep8uh161



0_12.00kHz_FW SB-216 EdgeTech

P:20ms_2.00_12.00kHz_FW SB-216 EdgeTech
No.54404
Time:15:57:58
Date:8/31/1999
Lat:41°37.382'N
Lon:70°54.361'W
Course:234
Speed:4.5
Line 15 sw

P:20ms_2.00_12.00kHz_FW SB-216 EdgeTech
No.54654
Time:15:58:44
Date:8/31/1999
Lat:41°37.340'N
Lon:70°54.410'W
Course:226
Speed:4.4
Line 15 sw

P:20ms_2.00_12.00kHz_FW SB-216 EdgeTech
No.54904
Time:15:59:29
Date:8/31/1999
Lat:41°37.304'N
Lon:70°54.465'W
Course:220
Speed:4.3
Line 15 sw

P:20ms_2.00_12.00kHz_FW SB-216 EdgeTech
No.55154
Time:16:0:15
Date:8/31/1999
Lat:41°37.261'N
Lon:70°54.515'W
Course:227
Speed:4.4
Line 15 sw

P:20ms_2.00_12.00kHz_FW SB-216 EdgeTech
No.55404
Time:16:1:0
Date:8/31/1999
Lat:41°37.223'N
Lon:70°54.568'W
Course:243
Speed:4.6
Line 15 sw

P:20ms_2.00_12.00kHz_FW SB
No.55654 EdgeTech
Time:16:1:46
Date:8/31/1999
Lat:41°37.193'N
Lon:70°54.618'W
Course:214
Speed:4.5
Line 15 sw

APPENDIX C

Field Records

CR ENVIRONMENTAL, INC.
ECOLOGICAL AND OCEANOGRAPHIC CONSULTANTS

(DBE/WBE)

CR ENVIRONMENTAL, INC. FIELD LOG Foster Wheeler

PROJECT New Bedford Harbor Geophysical Survey

DATE 5/30/99

PERSONNEL C. Ryther, A. Spinale, V Capone CR
R. Funk, J. Barkland FWENC Lee Cox, Dolan

0730: Go to Foster Wheeler Trailer for site orientation -

0900: Meet Lee Cox at Trailers, -
Continue vessel mob

1200: Complete vessel mob, All equipment checks out -

1315: Head to outer Harbor to test equipment and begin survey operations -

1500: Preparing to run survey lines -

1508: Begin running survey lines outside Hurricane Barrier -

1719: Complete running survey lines, have completed 29 East/West Lines

1845: Arrive At Dock, Backup DATA

1923: Suspend operations

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CR ENVIRONMENTAL, INC. FIELD LOG	FNEC
PROJECT	New Bedford Harbor Geophysical Survey
DATE	8/31/99
PERSONNEL	C. Ryther, A. Spinale V. Capac
	J. Bookland, R. Funk
0830:	Depart dock for outer New Bedford
	Harbor -
0927:	Begin running odd survey Lines
	outside Hurricane Barrier -
1029:	Lost Differential Corrections ABOUT
	LINE 33 - WILL Rerun Line -
	Switched to Montauk Beacon -
	LINE Lost Bathy end of LINE
1204	Complete EAST WEST LINE - Begin
	Cross tie LINES
1300	Complete cross tie Lines, Haul in
	Gear and head, to inner harbor -
1330:	Load 512 X-STAR Fish At Launching
	Ramp - Will make Hill Bridge opening
	to begin work in Middle HARBOR
1430	Testing X-STAR With 512 Fish
1515:	Preparing to run survey Lines with
	Large towfish - 512 towfish may not be working properly
	Experiencing problems with Triton Isis system
	may be hard disc failure.
1700:	Return to dock to try to repair system -
	New Harddrive will be Fed-x out for tomorrow
1800:	Suspend operation -

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CR ENVIRONMENTAL, INC. FIELD LOG FNEC

PROJECT New Bedford Harbor Geophysical Survey

DATE 8/31/99

PERSONNEL C. Ryther, A. Spinale V. Capone
J. Bookland, R. Funk

0830: Depart dock for outer New Bedford Harbor -

0927: Begin running odd survey lines outside Hurricane Barrier -

1029: Lost Differential Corrections about Line 33 - will Rerun Line -
Switched to Montauk Beacon -
Line lost Bathy end of Line

1204 Complete EAST West Line - Begin Cross tie Lines

1300 Complete cross tie Lines, Hauled in Gear and heading to inner harbor -

1330: Load 512 X-STAR Fish at Launching Ramp - will make 14.15 Bridge opening to begin work in Middle HARBOR

1430 Testing X-STAR with 512 Fish

1515: Preparing to run survey Lines with Large tow fish - 512 tow fish may not be working properly
Experiencing problems with Triton Isis system may be hard disc failure.

1700: Return to dock to try to repair system -
New Hard disc will be Fed-x out for tomorrow

1800: Suspend operation -

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(DBE/WBE)

CR ENVIRONMENTAL, INC. FIELD LOG	FWEL
PROJECT	NEWBEDFORD HARBOR
DATE	9/1/99
PERSONNEL	V Mastone, S. Marshall + crew
0900: Depart Dock to Middle Harbor	
0900 Bridge opening	
0930: Preparing to run survey lines	
0945: Begin survey lines at Line 25	
Middle Harbor - (Running without sidescan)	
Line 27 MH X-STAR computer hung up -	
1/2 way through line -	
1000: X-STAR back in operation	
1024 - Lost Differential - GPS OK	
1726: Heading back to MARINA to pick	
up Vince + side-scan system	
Have completed 10 survey lines with	
the mag and the sub-bottom -	
1230: Arrive at MARINA - Vince has repaired	
Triton system and will bring to MARINA -	
1415: Go through Bridge to Resume survey	
1430: Resume running survey lines, still	
Experiencing problems with side-scan	
Will begin lines without side-scan	
1530: Run aground Northern shore of Middle	
Harbor, will cut lines short -	
1650: Hit ROCK, will not go beyond Mummings	
Have run 35 lines in Middle Harbor	
1800 Complete survey operations head to dock	

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CR ENVIRONMENTAL, INC. FIELD LOG

PROJECT New Bedford Harbor Survey

DATE 9/2/99

PERSONNEL @ 10:00 AM Andy Spinale, Chris Wright, Lee Cox, Vince Capone. @ 11:00 AM F/W Mike Petaccia; Rich Funk

10:21: update laptop date

11:00 F/W personnel show up

Isis/X-star processors switched to APC

No paper record for side-scan - Line 38 off line @ barge

Line 26 - off line @ barge Evt. 1510

[illegible] return to dock for supplies and to format Jazz disks

for X-star: resume survey @

1117 X-star froze up, mid-line 16 in cell

No paper record lines 123-122

END survey @ 7:45 PM

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CR ENVIRONMENTAL, INC. FIELD LOG

PROJECT New Bedford Harbor Survey

DATE 9-7-99

PERSONNEL Andy Spinale, Chris Wright, Lee Cox, Vince Capone, Mike Petraccia, Rick Funk

- Arrive @ 6:30; survey mid-harbor until ~08:30.
- Tear down nav. masts for passage under C. St. bridges.
- remobilize, set mooring @ 10:00, waited for tide to rize until ~ 12:00
- Cyprinodon clutch malfunctions - remobilize nav. and sidescan in Aluminum Jonboat.
- Commence side-scan survey of inner harbor @ ~14:40
- finish side-scan inner harbor @ ~16:00
- side-scan mid-harbor (line 50 yards + shoreline)
- finish survey ops @ 16:30
- haul cyprinodon out @ ~18:00
- de-mobilize both vessels
- End day @ ~20:00

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CR ENVIRONMENTAL, INC. FIELD LOG

PROJECT

DATE 9/4/95

PERSONNEL C. Rythe, E. Steele, Lee Cox

0800 Arrive AT Popes Island Marina to set up JON BOAT FOR MAG survey of INNER harbor -

1100: Have waited for high tide, not complete

1123: Begin survey upper Harbor - with magnetometer - LINE 45 getting occaisonal bad navigation due to differential loss -

1420: Have completed over 20 N-South Lines Have NAV problems in Eastern cove Radio wave interference -

1600: Shut down Equipment, haul in Fish and head to Sawyer street to add fuel to Generator - Have run 37 lines -

1731: Resume [illegible] upper harbor move to middle Harbor to run short fill in Lines in cove on southeast corner of middle Harbor

1800: Run one Line along boat junk yard on west side of middle HARBOR.

1815. Depart middle Harbor for MARINA

1530: Arrive At Dock

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CR ENVIRONMENTAL, INC. FIELD LOG

PROJECT New Bedford Harbor Survey

DATE 9-7-99

PERSONNEL Andy Spinale, Chris Wright, Rob Webb, Rich Funk

Launch Cyprinodon @ 09:15 - Nav./Bathy setup by

10:30, Barcheck echosounder @ 10:31 = OK 1.0, 2.0, 3.0 m.

Setup X-star

11:30 Pick-up FW personnel - leave for inner harbor

12:45 arrive inner harbor - moor + wait for tide to come in

12:50 C.W./R.F. go to FW trailer to plot side-scan

track-lines.

16:00 start bathy/sub-bottom survey

END Survey OPS @ 7:26 PM

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CR ENVIRONMENTAL, INC. FIELD LOG

PROJECT New Bedford Harbor Survey

DATE 9-8-99

PERSONNEL Andy Spinale, Rich Fink, Chris Wright, Bob Webb

05:45 - leave Pope's Island Marina in Jon boat for site - arrive @ 06:00

06:25 - Barcheck ok @ 1.0m, 2.0m, 3.0m

06:50 - start survey

09:00 - end survey - hung prop on buoy - tide out

shut-down @ 9:21 - disembark

FWENC mgr (Jay Berkland) not present, so large sub-bottom tow vehicle (SB-512) not used for CDF survey. CR notified that SB-512 would be used on 9-9-99.

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CR ENVIRONMENTAL, INC.
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CR ENVIRONMENTAL, INC. FIELD LOG	
PROJECT	NEW BEDFORD HARBOR GEOPHYSICAL SURVEY
DATE	9/9/99
PERSONNEL	C. Blythe, F. Steele, J. Borkland, R. Wess, R. Funk

0630: Arrive at Marina run Jon Boat to Sawyer Street

0730: Load equipment and personnel prepare for survey operations –

0830 Off mooring, checking out X-STAR with Big Fish – Will run lines at the INNER HARBOR at the three CDF's

0900: Begin running LINE 45A in CDF A near Aerovox

1047: Complete X-STAR coverage 512 Fish at CDF, A, B, C at 2 frequencies and pulse lengths –

1121: Complete survey work in upper harbor waiting for low tide to get under bridge – Break for Lunch

1300: Pass under bridges into middle harbor

1330. Begin survey work at CDF D

1420: Complete sub-bottom survey with large fish at CDF-D

1530. Head back to upper harbor to drop off FWEC personnel and pick up Jon Boat – – OFFLOAD X-STAR 512 Fish and A-Frame at Limburg marine with Crane

1600: Return to MARINA, suspend operations

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CR ENVIRONMENTAL, INC. FIELD LOG 9/11/99

PROJECT FWEC NEW BEDFORD GEOPHYSICAL SURVEY

DATE 9/11/99

PERSONNEL J. Barkland, R. Weiss, Lee Cox, E. Steele -

0700 Meet Lee Cox at Marina, mob. Lee magnetometer to run calibration line in upper Harbor -

0730: Depart Marina for upper Harbor

0800 Begin mag survey in upper harbor, run calibration lines on western shore and one calibration line in South East Cove

1000: Complete mag survey, offload equipment at Sawyer Street Begin mobilizing X-Star system.

1100 Having problems with X-Star hard drive, system will not boot up -

1300 Replace Hard Drive with spare, System is up and running -

1310 Begin sub-bottom survey in upper Harbor -

1600. Suspend operation due to low tide, Fill generator - will complete operations on Rising tide

1730: Resume running survey lines at Wood Street Bridge

1900 Complete sub-bottom survey -

2000. Complete demobilization at Sawyer Street

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8/30/99 (1)

FWEC NEW BEDFORD HARBOR

	LINE #	TIME SOL	COURSE	FILE ID	SOL EVENT	EOL EVENT
1.	30 ON	708	58°	030 1908.NBH	1	4
2.	28 ON	719	235°	028 1919.NBH	8	726 59
3	[illegible]	[illegible]	58°	026 1927.NBH	62	[illegible] 107
4.	24 ON	734	235°	024 1934.NBH	114	[illegible]
5.	22 ON	740	58°	022 1940.NBH	156	746 207
6.	20 ON	746	235°	020 1941 NBH	95210	752 257
7.	18 ON	752	58°	018 1953.NBH		800 314
8.	16 ON	800	235°	016 2000.NBH	320	806 366
9.	14 ON	807	58°	014 2006.NBH	374	812 419
10.	14A ON	814	235°	014 2014.NBH	422	817 451
11.	320 N	820	58°	032 2020 NBH	455	826 503
12.	340 N	827	235°	034 2027.NBH	507	832 548
13.	360 N	834	58°	036 2033.NBH	552	839 593
14	380 N	839	235°	038 2039.NBH	598	844 636
15.	40 ON	845	58°	040 2045.NBH	637	850 646
16.	42 ON	851	235°	042 2051.NBH	647	855 656
17.	44 ON	856	58°	044 2056.NBH	657	900 666
18.	46 ON	901	235°	046 2101.NBH	667	905 675
19.	48 ON	906	58°	048 2106.NBH	676	910 684
20	500 N	911	235°	050 2111.NBH	685	915 693
21.	520 N	916	58°	052 2116.NBH	694	920 702
22.	540 N	921	235°	054 2121.NBH	703	925 711
23.	560 N	926	58°	056 2126.NBH	712	930 720
24.	580 N	931	235°	058 2131.NBH	722	935 729
25	570 N	938	58°	057 2138.NBH	730	943 739
26.	550 N	944	235°	055 2144.NBH		948 749
27	530 N	950	58°	053 2150.NBH	750	954 758

FWEC NEW BEDFORD HARBOR

	LINE #	TIME SOL	COURSE	FILE ID	SOL EVENT	EOL EVENT
28.	51 OH	956	235°	0512156.NBH	759	1000 768
29.	49 OH	1002	58°	0492202.NBH	769	1007 779
30.	1 Channel	1012	[illegible]	001[illegible]	780	1019 79[illegible]

8/31/99

	LINE #	TIME SOL	COURSE	FILE ID	SOL EVENT	EOL EVENT
1.	47 ON	13:28	58	047 1327.NBH	795	134 804
2.	45 ON	135	230	0451335.NBH	806	140 814
3	43 ON	142	58°	0431342.NBH	815	148 825
4.	41 ON	149	230°	0411349.NBH	826	155 836
5.	39 ON	156	58°	0391356.NBH	838	203 848
6	37 ON	204	230°	0371404.NBH	849	210 861
7.	35 ON	211	58°	0351411.NBH	862	219
8.	33 ON	220	230°	0331420.NBH	875	ABOUT LINE
9.	33 A	230	58°	0331430.NBH	885	238 896
10	31 ON	239	230°	0311439.NBH	897	245 908
11	29 ON	246	58°	0291446.NBH	909	254 921
12.	27 ON	255	230°	0271455.NBH	922	302 933
13.	25 ON	303	58°	0251503	934	310 946
14.	23 ON	311	230°	0231511.NBH	947	[illegible]
15.	21 ON	320	[illegible]	0211520	959	332 970
16.	19 ON	329	230°	0191529		345 976
17	17 ON	346	58°	0171546	987	353 999
18	15 ON	357	230°	0151557	1000	402 1011
19	13 ON	404	58°	0131104		410 1022
20	12 ON	414	230°	012	1022	416 1028
21	2 CT	424	20°	0021124	1030	430 1040
22	3 CT	432	146°	0031132	1040	438 1051
23	4 CT	441	340°	0041141		441 1162
	5 CT	451	17°	0051151	1061	457 1074

LOST DATA

318 5

4/1/99

(1)

FNEC NEW BLUFFERS [illegible]

	LINE #	TIME SOL	COURSE	FILE ID	SOL EVENT	EOL EVENT
	20 MH	740	15°	025		ABORT
1.	25 MH	140	20°	025 1340 NBH	1077	153 1097
2.	27 MH	154	195°	027 1354	1099	207 1119
3	29 MH	211	20°	029 1411	1120	1141
4	31 MH	228	190°	031 1430 NBH	1142	239 1164
5	34 MH	242	20°	034 1442	1165	253 1185
6	36 MH	254	190°	036 1454	1186	306 1206
7.	38 MH	306	20°	038 1506	1224	315 1224
8	41 MH	321	185	041 1520	1226	329 1246
	43 MH	401	20°	043 1601	1241	405 1255
10	45 MH	411	185°	045 1611	1257	420 1271
11.	47 MH	634	30°	0471833	1273	640 1283
12.	49 MH	842	180	049 1842	1284	649 1294
13	53 MH	650	20°	053 1850	1298	657 1305
14	60 MH	659	180°	060 1859	1307	1315
15	66 MH	708	180°	066 1908	1317	713 1325
16	72 MH	721	20°	072 1921	1324	727 1335
17	76 MH	730	30°	0761930	1344	END LINE ROCKS
18	80 MH	752	30°	080 1952	1345	1351
19	84 MH	759	18	0841959		803 1360
20	87 MH	804	130	0872004	1361	807 1368
21.	89 MH	809	190	0892008	1369	813 1377
22.	91 MH	814		0912014	1379	1385
23.	93 MH	818		0932018	1387	822 1393
24	95 M	923		0952023	1395	827 1400
25.	95A	840	190	0952040	1402	843 1406
26	93A	844		0932044	1407	

9/2/99 survey notes: pg. 1 of 2

011:*, MH

LINE #	TIME SOL	COURSE	FILE ID	SOL EVENT	EOL EVENT
21 MH					
30.mH	1600	3.05	030-1600	1480	1502
26 mH	1617	183.05	026-1617 MH	1503	1526
24 MH	1632	3.05	024-1632	1527	1547
23 MH	~~023-1646~~	183.05	023-1646	1548	1560
19 MH	~~019~~-1740	3.05	1740	1561	1565
16 MH	016-1748	183.06	016-1748	1566	1569
16A MH	016-1752	183.06	1752	1570	1574
14 MH	1756	3.06	014-1756	1575	1578
16B MH	1800	3.06	016-1800	1579	1582
12[illegible] MH	1813	3.05	123-1813	1583	1587
122 MH	1818	183.06	122-1818	1588	1591
121	Aborted			~~1584~~	
121 A	~~1824~~ 1829	3.05	121-1829	1594	1597
120	1833	183.05	120-1833	1600	1604
119	1837	3.05	119-1837	1605	1609
117	1839		117-1839	1610	1614
115	1842	3.05	115-1842	1617	1621
113	1845	183.06	113-1845	1622	1626
111	1848	3.06	111-1848	1627	1632
109	1852	183.05	109-1852	1633	1638
107	1857	3.05	107-1857	1640	1646
105	1902	183.05	105-1902	1647	1651
103	1905	3.05	103-1905	1652	1657
100	1910	183.05	100-1910	1658	1663
96	1916	3.05	096-1916	1664	1669
94	1919	183.05	094-1919	1670	1675

short field-line Diff. loss

off line Fishing

looking for [illegible]

[illegible] to [illegible]

[illegible] to [illegible]

9/2/99 Survey notes: Pg. 2 of 2

LINE #	TIME SOL	COURSE	FILE ID	SOL EVENT	EOL EVENT
92	1929	3.05	092_1929	1676	1681
90	1933	183.05	090_1933	1682	1691
88	1936	3.05	088_1936	1692	1699
86	1941	183	086_1941	1700	1706
82	1945	3.06	082_1945	1707	1713
78	1950	183.05	078_1950	1714	1720
74	1954	3.05	074_1954	1721	1727
69	1958	183.05	069_1958	1728	1734
63	2003	3.05	063_2003	1735	1743
37	2014	183.05	037_2014	1744	1764
42	2027	3.05	042_2027	1765	1778
126CT	2054	90.00	126_2054	1780	1787
99CT	2054	90.00	099_2054	1784	1787
87CT	2104	90.0	087_2104	1788	1793 End @ Fun line
87CT1	2120	90.0	087_2120	1795	1802 No loading
77CT	2126	270.0	077_2126	1803	1814
	Delineating off line over CJF wall				
67CT	2134	90	067A2134	1817	1826 Few pts
54CT	2145	90	058_2145	1829	1835
48CT	2151	90	048_2151	1836	1838
38CT	2155	90	038_2155	1839	1841
28CT	2157	90	028_2157	1842	1843
18CT	2200	270	018_2200	1844	1845
33	2226	3.05	033_2226	1847	1857
57	2252	183.05	057_2252	1868	1873
35	2301	3.05	035_2301	1874	1891
21	2320	3.05	021_2320	1895	1898
21A	2334	3.05	021_2334	1899	1901

Begin on line @ 1748

Back to wooded beach

No Footprint (@ soil replaced)

off line over rocks

V. shallow

Few pts @ 1851

Rocks J shore

Begin @ start of main line

	LINE #	TIME SOL	COURSE	FILE ID	SOL EVENT	EOL EVENT
	67CT~~A~~	11:49	90°	067_1149	1904	19
	87CT2	12:02	270°	087-1202	1916	1925
SIDESCAN						
	44 NH	18:45	360/0°	044 1845	1930?	1958
	42 NH	18:58	180°	042-1858	1954	1978
	47 NH	1916	360/0°	047_1916	1979	2002
	45 NH	1932	180°	045-1932	2003	2028
	59 NH	1949	360/0°	059 1949	2029	2039
	39 NH	1957	180°	039 1957	2040	2048
	1					
	50 MH	2016	183	050-2016	2049	2058
Shoreline	51 shoreline	2024	shoreline	051-2024	2058	
	1					
	JH36	not in log - recorded on 55 mo disc				

Rich 508-400-0331

9/4/99 (1)

	LINE #	TIME SOL	COURSE	FILE ID	SOL EVENT	EOL EVENT
1.	45 UH	323	North	045 1523	2104	336 2130
2.	46 UH	336	South	046 1538	2131	2163
3.	47 UH	349	North	047 1549	2164	403 2188
4.	49 UH	404	South	049 1603	2189	408 2195
5.	48 UH	409	South	048 1609	2200	417 2215
6.	44 UH	417	North	044 1617	2211	427 2235
7	43 UH	428	South	043 1628	2245	2268
8.	42 UH	439	North	042 1638	2268	2288
9	41 UH	449	South	041 1648	2289	2310
10.	40 UH	459	North	040 1658	2312	2332
11.	39 UH	509	SOUTH	039 1709	2335	520 2354
12	38 UH	520	North	038 1720	2355	525 2364
13.	36 UH	526	South	036 1726	2364	531 2377
14	34 UH	531	North	034 1731	2373	2381
15.	32 UH	536	South	032 1736	2382	539 2388
16.	25 UH	541	North	025 1741	2389	2392
17	21 UH	544	South	021 1743	2393	545 2396
18.	19 UH	546	North	019 1746	2397	2401
19.	17 UH	548	EYEBALL	017 1748	2404	550 2407
20	68 UH	552	South	068 1752	2408	554 2412
21	71 UH	555	North	071 1755	2413	ABORT
22	71 A	558	South	071 1757	2426	ABORT
23	76	600	North	076 1800	2436	2448
24	79	603	South	079 1803	2447	
25	81	606	North	081 1805	2453	2461
26	65	610	North	065 1810	2462	2469
27	61	615	South	061 1815	2470	

(2) 9/4/95

	LINE #	TIME SOL	COURSE	FILE ID	SOL EVENT	EOL EVENT
28	60	623	N	060 1825	2501	
29	55	635	N	055 1835	2503	2510
30	59	642	S	059 1842	2511	2517
31	63	646	N	063 1846	2518	2552
32	67	651	S	067 1851	2528	2533
33	70	655	N	070 1855		2540
34	73	659	S	073 1859	2541	2546
35	75	704	N	075 1904	2548	2553
36	52	708	S	052 1908	2554	2566
37	53	713	S	053 1918	2567	2581
38	56	807	N	056 2007	2583	2593
39	83	819	N	083 2019	2594	2603
40	85	825	S	085 2021	2604	2613
41	57 UH	834	S	057 2034	2614	2621
42	1	838	N	001 2038	2622	2626
43	56	847	S	056 2048	2627	2641
44	58	854	N	058 2054	2642	2655
45	62	901	S	062 2101	2656	2659
46	66	903	N	066 2103	2660	2662
47	14	912	S	014 2112	2666	2669
48	12					2673
49	15 UH	917	S	015 2116	2674	2677
50	80 MH	934	N	080 2134	2681	2685
51	83 MH	938	S	083 2138	2691	2694
52	84 MH	940	N	084 2140	2695	
53	86	943	S	086 2143	2701	2705
54	87 MH	946	N	087 2146	2706	2711

Line #	Time SOL	Course	File ID	SOL Event	EOL Event
45	2012	360°	045_2012.NBH	2759	2782
47	2026	180°	047_2026	2783	off-line @ 2786 for 27 shore EOL @ 2806
48	2042	360°	048_2042	2806	2820
			off line 2808 (~20 ft) 2809		
43	2054	180°	043_2054	2821	2841
44	2108	360	044_2108	2842	2865
46	2122	180°	046_2122	2866	2889
51	2142	360°	051_2142	2890	2903
53	2151	180°	053_2151	2904	~~2904~~ ~~[illegible]~~ 2916
		off-line ~20' at bouys			
53A seg.	2201	180°	053_2201	2917	2919
56	2203	360°	056_2203	2920	2933
		@ 2929 vessel ~40' w of marsh			
58	2213	180°	058_2213	2934	Line follows edge of marsh (shoreline) between 29[illegible]
40	2223	360°	040_2223	2948	2969
			off line ~22:28 ~25' to avoid potential shore hazards		
39	2238	180°	039_2238	2970	2981
38	2247	180°	038_2247	2982	2997
41	2254	360°	041C2254	2998	3022
42	2309	180°	042_2309	3023	3047

Intermittent heavy rain

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CR ENVIRONMENTAL, INC. FIELD LOG

PROJECT

DATE 9-8-99 pg. 1 of 2

PERSONNEL

Line #	Time SOL	Course	File ID	SOL Event	EOL Event
164CT	10:50	269.6	164_1050.nbh	3047	3050
154CT	10:56	269.6	154_1056.nbh	3051	3058
144CT	11:01	89.6	144_1101.nbh	3059	3065
130CT	11:06	269.6	130_1106.nbh	3066	3070
120CT	11:10	89.6	120_1110.nbh	3071	3075
109CT	11:15	269.6	109_1115.nbh	3076	3079
99CT	11:18	89.6	099_1118.nbh	3080	3084
89CT	11:23	269.6	089_1123.nbh	3085	3088
79CT	11:26	89.6	079_1126.nbh	3089	3092
82	11:38	180°	082_1138.nbh	3093	3096
74	11:41	360°	074_1141.nbh	3097	3101
79	11:43	180°	079_1143.nbh	3102	3106
76	11:46	360°	076_1146.nbh	3107	3111
81	11:48	180°	081_1148.nbh	3112	Aborted
81A	11:53	180°	081_1153.nbh	3115	3119
78	11:56	360°	078_1156.nbh	3120	3124
80	11:59	180°	080_1159.nbh	3125	3129
Aborted 77	12:04	360°	071_1204.nbh	3132	3136
68	12:07	180°	068_1207.nbh	3137	3141
65	12:14	360°	065_1214.nbh	3142	3148 on Estuary off marsh
61	12:19	180°	061_1219.nbh	3149	3158
36	12:27	360°	036_1227.nbh	3159	3168
34	12:34	180°	034_1235.nbh	3169	3178

639 Boxberry Hill Road, East Falmouth, Massachusetts 02536
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CR ENVIRONMENTAL, INC.
ECOLOGICAL AND OCEANOGRAPHIC CONSULTANTS

(DBE/WBE)

CR ENVIRONMENTAL, INC. FIELD LOG

PROJECT New Bedford Harbor Survey

DATE 9-8-99 pg 2 of 2

PERSONNEL

Line #	Time SOL	Course	File ID	SOL Event	EOL Event	
32	12:42	360°	032_1242.nbh	3179	3187	
37	12:50	360°	037_1250.nbh	3188	3199	Furthest west poss. in Cyprine
35	12:59	180°	035_1259.nbh	3200	Aborted mid-line (hung on bouy)	

639 Boxberry Hill Road, East Falmouth, Massachusetts 02536
Telephone/FAX (508) 563-7970

PWBC

9/9/95

LINE #	TIME SOL	COURSE	FILE ID	SOL EVENT	EOL EVENT
~~STG~~					
45 A	1:00	210	045 1259	3206	3211
37 A	1:07	40	037 1307	3212	3218
46 A	1:12		046 1312	3215	3225
46 A 2	1:19	0	046 1320	3226	3233
47 A 2	127	180	047 1327	3234	3240
39 B	1:44	0	039 1344	3241	3252
37 B	1:54	180	037 1354	325[illegible]	3266
39 B 2	206	340	039 1403	3267	3277
37 B 2	[illegible]	180	037 1412	3279	3288
34 C	2:24	185	034 1424	3285	3294
38 C	2:25	0	038 1428	3295	3301
34 C 2	2:33	150	034 1433	3302	3308
38 C 2	238	330	038 1438	3309	3315
51	2:47	30	051 1447	3316	3328
44	258	180	044 1458	3329	3340
19 D	532	210	019A 1732	3343	3350
17 D	537	20	017 1737	3351	3359
15 D	554	190	015 1754	3360	3369
13 D	552	30	013 1752	3370	3380
17 D 2	6:00	210	017 1800.NA	3381	3389
19 D 2	6:06	20	019 1806	3390	3398
15 D 2	6:12		015 1812	3399	3409
13 D 2	6:20	20	013 1820	3410	3420

FNEC
NOW BEDFMO

9/11/99

LINE #	TIME SOL	COURSE	FILE ID	SOL EVENT	EOL EVENT
17	6:52	~~360~~ 180	017_1852	3568	3571
16	6:56	360	016_1856	3572	3575
15	6:59	180	015_1859	3576	3579
14	7:03	360	014_1903	3580	3583
SWITCH	TO E-W	DATA	COLLECTION		
W	"FREE	FORM"	LINES		
13	7:10	EAST	013_1910.	3584	
→	REC TGT.	19:14	:14 ←	@ EAST END	
		WEST			
	REC TGT	19:18:19	@ W END	← MISSED EAST END.	
	REC TGT	19:29:02	@ W. END		
	REC TGT	19:38:10	@ E. END		
	REC TGT	19:47	@ W. END	← MISSED E END	
	REC TGT	19:54:56	@ W END		
BREAK					
62	9:47	360	062-2147	3624	3664
	TARGET -	21:54:39	- HIT BOTTOM w/ BOAT		
	LOOP AROUND	N. of	WOOD ST	BRIDGE	
47	10:40	360	047_2240	3665	3668
52	10:45	180	052_2245	3669	3674
57	10:50	360	057_2250	3675	3681
63	10:55	180	063_2255	3682	3690

RUN T SHORE THEN Follow SHORELI

APPENDIX B

"Report of Marine Geophysical Surveys:

Phase I Uniboom and Seismic Refraction and

Phase II Seismic Refraction"

(September 2001)

by Foster Wheeler Environmental Corporation

USACE CONTRACT NO. DACW33-94-D-0002
TASK ORDER NO. 017
TOTAL ENVIRONMENTAL RESTORATION CONTRACT

REPORT OF MARINE GEOPHYSICAL SURVEYS: PHASE I UNIBOOM & SEISMIC REFRACTION AND PHASE II SEISMIC REFRACTION, NEW BEDFORD HARBOR SUPERFUND SITE OPERABLE UNIT #1

New Bedford, Massachusetts

September 2001

Prepared for

U.S. Army Corps of Engineers
New England District
Concord, Massachusetts

2001-017-0273
12/27/11

USACE CONTRACT NO. DACW33-94-D-0002
TASK ORDER NO. 017
TOTAL ENVIRONMENTAL RESTORATION CONTRACT

REPORT OF MARINE GEOPHYSICAL SURVEYS: PHASE I UNIBOOM & SEISMIC REFRACTION AND PHASE II SEISMIC REFRACTION, NEW BEDFORD HARBOR SUPERFUND SITE OPERABLE UNIT #1 New Bedford, Massachusetts

September 2001

Prepared for

U.S. Army Corps of Engineers
New England District
Concord, Massachusetts

Prepared by

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133 Federal Street
Boston, MA 02110

Revision	Date	Prepared By	Approved By	Pages Affected
	0	12/27/11	R. Funk	J. Borkland
	All			

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1.0 INTRODUCTION

This "Report of Marine Geophysical Surveys: Phase I Uniboom and Seismic Refraction, and Phase II Seismic Refraction" was prepared by Foster Wheeler Environmental Corporation for the U.S. Army Corps of Engineers - New England District (USACE) under Task Order #17 (TO #17) of the New England Total Environmental Restoration Contract (TERC) (Contract No. DACW33-94-D-0002). The work was completed as part of the New Bedford Harbor Superfund Site (Site) cleanup, which the USACE is undertaking on behalf of the U.S. Environmental Protection Agency (USEPA). As part of the cleanup of the Upper and Lower New Bedford Harbors (known as Operable Unit #1), the remedy includes an option for the construction of Confined Disposal Facilities (CDFs), into which sediments (contaminated with polychlorinated biphenyls [PCBs]) dredged from the bottom of the harbor, will be placed. The area of this study is known as CDF D, and is located in the lower portion of the upper section of New Bedford Harbor, Massachusetts, approximately halfway between the Coggshall Street Bridge and the Route 6 Bridge (see Figure 1).

The objective of this Marine Geophysical Investigation was to detect and map the surface of bedrock beneath the harbor bottom along survey lines within the proposed CDF in area D. The geophysical data on top-of-bedrock was required at CDF D in order to supplement information being gathered through a drilling campaign, which was undertaken as part of pre-design investigative activities prior to the USACE's design of CDF D.

The results of the drilling campaign to date had indicated that the bedrock surface at CDF D was somewhat irregular, and that drilling data alone would not be sufficient to characterize the bedrock surface to the extent desired by design engineers. Therefore, the supplemental geophysical program described in this report was undertaken to provide supporting information and data on the topography and character of the bedrock surface at CDF D.

The report presented herein summarizes both the Phase I (1999) and Phase II (2000) Seismic Refraction Marine Geophysical work conducted at CDF D in New Bedford Harbor. This report presents new information as well as a re-interpretation of the older Phase I information, and supercedes the previous draft report on the Phase I (1999) Marine Seismic Refraction activities, which was entitled: "Draft Report of Marine Geophysical Surveys: Uniboom and Seismic Refraction", and was submitted in February of 2000.

1.1 Background

The geologic setting of New Bedford Harbor has been summarized in previous studies by several investigators. Foster Wheeler reviewed numerous documents prior to commencing geophysical operations in the harbor, in order to obtain background information concerning the general geologic regime present in and around the Site. Among the documents and reports reviewed as part of the background information review were *The Bedrock Geology of Massachusetts* (Hatch, N.L., ed., 1991) and *The Bedrock Geologic Map of Massachusetts* (Zen, E.A., 1983). A full list of the references reviewed by Foster Wheeler is included at the back of this report (Section 6.0).

The bedrock regime of the greater New Bedford Harbor area (including Fairhaven and Acushnet) is composed of the gray granitic gneiss of the Alaskite Formation (Zen, 1983), described as a 'light gray and pinkish-gray to tan, mafic-poor gneissic granite (and granitic gneiss) commonly containing muscovite'. The Alaskite Gneiss, which formed initially as a granitic intrusive during the Proterozoic, was subsequently metamorphosed to a gneiss, and is similar to other hard bedrock materials found within the gneissic terrain of the Milford-Dedham Geologic Zone. The bedrock encountered in cores within the study area is a dark to light gray, massive, hard, salt and pepper granitic gneiss. Additionally, the rock

Figure 1 CDF D Site Location Map

cores taken from the study area also contained bands and veins of pegmatitic and quartzitic late-stage intrusive materials, evidence that fracturing and faulting within the area was followed by late-stage intrusive influx.

The Alaskite Gneiss is moderately fractured (Zen, 1983), with the primary fracture orientation being north-northeast to south-southwest in this area. Secondary fractures have been noted (Goldsmith, 1978), which trend in an east-westerly direction. The fractures tend to be filled either with (quartzitic or pegmatitic) solidified late stage fluids (as "healed" fractures), or with silt (as "open" fractures). The fractures range from moderate to high angle, with the primary fracture set (approximate orientation NNE-SSW) being of moderate angle (approximately 45 degrees), while the secondary fracture set (approximate orientation E-W) is at a higher angle (between approximately 60 to 90 degrees), as determined through the CDF D borings and through assessment of nearby outcrops (such as on Marsh Island). In addition to the fractures, the bedrock exhibits a foliation. As observed in the outcrops on Marsh Island, the foliation appears to be oriented roughly E-W, and dips at a low to moderate angle (20 to 30 degrees) to the North. Borings from the CDF D area also contain core segments that display similar foliation dip orientations of approximately 10 to 40 degrees. Faulting of the Alaskite Formation has been documented (Goldsmith, 1978). Fault planes in the formation generally trend north-south, following the overall fabric of the Appalachian Orogenic stress patterns, though some cross-structural faults have been identified (Goldsmith, 1978), mainly representing stress relief fractures of the highly folded and deformed terrain. These (cross-structural) faults appear to have trends that range from slightly east and west of north to nearly east-west, and apparently represent regional oblique strain release features.

Above the bedrock surface, the sediments of New Bedford Harbor consist of a mixture of marine, glacial, and post-glacial sediments. This area is characteristic of the southern New England marine/glacial sequence that developed upon the retreat of the glaciers at the end of the Pleistocene. The lowest unconsolidated strata in the sequence found at New Bedford Harbor includes a glacial till, which consists of a dense mixture of coarse to fine materials with silt, clay, cobbles, and some boulders. The till represents a sedimentary veneer that was emplaced during glacial advance, and is found only sporadically in the harbor area (much of the areal extent of this formation was re-entrained as sediment as fast-moving rivers and marine induration created a high energy environment in the harbor during post-glacial ice retreat and sea level rise).

Glacial outwash deposits, consisting of coarse to fine sands, silts, and gravels are found above the till (where it exists) and above bedrock (where it does not) throughout the harbor area. The outwash deposits show characteristics of rapidly moving fresh water deposition, evidence of high energy post-glacial fluvial deposition on a broad scale. Braided stream patterns, cut and fill channels, and filled gullies have been identified throughout the region within the glacio-fluvial sediment column (Goldsmith, 1978). In places, the surface of the glacio-fluvial deposits are separated from the overlying marine deposits by an erosional surface, which represents high energy outwash prior to marine induration. In places, marine sediments may be inter-fingered (or "feathered") with the upper glacio-fluvial, as it is likely that induration occurred in stages in the area, allowing cyclic deposition of fluvial, then marine, then fluvial, followed by marine sedimentation.

The marine sediments (found above the glacio-fluvial sediments) consist of poorly graded sands, gravels, silts and clays, sometimes containing shell hash and sometimes displaying seasonal varving. Sandy and gravelly marine deposits represent higher energy beach areas, whereas silts and clays are indicative of deeper and calmer water deposition. These various marine deposits are overprinted on one another throughout the sediment column, evidence that post-glacial variations in sea level within the harbor area led to complex marine and estuarian depositional regimes.

In some areas, erosional surfaces may exist within the marine sediments as well, as evidenced by the presence of peat deposits in some areas within the marine sedimentary sequence. The uppermost sedimentary units within the harbor exist as modern estuarian and shallow marine deposits. In deeper water, lower energy areas, these sediments exist as a thick muck layer, consisting of a mixture of silt, fine sand, and decaying organic material (and often contain biogenic "gas" pockets, the residuals of the decomposition process) . In shallower areas, the recent bottom sediments may consist of coarser sands and shell hash, indicative of the presence of a higher energy environment.

1.2 Phase I and Phase II

The work conducted as part of the Phase I (Uniboom and Seismic Refraction) was completed during the summer of 1999. The Phase I geophysical program was undertaken in an attempt to characterize the bedrock surface in the area of the proposed CDF D, after several borings in that area encountered a highly variable bedrock surface. Seismic lines (shown in Figure 2) were conducted in an attempt to better understand the nature and character of the bedrock surface beneath the sediments in the area of the future proposed CDF D. The seismic data was used in conjunction with boring data in order to develop a model of the shape and character of the bedrock surface below the sediment in the area of proposed CDF D. An initial attempt to collect seismic information was conducted using a Uniboom in-water seismic system. The Uniboom system is a standard sub-bottom profiling tool used in many marine applications. It consists of a transducer system which imparts energy into the water, and a series of hydrophone sensors that sense the vibrational returns as the seismic energy "bounces" off of subsurface layers. In this case however, the presence of biogenic gas within the upper sediment layers in large portions of the study area precluded the collection of good Uniboom data. After consultation with the USACE, Foster Wheeler geophysicists then attempted to collect seismic refraction data using a bottom-lying cable and seismic energy sources buried in the harbor bottom. This technique netted satisfactory results, and 13 seismic lines were collected during the 1999 seismic refraction data collection season in the areas of interest for CDF D (see Figure 2 for line locations of the Phase I seismic refraction data Lines 1-13).

Upon evaluation of the geotechnical boring and geophysical information obtained during the Phase I work, the team designing CDF D determined that the overall alignment of the CDF walls would need to be modified. The additional engineering analyses required to modify the design required that additional information concerning the character and topology of the bedrock surface be obtained. Specifically, more information was required to the west and to the east of the area previously surveyed with seismic, and additional information was required at the south end of the CDF D proposed construction area, where sparse data had been previously collected.

A Phase II Seismic Refraction program was developed through joint analysis of the data gaps and information needs by Foster Wheeler and USACE scientists and engineers. The Phase II program consisted of an additional 11 seismic refraction lines and an additional 18 soil borings, 7 sediment probes, and 31 Cone Penetrometer Test pushes. The location of the Phase II geophysical and geotechnical boring test locations are shown in Figure 2.

Upon completion of the Phase II fieldwork, this report of the geophysical operations undertaken as part of the Phase I and Phase II activities has been prepared. Additionally, a companion report describing the results of the Phase I and Phase II geotechnical boring program has been submitted to the USACE under separate cover, and is entitled "Draft Report of Phase II Geotechnical Boring Program", dated March 2001.

1.3 Approach to the Report Presentation

This report summarizes the information obtained during two separate phases of geophysical data collection. Phase I data collection involved the collection and processing of Uniboom sub-bottom data and Marine Seismic Refraction data in the proposed CDF D area. This information was previously presented in a draft document entitled "Draft Report of Marine Geophysical Surveys: Uniboom and Seismic Refraction." Phase II involved the collection of additional Seismic Refraction data over new CDF wall alignments and across the channel areas outboard of the future CDF D footprint. The Phase II data is presented for the first time in this report, and is integrated with the interpretations of the Seismic Refraction data collected from Phase I. One composite interpretation of all of the seismic and geotechnical data collected to date is presented in this volume. To avoid confusion and conflicting interpretations, it is suggested that future analysis of the subsurface in the area of CDF D utilize the information presented herein (this Phase II Report), and that the Draft Phase I Report not be used for any future decision-making.

This Phase II report is organized by sections that provide a functional framework for the presentation of the information that was gathered from multiple programs and is synthesized here into one composite interpretation. The first part of this volume includes the text, which describes the methods and results of the seismic refraction programs. The second part of this volume presents a series of maps and plans, which represent a visual depiction of the results of the investigations. The following provides an outline of the approach to the presentation of the information.

Section 1.0 (Introduction) of the report includes introductory information, which describes the contractual framework for the program, and the background information. Section 1.1 includes the historical and published geologic framework of the study area upon which the information gathered as part of this investigation is built. The Introduction also includes a description of the Phase I vs. Phase II programs (Section 1.2), as well as this approach to the presentation of the information.

Section 2.0 (Methods) describes the means and methods by which the information, for both the Phase I and Phase II investigations, were collected, processed and interpreted. This section is broken into three subsections: a subsection describing the Uniboom portion of the work (Section 2.1); a subsection describing the Phase I Seismic Refraction program (Section 2.2), and a subsection describing the Phase II investigations (Section 2.3). Within these subsections, each program (Uniboom, Phase I, and Phase II Seismic Refraction), the equipment used to collect the various data streams is presented, along with a definition of the study area, and a description of the data collection, data processing, and data interpretation procedures undertaken for each program.

Section 3.0 (Results) describes the findings of the Uniboom program and presents the combined findings of the Phase I and Phase II Seismic Refraction investigation. This section is broken into two subsections: a subsection describing the Uniboom portion of the work (Section 3.1); and a subsection describing the results of the Phase I and Phase II Seismic Refraction programs (Section 3.2). Within these subsections, the results of each program (Uniboom, and Phase I and Phase II Seismic Refraction) are presented. Within this section, the synthesized combined results of the geophysical investigations are merged with relevant findings from the geotechnical investigations also conducted in the study area.

Section 4.0 presents the Conclusions of the investigations, including an assessment of the overall geologic findings for the study area which describes the big picture as determined from the data collected from all programs to date. Section 5.0 presents the Limitations of the program.

The maps and plans presented in this report follow a progression that mirrors the data processing and interpretation process.

Figure 1 is the site location map. Figure 2 presents the location of the seismic refraction (Phase I and II) lines and the locations of the Geotech borings (Phase I and II). The cross sections of Figure 3A-E are the results of the interpretation of the SIP inversion models. Figure 4A-E overlays the interpretation from Figure 3A-E onto the SeisOpt models of the Seismic lines and include the interpretation of the SeisOpt models. Figure 5A-D are the bedrock maps. Figure 5A has only the bedrock contours, Figure 5B has the color bedrock grid with the contour overlain on it, Figure 5C has just the color bedrock grid and Figure 5D drapes the bathymetry contours onto the color bedrock grid. Figure 6A-E are samples of the SeisOpt velocity field at 5 and 10 feet above and below the SIP bedrock surface. So the SIP bedrock surface of Figure 5 was moved up and down through the SeisOpt velocity field and the SeisOpt velocity at the point of intersection with the SIP bedrock surface was then gridded to generate Figure A-E. Figure 7A-F are planar slices through the SeisOpt velocity field at 10 foot elevation steps from – 40 feet down to – 90 feet (NGND29). To generate Figure 8, the Phase I and II geotech borings (RQD) were entered into a 3-dimensional visualization program to yield the color grid overlain on the bedrock contour map. Figure 9 is the synopsis of the interpretation for the entire program. Figure 10 then applies confidence levels to the different sections of the survey area based on all the data available.

2.0 METHODS

The geophysical methods used for this characterization were Uniboom Seismic Sub-bottom Profiling (Uniboom) and Seismic Refraction surveying. The additional marine surveys were conducted in two phases. Initially, a regular space survey of the area of interest was conducted using the Uniboom equipment. This was followed by a more widely spaced Seismic Refraction survey consisting of a number of seismic lines established in the field to approximately correspond to the proposed locations of the CDF walls. Both were performed from survey boats outfitted with the necessary equipment for high quality data collection. Foster Wheeler provided qualified shipboard geophysicists to oversee the collection of the data and assisted in the operation of the Uniboom and Seismograph equipment.

Foster Wheeler geophysicists self-performed the geophysical survey design, collection oversight, data reduction, and data interpretation. Specialty subcontractors with the appropriate equipment and licenses for the project assisted in the collection of the high quality geophysical data. The subcontractors utilized included CR Environmental, Inc. of Falmouth, Massachusetts, to assist with the Uniboom data collection, and Seismic Refraction and Northeast Geophysical, Inc. of Bangor, Maine, to assist with the Seismic Refraction data collection.

The Uniboom is a single channel analog seismic reflection system that creates images of the sub-bottom beneath the harbor by discriminating between layers based on how reflective they are to sound waves. The seismic energy source is a large transducer which is placed in the water and that generates a sharp snapping sound. Uniboom data collection was performed from a survey vessel outfitted with the Uniboom and a Differential Global Positioning System (DGPS), so that positioning information could be determined by matching the event stamp on the Uniboom data printout at regular intervals with that in the HyPak DGPS files. The subcontractor, CR Environmental, provided the survey boat (including a boat captain), the DGPS system with navigation software, a Uniboom technician, and the Uniboom system.

Seismic Refraction surveying is a common and reliable geophysical survey technique used to locate layers in the subsurface having differing seismic velocities [e.g., sediment (low relative seismic velocity) vs. bedrock (fast relative seismic velocity)]. The Phase I survey consisted of 13 seismic refraction spreads, each spread consisting of 24 hydrophone receivers (24 channels), with a nominal hydrophone spacing of 20 feet. Thus, each spread measured approximately 460 feet in length, and consisted of 24 data points along the line at which seismic information was collected. The Phase II survey consisted of 11 refraction spreads having 48 channels with a nominal hydrophone spacing of 20 feet, with each spread measuring approximately 940 feet in length. Seismic energy was provided by burying small seismic charges into the sediment of the harbor bottom. For the Phase I survey seismic energy was initiated from both ends of each seismic spread and from off-set points off each end of each seismic spread, for a total of an average of four shot points per seismic spread. For the Phase II survey seismic energy was also initiated from both ends of each seismic spread and from off-set points off each end of each seismic spread, but, since the lines were twice as long as those used for the Phase I survey, three additional shots along the line (at approximately phone 12, 24, and 36) were done for a total of seven shot points per seismic spread.

2.1 Uniboom

The Uniboom method utilizes acoustic energy to profile the subsurface in marine areas. It is similar to other sub-bottom profiling methods, except that it utilizes a larger, higher energy source. The Uniboom survey was completed within the study area in an attempt to obtain detailed information on the stratigraphy and the depth to bedrock surface. It was undertaken after previous attempts to obtain deep stratigraphic and bedrock information using an X-Star sub-bottom profiler failed to generate the desired

result. The following sections describe the Uniboom equipment, study area data collection spacing and procedures, interpretation, and results.

2.1.1 Equipment

The Uniboom Sub-bottom profiling geophysical survey was performed using precision marine navigation, and a Uniboom Sub-bottom profiling analog system. The equipment specifications are noted below:

- A Trimble Digital Sub-meter Accuracy DGPS;
- Digital Navigation Software for DGPS integration with real-time steer-to navigation and target and way-point capability (HyPak); and
- An EG&G Uniboom system with EPC plotter.

2.1.2 Study Area

The marine geophysical data was collected in the Lower Harbor portion of New Bedford Harbor, in the area of interest corresponding with the location of the proposed CDF D. The Uniboom data was collected from a moving survey vessel while traversing survey lines within the area of interest The area of the marine survey using the Uniboom equipment stretched from just north of the northern-most CDF D wall, to just south of the southern-most CDF D wall, to just east of the eastern-most CDF D wall. All of the Uniboom data collection took place in the harbor, and the survey area was bounded on the west by the shoreline. Uniboom track lines were collected in:

- An area encompassing the proposed CDF D configuration which measured approximately 2,000 feet (north-south) by 1,000 feet (east-west).

The track-line spacing for the Uniboom survey was approximately 50 feet (during the survey of the harbor, the survey vessel collected data along track-lines that were approximately 50 feet apart). Approximately 30 lines were surveyed with the Uniboom equipment, for a total of approximately 12 line-miles of data collection:

- Thirty survey lines in the CDF D area;
- Twenty-two north-south lines, of which 10 were repeated with different instrument settings; and
- Eight east-west lines, one of which was repeated with different instrument settings.

The location of the Uniboom survey lines is shown on Figure A-1 in Appendix A.

2.1.3 Procedures

The track-line spacing for the Uniboom survey was approximately 50 feet (during the survey of the harbor, the survey vessel collected data along track-lines that were approximately 50 feet apart). The survey consisted of 22 lines north-south (with 10 repeated) and eight cross-lines collected east-west (with one repeated) at approximately 300-foot intervals down the length of the survey area. There were 30 lines surveyed, for a total of approximately 12 line-miles of data collection. The Uniboom survey work took two days to complete, one day of mobilization and testing, and one day of data collection. The survey vessel used was the 30-foot long *Cyprinadon* of Falmouth, Massachusetts. The survey set-up involved a

towed array, with the Uniboom transducer towed from an A-frame off of the rear of the vessel. The neutral buoyancy 10-hydrophone streamer portion of the system was towed adjacent to the transducer from a position off of the port stern of the boat. The transducer and hydrophone array were integrated into an EPC data recorder, which also served to fire the pulse for the Uniboom system. Data was collected with a band-pass filter, which allows the incoming seismic signal to be cut below one frequency, and above another, allowing an optimal 'band' of frequencies through for the given conditions encountered during data collection.

HyPak, a digital navigation software for DGPS integration with real-time steer-to navigation and target and way-point capability, was used to design and locate the survey lines. HyPak was set to record a unique, sequentially numbered 'event' every 100 feet of travel along the survey lines. The EPC data recorder was synchronized with the DGPS via HyPak. The EPC analog printout was stamped to correspond with the HyPak event numbers, allowing for accurate X,Y location of recorded features. The data is recorded as a time-depth section; a converter tool was developed for this data application allowing the time sections records to be converted to depths. The printouts from the Uniboom equipment, with interpretations, are included in Appendix A.

2.1.3.1 Data Collection

Uniboom sub-bottom data was collected over the proposed CDF D footprint between October 27 and 29, 1999. The data was collected with an EG&G Uniboom sub-bottom profiling system attached to an EPC paper plotter for the production of hard copy output. The Uniboom system was deployed from a research vessel, and the data was collected using a steer-to navigation system comprised of a DGPS and a marine survey software package called "HyPak".

The Uniboom equipment was deployed off of the stern of the research vessel. The energy source and the acoustic receiver array were placed in the water and towed behind the boat using a tow-line. A waterproof data communications cable was utilized to port the continuous data stream received by the unit's hydrophone array to the topside processor unit, where the data was processed and printed on a flatbed plotter. During the survey, the research vessel traversed up and down the track-lines established over the harbor area of interest. Uniboom sub-bottom data was collected continuously along the survey track-lines.

The area of the marine survey using the Uniboom equipment stretched from just north of the northern-most CDF D wall, to just south of the southern-most CDF D wall, and to just east of the eastern-most CDF wall. The survey area was bounded on the west by the shoreline. The track-line spacing for the Uniboom survey was approximately 50 feet (during the survey of the harbor, the survey vessel collected data along track-lines that were approximately 50 feet apart). Approximately 30 lines were surveyed with the Uniboom equipment, for a total of approximately 12 line-miles of data collection.

2.1.3.2 Data Processing

Uniboom Sub-bottom Profiler generates data as "time/depth sections", which are time-dependent reflections of the sub-bottom features. The Uniboom data sections were used in conjunction with the Seismic Refraction data in order to produce cross-sections of the harbor bottom along the surveyed track-lines. Because the Uniboom instrument is a closed-loop, analog system, no post-processing can be accomplished on the data. The instrument is adjusted in the field until a maximum signal response is achieved, and the data is displayed on paper record printouts. Signal adjustment consists of frequency and pulse strength adjustment, both made by turning variable rheostats on the instrument. A test run of the instrumentation was performed within the survey area so that the equipment operator could adjust the instrument controls until a maximum signal quality was obtained. Once the controls were adjusted, they

were generally set for the duration of the survey, with occasional minor adjustment by the equipment operator to account for minor signal drift. Several calibration lines were conducted as part of survey Quality Control (QC), whereby the frequency and pulse strength were modified and a survey line was repeated. This QC step acts as an independent check that the most appropriate settings are being utilized in a particular area.

The Uniboom paper records collected during the survey were then photocopied, and a qualified geophysicist interpreted the copies. These records are included in Appendix A. Many of the data profiles contained data that was masked by "gas" in the subsurface, resulting in poor quality records. Interpretation notes on these records indicate that the data was of poor quality. On records that contained interpretable data, the interpretations were rendered directly on the copies of the data records (included in Appendix A).

2.1.3.3 Data Interpretation

Interpretation involved refining models and comparing with calibration data until the most likely version model (most reasonable interpretation of data given ALL input) was found. The objective of the data analysis and interpretation phase was to characterize the responses from the geophysical data. An integrated approach to the analysis and interpretation phase was implemented for this project: data was analyzed and interpreted in concert with the lithologic and geotechnical sampling data available for the harbor.

Uniboom Sub-bottom data were interpreted from the graphic time-domain cross-sections, and were converted into depth cross-sections during interpretation using an encoded conversion ruler developed for seismic reflection time-domain cross section conversion. The boring log information was also overlain onto the seismic records to assist with interpretation.

As a result of the presence of significant quantities of biogenic gas in the bottom sediments in the proposed CDF D footprint, the results of the Uniboom survey were considered insufficient to accurately characterize the bedrock surface in the area. The Foster Wheeler/USACE team decided to attempt a modified version of land seismic refraction (adapted for marine use), which is significantly less sensitive to the presence of biogenic gases in the bottom sediments, to try to profile the bedrock surface in the CDF D harbor area.

2.2 Seismic Refraction Phase I

After reviewing the Uniboom data, and determining that the results of the Uniboom survey would not meet the requirements for characterizing the bedrock under the proposed CDF D area, Foster Wheeler geophysicists and USACE engineers designed and conducted a marine seismic refraction survey of the area of interest for CDF D.

2.2.1 Equipment

The marine Seismic Refraction geophysical survey was performed using precision marine navigation, a digital seismograph, and a hydrophone "Bay Cable." The equipment specifications are noted below:

- A Trimble Digital Sub-meter Accuracy DGPS).
- A Digital 24 channel EG&G Geometrics 2401 signal enhancement Seismograph with a Mitchum Industries hydrophone bottom sensor array (a "Bay Cable"), capable of supporting 48 channels of data collection.

2.2.2 Study Area

The marine geophysical data was collected in the lower portion of the upper harbor of New Bedford Harbor, in the area of interest corresponding with the location of the proposed CDF D. The Seismic Refraction data was collected from stationary vessels via a hydrophone cable stretched out on the bottom of the harbor. The Seismic Refraction survey consisted of refraction spreads having 24 channels with a nominal hydrophone spacing of 20 feet, with each spread measuring approximately 460 feet in length. Spreads were located in the harbor as close to the CDF walls as possible. The following number of lines were surveyed, for a total of approximately 5,980 feet of data collection:

Thirteen survey lines in the CDF D area (all in the upper portion of the Lower Harbor) as follows:

- Four survey spreads along the outer-most edge of the eastern CDF wall;
- Four survey spreads along the inner-most edge of the eastern CDF wall;
- Two survey spreads near the north edge of the northern CDF wall;
- One survey spread along the southern-most edge of the northern CDF wall;
- One survey spread along the northern-most edge of the southern CDF wall; and
- One survey spread along the southern-most edge of the southern CDF wall.

Each survey spread consisted of three to four shot points (locations where energy was initiated into the subsurface). Each spread consisted of, at a minimum, a shot point at either end of the spread. Additionally, off-set shot points were used where possible. These consisted of setting off seismic shots at some distance from the end of the seismic spread but in line with the seismic spread. The use of off-set shots is a common practice in refraction surveying which helps support the information gained from bedrock layers in the subsurface. An off-set shot was used off of each end of most of the survey lines, except in cases where access was limited (e.g., spreads that ended immediately adjacent to the land). In those cases, one off-set shot was utilized.

The location of the Seismic Refraction survey spreads is shown on Figure 2. The spread locations are depicted as a series of crosses, one for each hydrophone.

2.2.3 Procedures

The survey consisted of 13 refraction spreads, each spread having 24 channels with a nominal hydrophone spacing of 20 feet, with each spread measuring about 460 feet in length, totaling roughly 5,980 feet. All 13 spreads were located in the harbor as close to coincident with the CDF walls as was possible (see Figure 2).

The harbor shallow subsurface is known to contain pockets of biogenic gas (the reason previous surveys were unsuccessful in delineating the bedrock surface). Therefore, small explosive seismic capsules, capable of producing a sharp, strong, and distinct energy source, were used. These energy capsules were buried into the harbor bottom sediments 18” to 36”, and were covered by a ½ inch thick steel plate in order to promote maximum coupling of the energy source with subsurface. This approach to the energy initiation maximizes the amount of energy that can be transmitted into the subsurface per shot, and in most cases, over-rides the effect of the biogenic gases in the subsurface.

The survey setup in the harbor consisted of laying out the Mitchum Industries 48 channel, 940 foot long, hydrophone ‘Bay’ cable (which had three mushroom anchors - one at each end and one in the

middle - attached to it to secure it to the bottom). Then the seismograph recording vessel anchored at one end of the spread, attached to the cable head, and recorded the data. Concurrently, the second boat placed the seismic charges. Once the first spread was completed, the recording vessel moved to the other end of the cable and the process was repeated. Cable and shot point locations were surveyed in with DGPS.

The Mitchum Industries 48 channel hydrophone 'Bay' cable takeouts are spaced 30 feet apart. For this work we wanted 20-foot spacing, so 10 feet of the cable between each takeout was folded and taped up to create a hydrophone spacing of 20 feet. The 'Bay' cable system is designed to be primarily used to collect seismic reflection with up to five cables connected in series for a total of 240 channels capable of rolling along via a roll along box. The roll along box is just a switch that enables switching the last channel of an array off while 'rolling' each other channel 'along' the spread up one position (i.e., in a 12 channel setup channel 12 is 'rolled off' the array and channel 11 becomes channel 12, 10 becomes 11 etc.).

The EG&G 2401 seismograph collects data digitally and prints out records via a built-in thermal printer. A minimum of two copies of each record was printed out in the field as a back up for the digital data, as well as for field interpretation. The seismograph recorded the voltage generated by each hydrophone on the harbor bottom, and displayed the result as one waveform for each channel. Hydrophones are highly sensitive transducers that generate a voltage that is proportional to a change in pressure (i.e., a pressure wave propagating through a medium such as the mud of the harbor bottom). Ideally, the seismic signal returns from the subsurface are stronger than background noise present in the water column in the area. Some background noise was experienced in the survey area during the survey data collection. Vibrational background "noise" (from the fishing fleet and on-land machinery working adjacent to the harbor) was common at the south end of the survey area, near the fish processing plant south of Harvey Tichon Avenue, complicating the data processing and interpretations rendered in that area. Additionally, the large amount of derelict vessels and other debris in the water adjacent to the former Herman Mellville Shipyard hampered data collection activities in that area. While background noise did effect the data in some areas, in general the data collected was of excellent quality, and in only a few cases did the background noise overwhelm the seismic signal to the point where the data from a particular hydrophone could not be interpreted. Some example seismograph records are included in Appendix B.

2.2.3.1 Data Collection

Seismic Refraction data was collected over the proposed CDF D footprint between November 4 and 20, 1999. The data was collected using the high-resolution seismograph coupled to the non-buoyant hydrophone cable outfitted with 48 high impedance hydrophones noted above. The seismic energy was provided by small electrically primed seismic energy charges consisting of an encapsulated, two-stage, chemically accelerated, physically actuated energy source.

The seismic refraction cable was deployed from the stern of a research vessel. Position information was collected while laying out the cable using DGPS. Real-time X, Y position information was fed into a computer system from the DGPS system, which logged the position of the cable as it was deployed.

Three of the four seismic lines (those trending approximately east-west (1, 3 & 13) from the shore line), were conducted using three seismic shot locations, one at each end of the line and an offset from the east. Line 12 utilized four shots, one at each end, one in the middle of the spread, and an offset to the east. The remaining lines (2, 4, 5, 6, 7, 8, 9, 10 & 11) all were conducted with four shots, one at each end and an offset to both ends.
The seismic data acquisition system used for this project was a modified version of the systems typically used for on-land seismic data acquisition. Part of the modification of the system was the addition of a "roll along" box, which allowed the data collection geophysicist to set the data collection channels on the

seismograph to record data from any of the hydrophones (in sequence). For this survey, the "roll along" box was set to a fixed "roll", establishing a set sequence with which the seismograph would record the data from the 48 hydrophones laying on the bottom of the harbor. A custom cable-head adapter was developed to connect the hydrophone array to the seismic recording device (the 24 channel EG&G model 2401 seismograph). Once the roll along box was set to 'zero roll' it was not adjusted for the remainder of the survey. This set-up, when utilized with the EG&G seismograph, resulted in output data being displayed in a "split-spread" format, whereby the data records displayed the data in split sequence, or first channels 1 through 12, followed by channels 24 through 13. This data display characteristic had no effect on the quality of the data; however, for ease of processing, the data files were edited during final processing to reorder the channels so that they were in "linear-spread" format (numbered sequentially 1 through 24).

2.2.3.2 Data Processing

The data processing for this study was conducted in keeping with industry standards, and was performed using state-of-the-art and well-tested software. Processing was completed initially using the U.S. Geological Survey (USGS) seismic interpretation software know as "SIP". This software has been used for nearly a decade by the USGS for nearly every seismic refraction application completed by the government. The data was also processed using a software package called SeisOpt@2D (SeisOpt), which is a commercial package used in the mining and petroleum industries. The SeisOpt software has certain advantages over the more traditional SIP program in that it uses a more sophisticated mathematical routine to model the energy ray-path's transmission through the subsurface. The "monte-carlo" approach used by the SeisOpt program allows for both unique and non-unique solutions to be assessed. It processes data in an iterative fashion whereby possible solutions are modeled until the one most-representative solution (that which fits the data the best) is found. Data was processed using both software packages in sequence so that the best-fit model was identified by both programs, resulting in the most appropriate solution to the data.

Data processing of the records began in the field as data was being collected. Post-processing of the data allowing the creation of initial subsurface models began immediately upon returning from the field. The initial model runs through the SIP computer program were completed first for all of the seismic spreads collected (13 spreads). The following steps were followed in the processing of the Seismic Refraction data:

1. Field seismograms were transferred to digital disc media to enable desk-top computer processing.
2. The computer program "First-picks" (a module of SIP) was utilized to enhance and filter the raw seismogram records, including:
    - The data was filtered using a "band-cut" filter to remove high frequency noise which is imparted onto the data by the pressure wave that travels through the water column after a seismic shot; and
    - The gain controls were adjusted until the first breaks of the seismic waveforms were as clear as possible.
3. The "first breaks" of all of the seismic records were then "picked", and a data file of all of the arrival times of the energy first breaks was created for each hydrophone for each record for every shot conducted (usually four shots per spread).
4. The lateral distance from the shot point of each hydrophone was determined by producing maps of the DGPS positions of the shots and spreads as collected in the field.

5. Using the DGPS data collected in the field during the data collection phase, and the bathymetry maps produced by the USACE and provided to Foster Wheeler, the elevation of each hydrophone along the 'bay' cable was digitized for each seismic spread.
6. The data was then elevation corrected to the harbor bottom, by merging the data sets including the digitized bathymetry (elevation) files for the hydrophones, and the "picked" seismogram waveform files for each spread.
7. From the elevation corrected data, "Time vs. Distance" (see Appendix B) plots were created using the SIP program, which allow the interpreter to determine the number of layer responses which are apparent in the data, and which will be used by the program to create the layer models.
8. Layer numbers were then assigned to the various layer segments interpreted from the "Time vs. Distance" plots - these layer numbers form the basis upon which the model calculates seismic velocities that it uses in the production of the resultant depth models.
9. An initial run of the SIP modeling program was then conducted using all of the above as input information, and initial resultant depth profiles were generated.

After the preliminary interpretations of the field data there were a number of (in places large) inconsistencies in the data sets that were resolved in future runs of the seismic model. These inconsistencies are expected, and are always present in the first run of seismic models through all of the processing software packages currently in use. The inconsistencies result from three primary sources:

1. The elevation of a particular sensor (hydrophone) along the sensor string is incorrect, either because the sensor has been located improperly along the string, or the bathymetry data in the area of that hydrophone is insufficient.
2. The first energy "break" of the seismic waveform (which is the signal the interpreter is looking for) has been incorrectly picked by the interpreter, either because the waveform is "noisy" due to ambient or background vibrations which had interfered with clear signal production, or because the gain control for the waveform was set too high or too low.
3. The seismic velocities that were interpreted from the data and were used by the models to create the layer profiles were inaccurate. This occurs primarily because the velocities used by the initial run of the modeling program are chosen automatically by the computer program, which cannot differentiate between actual lateral velocity changes in the data and "false" velocity profiles which occur when the harbor bottom is not flat; one of the subsurface layers (i.e., bedrock surface) dips; or faults, fractures or other irregularities are present which cause seismic "low-velocity-zones".

Of these, the inconsistencies in velocity represent the largest area for error to be imparted into the initial interpreted profiles. A relatively small change in the bedrock velocity chosen for a spread (such as 15,000 ft/sec as opposed to 16,000 ft/sec), can make a dramatic difference in the depth of bedrock interpreted by the model. The velocity issues were studied in further runs of the modeling program, and the inconsistencies were rectified, as were any resulting from improper initial "picks" or elevation errors.

In order to rectify the initial inconsistencies, other calibration data were used to check the parameters used as inputs to the seismic models. The calibration data included USACE bathymetry charts of the harbor, boring logs from the geotechnical-drilling program at CDF D, Uniboom geophysical data collected as part of this seismic survey, and geophysical data collected by Foster Wheeler during previous investigations of the area.

It became obvious from the initial SIP processing runs, that this particular geographic area contains a significant amount of lateral velocity change, particularly in the bedrock. While some lateral velocity variations (mostly spread to spread) can be dealt with in SIP, the program has difficulties with complicated lateral velocity scenarios. In order to deal with the lateral velocity changes, an initial run of another seismic refraction inversion software, SeisOpt@2D (SeisOpt), was used. SeisOpt, unlike SIP, is not limited to a 'layer cake' model. It assigns velocities to individual cells (thousands of cells for each model), and therefore the models generated allow for complicated lateral velocity changes. The SeisOpt models were also helpful in determining the overall velocity structure in the subsurface in the study area as a starting point for calibration of the SIP models.

Calibrating the SIP models was an iterative process that involved changing the input parameters of layer velocities and first pick's layer assignments until there was agreement with existing information (boring logs, SeisOpt models, other SIP models at crossing points, other geophysical information). The calibration took as many as several dozen iterations to resolve all discrepancies, depending on the data particulars and the line location.

2.2.3.3 Data Interpretation

Interpretation involved refining models and comparing with calibration data until the most likely version model (most reasonable interpretation of data given ALL input) was found. The objective of the data analysis and interpretation phase was to characterize the responses from the geophysical data. An integrated approach to the analysis and interpretation phase was implemented for this project: data was analyzed and interpreted in concert with the lithologic and geotechnical sampling data available for the harbor.

The Seismic Refraction data was interpreted using commercial software packages (Geosoft Oasis Montaj, USGS-SIP, Optim SeisOpt@2D). Experienced geophysicists identified feature responses within the data and generated the cross-sections and coded maps seen in Figures 3 through 5. When it was necessary to improve feature recognition capabilities, the geophysical data was intensively analyzed with mathematical processes, which included simplistic filtering, and other data enhancement operations.

Geosoft Oasis Montaj (Montaj), a data processing and analysis (DPA) system for earth science applications, was used to produce color coded maps for the project. Montaj was used to integrate the DGPS, bathymetry or bedrock elevation information onto geo-referenced maps. The Rimrock Geophysics software package called "SIP2" (which includes the latest version of the USGS SIP program) was used to do the "first picks" and ray tracing inversion of the seismic data. Optim Software SeisOpt@2D (SeisOpt), which uses a modified "monte-carlo" statistical method called "Simulated Annealing" to arrive at the best-fit velocity field for the observed first arrivals, was used to complete the processing iterations and arrive at the best-fit model scenarios for the data.

Data interpretation involved repeating many of the initial data processing steps described in Section 2.2.3.2 until the most appropriate best-fit model was generated. For some of the records, the "first breaks" of the seismic records were "re-picked", where the initial "first break" interpretation could be improved, in order to achieve a better-fit model.

Another adjustment that was made during interpretation was the modification of hydrophone layer assignments on the "Time vs. Distance" plots (examples are included in Appendix B), which were created using the SIP program. These layer assignments form the basis upon which the model calculates seismic velocities that it uses in the production of the resultant depth models. Changing the layer assignments revises the morphology of the model, both shape and depth of interface. After numerous iterations, it was determined for this data set that the most accurate models required that all of the sections

be generated using a two layer case when running the SIP program. Three layer models were attempted for some spreads to see if additional layers (such as the organics) could be resolved from the other overburden; however, it appears that the other layers are either not thick enough or of insufficient velocity difference from the surrounding material to be resolved by the SIP program.

In order to deal with lateral velocity changes an initial run of another seismic refraction inversion software, SeisOpt, was used. SeisOpt, unlike SIP, is not limited to a 'layer cake' model. It assigns velocities to individual cells (thousands of cells for each model) calculating a velocity field, and therefore, models lateral velocity changes correctly. This also helped to get a handle on the overall velocity structure as a starting point for calibration of the SIP models.

The lines with the best control (most numerous and reliable borings) were inverted first (iteratively with the SIP program) until the models achieved the "best-fit." Then the resulting SIP models were used to augment the boring data (and in some cases in lieu of boring data) for calibrating crossing lines, along with the SeisOpt model results.

2.3 Seismic Refraction Phase II

The following sections describe the equipment used for the Seismic Refraction II survey, the data collection methods, and the data processing and data interpretation methodologies for all aspects of the marine geophysical survey.

2.3.1 Equipment

The marine geophysical survey used precision marine navigation, side scan sonar, and a digital seismograph for Seismic data recording. The equipment specifications are noted below:

<u>Geophysical Equipment Used</u>

- A Trimble Pro XRS Digital Sub-meter Accuracy DGPS;
- Digital Navigation Software for DGPS integration with real-time steer-to navigation and target and way-point capability (HyPak);
- EG&G DF-1000 Digital Side Scan Sonar with the 560 Topside coupled to a PC running SeaSone Hunter V2.08c data collection software; and
- A Digital 48 channel OYO DAS-1 signal enhancement Seismograph with a Mitchum Industries hydrophone bottom sensor array (a "Bay Cable"), capable of supporting 48 channels of data collection (see note)

Note: An active 48 channel seismic "streamer" cable with piezo-polymer film hydrophone groups was initially used along with a TZ/OBC (shallow marine) acoustic cable positioning system, but the "streamer" cable proved to be too buoyant for this application, and the Site proved to be too noisy for the TZ/OBC (shallow marine) acoustic cable positioning system.

HyPak, a digital navigation software for DGPS integration with real-time steer-to navigation and target and way-point capability, was used in the accurate payout of the hydrophone "bay" cable.

2.3.2 Study Area

The marine geophysical data was collected in the lower portion of the upper harbor of New Bedford Harbor, in the area of interest corresponding with the location of the proposed realignment of CDF D. The Seismic Refraction data was collected from stationary vessels via a hydrophone cable stretched out on the bottom of the harbor. The Seismic Refraction survey consisted of refraction spreads having 48 channels with a nominal hydrophone spacing of 20 feet, with each spread measuring approximately 940 feet in length. Four spreads were located in the harbor as close to the realigned CDF walls as was possible, and seven east-west cross lines were collected. The following number of lines was surveyed, for a total of approximately 10,340 feet of data collection:

Eleven survey lines in the CDF D area (all in the lower portion of the Upper Harbor) as follows:

- Two survey spreads along the outer-most edge of the re-aligned eastern CDF wall;
- Two survey spreads along the inner-most edge of the re-aligned eastern CDF wall; and
- Seven east-west survey spreads crossing the re-aligned eastern CDF wall.

Each survey spread consisted of five to seven shot points (locations where energy was initiated into the subsurface).

The location of the Seismic Refraction survey spreads is shown on Figure 2. The spread locations are depicted as a series of crosses, one for each hydrophone.

2.3.3 Procedures

The Mitchum Industries 48 channel hydrophone 'Bay' cable takeouts are spaced 30 feet apart. For this work we wanted 20 foot spacing, so 10 feet of the cable between each takeout was folded and taped up to create a hydrophone spacing of 20 feet. The 'Bay' cable was connected to a 48 channel OYO DAS-1 seismograph.

The survey consisted of 11 refraction spreads, each spread having 48 channels with a nominal hydrophone spacing of 20 feet, with each spread measuring about 940 feet in length, totaling roughly 10,340 feet. All 11 spreads were located in the CDF D area of the harbor as directed by USACE Scientists and Engineers.

As in the Phase I survey, explosive charges were used as the seismic source. These charges were buried into the harbor sediments 18"-36" and covered by a steel plate, in order to get the energy into the subsurface and below the "gassy" sediments, wherever possible.

Line 24 had five shot points; Line 19 and 20 had six shots each. Line 19 missing the western end shot, and Line 20 missing the shot at the south end and Line 24 was missing the eastern off end shot. The remaining lines (14, 15, 16, 17, 18, 21, 22 & 23) all had seven shots, two end at 20 and 200 feet, one in the center of the spread (phone 24) and two at the mid point between the center and the ends (approximately phone 12 and 36).

The survey set-up in the harbor consisted of laying out the Mitchum Industries 48 channel, 940 foot long, hydrophone 'Bay' cable, which had three anchors (one at each end and one in the middle) attached to it to secure it to the bottom. The cable also had specially designed sonar reflectors at phones 1, 24 and 48 to aid in the accurate positioning of the cable using a side scan sonar system. The cable head at one end of

the cable was kept on the surface of the water using a large buoy for ease of retrieval and hook-up with the seismic recording vessel.

Once the cable was deployed the seismic recording vessel then collected side scan sonar data to accurately locate the hydrophone cable on the harbor bottom. A minimum of two passes per spread were collected, one from each side of the cable at a water depth dependent off-set distance (a smaller off-set in shallower water, than in deeper water) of about 25 to 75 feet.

The seismic recording vessel then anchored at the end of the spread, attached to the cable head, and recorded the Seismic data, while the seismic shot boat emplaced the seismic charges. Cable and shot point locations were surveyed using DGPS.

For this survey, a single 48 channel 'Bay' cable was used. The hydrophone array was connected to a 48 channel OYO DAS-1 seismograph via a cable head adapter.

The OYO DAS-1 seismograph collects data digitally and prints out records via a built-in thermal printer. A minimum of two copies of each record were printed out in the field as a back up for the digital data, as well as for initial field interpretation. The seismograph recorded the voltage generated by each hydrophone on the harbor bottom, and displayed the result as a wiggle trace or waveform for each channel. Hydrophones are highly sensitive transducers that generate a voltage that is proportional to a change in pressure (i.e., a pressure wave propagating through a medium such as the mud of the harbor bottom). Ideally the seismic signal returns from the subsurface are stronger than background noise present in the water column in the area. Some background noise was once again experienced in the survey area during data collection. Vibrational background "noise" (from the fishing fleet and on-land machinery working adjacent to the harbor) was common at the south end of the survey area, near the fish processing plant south of Harvey Tichon Avenue, complicating the data processing and interpretations rendered in that area. While background noise did affect the data in some areas, in general the data collected was of excellent quality, and in only a few cases did the background noise overwhelm the seismic signal to the point where the data from a particular hydrophone could not be interpreted. These "noisy" hydrophones were "zeroed" out (not used during processing) in the processing of the data.

2.3.3.1 Data Collection

Seismic Refraction data for Phase II was collected over the proposed CDF D footprint between July 29 and August 25, 2000. As in Phase I, the data was collected using a high-resolution seismograph coupled to a non-buoyant hydrophone cable outfitted with 48 high impedance hydrophones. The seismic energy was provided by small electrically primed seismic energy charges consisting of an encapsulated, two-stage, chemically accelerated, physically actuated energy source.

The survey consisted of 11 refraction spreads, each spread having 48 channels (as opposed to 24 channels for the Phase I work) with a nominal hydrophone spacing of 20 feet, with each spread measuring about 940 feet in length, totaling roughly 10,340 feet of data collection (see Figure 2).

The same small explosive seismic capsules, capable of producing a sharp, strong, and distinct energy source that were effectively used in the Phase I survey, were once again used. These energy capsules were buried into the harbor bottom sediments 18" to 36", and were covered by a ½ inch thick steel plate in order to promote maximum coupling of the energy with subsurface. This approach to the energy initiation maximizes the amount of energy that can be transmitted into the subsurface per shot, which overrides the effect of the biogenic gases in the subsurface.

The survey set-up in the harbor consisted of laying out the Mitchum Industries 48 channel, 940-foot long, hydrophone 'Bay' cable which had three anchors (one at each end and one in the middle) attached to it to secure it to the bottom. There is a cable head at each end of the cable. One cable head was floated on a buoy for easy retrieval by the seismic recording vessel. Once the cable was deployed the seismic recording vessel then collected side scan sonar data to accurately locate the hydrophone cable on the harbor bottom. A minimum of two passes per spread, were collected, one from each side of the cable at a water depth dependent off-set distance (a smaller off-set in shallower water, than in deeper water) of about 25 to 75 feet. The Side Scan operator would monitor the data collection in real-time to ensure that the images collected were as clear as possible, and to confirm that the cable was not caught or suspended above the harbor bottom. The Side Scan data was also stored digitally for later post-processing and more intensive interpretation.

The seismic recording vessel then anchored at one end and recorded the data while the second boat placed the seismic charges. Once the first spread was completed the seismograph boat moved to the other end of the cable and the process was repeated. Cable and shot point locations were surveyed with a DGPS.

The OYO DAS-1 seismograph collected the data digitally and records were printed out in the field via a built-in thermal printer. The seismograph recorded the voltage generated by each in-water hydrophone as the 'phone was energized by the passing energy wave created by the seismic "shot." One recorded waveform is presented for each hydrophone that is active on the harbor bottom. Hydrophones are highly sensitive transducers that generate a voltage that is proportional to the change in pressure in the water. Ideally the seismic signal returns from the subsurface are stronger than the background noise. Appendix B shows some example seismograph records.

The seismic refraction cable was deployed from the stern of the seismic recording vessel. Position information was collected while laying out the cable using a steer-to navigation system comprised of a DGPS and a marine survey software package called "Hypak." Real-time X,Y position information was fed into a computer system from the DGPS system, which logged the position of the cable as it was deployed.

2.3.3.2 Data Processing

The data processing for this study was conducted in keeping with industry standards, and was performed using state-of-the-art and well-tested software. Processing was completed initially using the USGS seismic interpretation software know as "SIP". This software has been used for nearly a decade by the USGS for nearly every seismic refraction application completed by the government. The data was also processed using a software package called SeisOpt@2D, which is a commercial package used in the mining and petroleum industries. The SeisOpt@2D software has certain advantages over the more traditional SIP program in that it uses a more sophisticated mathematical routine to model the energy ray-path's transmission through the subsurface. The "monte-carlo" approach used by the SeisOpt program allows for both unique and non-unique solutions to be assessed. It processes data in an iterative fashion whereby possible solutions are modeled until the one most-representative solution (which fits the data the best) is found. Data was processed using both software packages in sequence so that the best-fit model was identified by both programs, resulting in the most appropriate solution to the data. The Side Scan Sonar data was collected and processed using SeaSone Hunter V 2.08c, mosaics of the data were generated with the SeaSone Mapper 2.06 software package.

<u>Seismic Refraction</u>

Data processing begun in the field as data was collected. Post-processing of the data allowing the creation of initial subsurface models began immediately upon returning from the field. The initial model

runs through the SIP software were completed first for all of the seismic spreads collected (11 spreads). The following steps were followed in the processing of the Seismic Refraction data:

1. Field seismograms were transferred to digital disc media to enable desk-top computer processing.
2. The computer program "First-picks" (a module of SIP) was utilized to enhance and filter the raw seismogram records, including:
    - The data was filtered using a "band-cut" filter to remove high frequency noise which is imparted onto the data by the pressure wave that travels through the water column after a seismic shot; and
    - The gain controls were adjusted until the first breaks of the seismic waveforms were as clear as possible.
3. The "first breaks" of all of the seismic records were then "picked", and a data file of all of the arrival times of the energy first breaks was created for each hydrophone for each record for every shot conducted (usually seven shots per spread).
4. The lateral distance from the shot points to each of the hydrophones was determined by:
    - Producing maps of the DGPS positions of the shots and the side scan sonar spread location; and
    - Using the travel time to the first breaks multiplied by the velocity of water, as calculated from tests performed in the harbor during the survey.
5. Using the DGPS data collected in the field during the data collection phase, and the bathymetry maps produced by the USACE and provided to Foster Wheeler, the elevation of each hydrophone along the 'bay' cable was digitized for each seismic spread.
6. The data was then elevation corrected to the harbor bottom, by merging the data sets including the digitized bathymetry (elevation) files for the hydrophones, and the "picked" seismogram waveform files for each spread.
7. From the elevation corrected data, "Time vs. Distance" (see Appendix B) plots were created using the SIP program, which allow the interpreter to determine the number of layer responses which are apparent in the data, and which will be used by the program to create the layer models.
8. Layer numbers were then assigned to the various layer segments interpreted from the "Time vs. Distance" plots - these layer numbers form the basis on which the model calculates seismic velocities that it uses in the production of the resultant depth models.
9. An initial run of the SIP modeling program was then conducted using all of the above as input information, and initial resultant depth profiles were generated.

After the preliminary interpretations of the field data there were a number of (in places large) inconsistencies in the data sets that were resolved in future runs of the seismic model. These inconsistencies are expected, and are always present in the first run of seismic models through all of the processing software packages currently in use. The inconsistencies result from three primary sources:

1. The elevation of a particular sensor (hydrophone) along the sensor string is incorrect, either because the sensor has been located improperly along the string, or the bathymetry data in the area of that hydrophone is insufficient.

2. The first energy "break" of the seismic waveform (which is the signal the interpreter is looking for) has been incorrectly picked by the interpreter, either because the waveform is "noisy" due to ambient or background vibrations which had interfered with clear signal production, or because the gain control for the waveform was set too high or too low.
3. The seismic velocities that were interpreted from the data and were used by the models to create the layer profiles were inaccurate. This occurs primarily because the velocities used by the initial run of the modeling program are chosen automatically by the computer program, which cannot differentiate between actual lateral velocity changes in the data and "false" velocity profiles which occur when the harbor bottom is not flat; one of the subsurface layers (i.e., bedrock surface) dips; or faults, fractures or other irregularities are present which cause seismic "low-velocity-zones."

Of these, the inconsistencies in velocity represent the largest area for error to be imparted into the initial interpreted profiles. A relatively small change in the bedrock velocity chosen for a spread (such as 15,000 ft/sec as opposed to 16,000 ft/sec), can make a dramatic difference in the depth of bedrock interpreted by the model. The velocity issues were studied in further runs of the modeling program, and the inconsistencies were rectified, as were errors resulting from improper initial "picks" or elevation errors.

In order to rectify the initial inconsistencies, other calibration data was used to check the parameters used as inputs to the seismic models. The calibration data included USACE bathymetry charts of the harbor floor, boring logs from the geotechnical-drilling program at CDF D (Phase I and II).

It became obvious from the initial SIP processing runs, that this particular geographic area contains a significant amount of lateral velocity change, particularly in the bedrock. While some lateral velocity variations (mostly spread to spread) can be dealt with in SIP, the program has difficulties with complicated lateral velocity scenarios. In order to deal with the lateral velocity changes, an initial run of another seismic refraction inversion software, SeisOpt@2D (SeisOpt), was used. SeisOpt, unlike SIP, is not limited to a 'layer cake' model. It assigns velocities to individual cells (thousands of cells for each model), and therefore the models generated allow for complicated lateral velocity changes. The SeisOpt models were also helpful in determining the overall velocity structure in the subsurface in the study area as a starting point for calibration of the SIP models.

Calibrating the SIP models was an iterative process that involved changing the input parameters of layer velocities and "first pick" layer assignments until there was agreement with existing information (boring logs, SeisOpt@2D models, other SIP models at crossing points, other geophysical information). The calibration took as many as several dozen iterations to resolve all discrepancies, depending on the data particulars and the line location.

Side Scan Sonar

The best Side Scan runs were used to create a "mosaic" of the harbor bottom, in which the cable can be clearly seen. This image was geo-referenced and the position of the cable obtained by digitizing at short intervals along the sonar image of the cable. The positions of the cable middle and ends were clearly seen by the use of custom sonar reflectors (see Illustration 1 below).

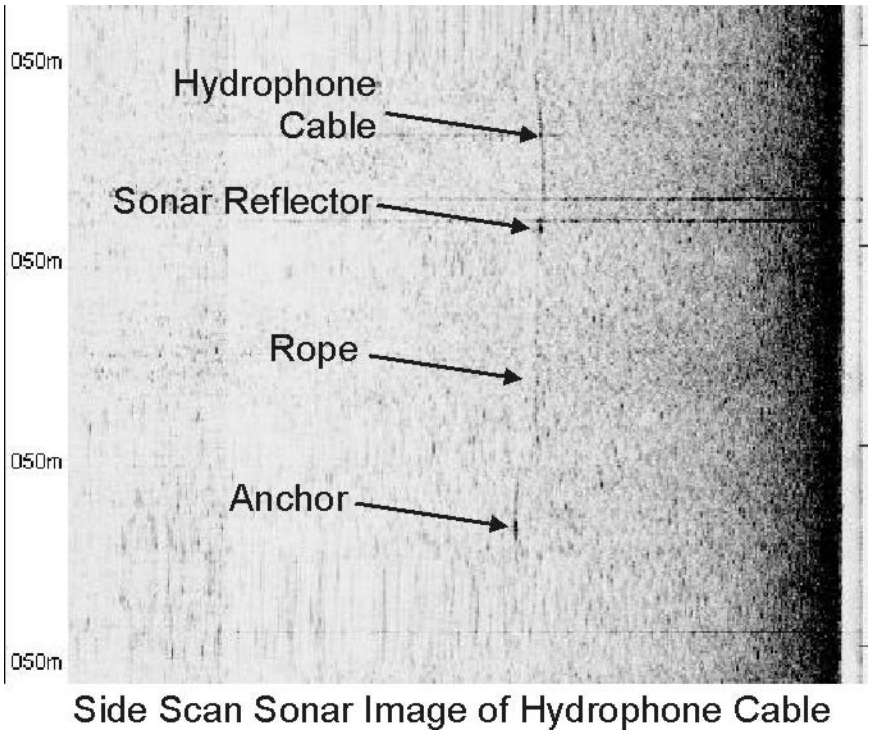

Illustration 1

Sample Side Scan Sonar Image

2.3.3.3 Data Interpretation

As with the data from the Phase I Seismic program, interpretation of the Phase II data involved refining models and comparing with calibration data until the most likely version model (most reasonable interpretation of data given ALL input) was found. Again, the objective of the data analysis and interpretation phase was to characterize the responses from the geophysical data. An integrated approach to the analysis and interpretation phase was implemented for this project: data was analyzed and interpreted along with the lithologic and geotechnical sampling data from both the 1999 and 2000 drilling campaigns conducted at the harbor.

The Seismic Refraction data was interpreted using commercial software packages (Geosoft Oasis Montaj, USGS-SIP, Optim SeisOpt@2D). Experienced geophysicists identified feature responses within the data and generated the cross-sections and coded maps seen in Figures 3 through 7. When it was necessary to improve feature recognition capabilities, the geophysical data was intensively analyzed with mathematical processes, included filtering as well as other data enhancement operations.

Geosoft Oasis Montaj (Montaj) V 5.06, a data processing and analysis (DPA) system for earth science applications, was used to produce color coded maps for the project. Montaj was used to integrate the DGPS, bathymetry and bedrock elevation information onto geo-referenced maps. The Rimrock Geophysics software package called “SIP2” (which includes the latest version of the USGS SIP program) was used to do the “first picks” and ray tracing inversion of the seismic data. Optim Software SeisOpt@2D (SeisOpt) V 2.8, which uses a modified “monte-carlo” statistical method called “Simulated

Annealing" to arrive at the best-fit velocity field for the observed first arrivals, was used to complete the processing iterations and arrive at the best-fit model scenarios for the data.

Data interpretation involved repeating many of the initial data processing steps described in Section 2.3.3.2 until the most appropriate best-fit model was generated. For some of the records, the "first breaks" of the seismic records were "re-picked", where the initial "first break" interpretation could be improved, in order to achieve a better-fit model.

Another adjustment that was made during interpretation was the modification of hydrophone layer assignments on the "Time vs. Distance" plots (examples are included in Appendix B), which were created using the SIP program. These layer assignments form the basis upon which the model calculates seismic velocities that it uses in the production of the resultant depth models. Changing the layer assignments revises the morphology of the model, both shape and depth of interface. After numerous iterations, it was determined for this data set that the most accurate models required that all of the sections be generated using a two layer case when running the SIP program. Three layer models were attempted for some spreads to see if additional layers (such as the organics) could be resolved from the other overburden; however, it appears that the other layers are either not thick enough or of insufficient velocity difference from the surrounding material to be resolved by the SIP program.

In order to identify and characterize areas within the bedrock containing lateral (seismic wave) velocity changes, the SIP2 seismic results were re-processed using the SeisOpt software. Velocities were assigned to individual subsurface "cells" (thousands of cells for each model), resulting in the calculation of a subsurface velocity field. The SeisOpt data reduction runs are used as an additional calibration of the SIP data, and provides for consistency and data variability checks.

The seismic lines with which geophysicists had the most confidence (i.e., contained the most numerous and reliable borings and/or best matched the SeisOpt interpretations) were inverted first (iteratively with the SIP program), until the overall models achieved the "best-fit" given all of the data collected. The "high confidence" SIP modeled lines were then used (along with boring data) to calibrate seismic cross-lines (lines of lower confidence which crossed lines in which the geophysicists had greater confidence in their interpretations). A discussion of the relative confidence levels achieved for the various data is included in Section 4.1.1.

2.4 Data Synthesis

Once all of the data had been interpreted, then the process of synthesizing all of the data sets into one composite interpretation was undertaken. As several data sets were involved (the year 1999 seismic refraction results, the year 2000 seismic refraction results, the year 1999 boring program results, and the year 2000 boring program results, as well as other published geologic data), the synthesis of the data involved the fusion of these multiple data sets. However, a direct merging of the data sets and resulting interpretations was not possible, as the data sets each were considered to have different confidence levels. Therefore, the first step in the data fusion process was to create a tiered hierarchy of the confidence of the data sets. The most weight was placed on the data with which the geophysicists had the highest confidence, less weight was placed on data that the geophysicists felt they did not have as high a confidence.

The process by which confidences were assigned to various data points, and the resulting confidence map (Figure 10) are presented in Section 4.1.1. The data with which geophysicists had the highest confidence became the basis by which the final composite interpretations were made. Other data, having lower confidence factors, were then included in the final interpretations of the data in order to fill in data gaps or to add detail to the interpretations.

In general, the geophysical and bedrock coring data from the year 2000 geophysical and geotechnical programs was considered to be the data with which the geophysicists had the most confidence. These data sets formed the basis of the data fusion. Interpretations of most of the year 1999 seismic refraction data was then considered in the final interpretive models, as was the data from the few cores conducted during the 1999 drilling campaign that encountered good quality bedrock material (had high Rock Quality Designations [RQDs]), and the drilled probes which were thought to have encountered bedrock. Finally, the data in which the geophysicists had the least confidence in (the seismic lines from the year 1999 program which were inconsistent with other data in the area, and the rock core data from the 1999 drilling campaign which exhibited low RQDs, was folded into the composite interpretation of the data).

The synthesis of all the data (geotechnical and geophysical) into a composite interpretation was conducted in an iterative fashion. A basic interpretation was formed from the data with which the geophysicists had the highest confidence. Contour plans of the bedrock surface were generated based upon this high confidence data. These contour plans were then compared to regional geologic maps in an attempt to identify trends in the data which matched with mapped or known trends in the bedrock geology of the area. Slight modifications were then made to the initial interpretations so that the trends resulting from the data were consistent with published information and made sense geologically and geophysically. Then, in an iterative fashion, the lower tier confidence level data was folded into the interpretations. In some cases the data points were added to the interpretive maps one at a time, so that their effect on the overall models and interpretations could be gauged. In some cases, the (lesser confidence level) data did not fit with the interpretations that were developing from the data. In these cases the data was either left out of the final interpretive sections and maps (in the case of suspect borings), or the model was adjusted during the interpretation (overridden dashed lines on Figures 3A through 3E and Figures 4A through 4E) to achieve closure within the model and achieve the best fit.

3.0 RESULTS

The following sections describe the results of the Uniboom and Seismic Refraction Phase I and Phase II field surveys, as well as the results of the data processing and interpretation of the data collected in CDF D, at the Site.

3.1 Uniboom

Reproductions of the Uniboom records from the marine geophysical survey of Area D are included in Appendix A. The records are presented in the form that the equipment generates: time sections of the acoustic response. The records depict the acoustic response of the subsurface to the output signal generated by the instrument. The vertical axis represents time from energy output to waveform receipt in milliseconds, with each "tic-mark" on the record representing approximately 10 milliseconds. The approximate conversion factor used (generally) to convert from time section to depth is approximately 25 feet per 10 millisecond division, and the records in Appendix A that have depth notation were converted using this relation.

In general, the results of the Uniboom survey show that the Uniboom records are characterized by poor signal penetration. This is presumably due to elevated amounts of biogenic "gas" in the sediments, which inhibits the transmission of acoustic energy into the subsurface. In essence, the presence of "gas" in the sediments causes the entire signal output by the system to be reflected up to the water surface, rather than being transmitted deeper into the sediments. The records from the survey are characterized by solid acoustic returns from the upper couple of feet of sediment (above the "gas"), followed by poor or no returns from the deeper sediments. The signal penetration does improve somewhat in areas east of the CDF location, nearer to the Fairhaven shoreline (presumably because there is less biogenic "gas" in the sediments there).

As a result, most of the Uniboom survey data lines collected on the New Bedford side of the harbor (in the CDF area) yielded little useful information concerning the sub-bottom below the surficial few feet. Toward the Fairhaven side of the harbor, where the penetration was slightly better, some of the Uniboom records yielded a small amount of interpretable sub-bottom data. In most cases; however, this data was spotty, and not particularly useful in determining the bedrock profile. Those data profiles in Appendix A that were considered interpretable contain the interpretations that were considered reasonable given the data. On a few of the records where, data at depth was interpretable, the later returns on the records are depicted as a layer surface at depth. In general, the layer was designated as either possible bedrock surface or potentially a former erosional (soil) surface. This is because, even for those records that contained interpretable sub-bottom returns, the returns were not strong enough to enable the interpreter to differentiate a bedrock surface signature from those of a possible relict or former (for instance post-glacial) erosional soil surface.

Because of the relative uncertainties associated with the Uniboom data, the decision was made to conduct a Seismic Refraction survey of the CDF D area. The results of that survey were significantly more definitive than those of the Uniboom survey, and the results of that survey are included in Section 3.2.1. The interpretable portions of the Uniboom data were compared with the results from the Seismic Refraction survey to verify that the Refraction interpretations were consistent with all available data concerning the harbor sub-bottom. The cross-sections and profiles presented in the results section of the Seismic Refraction survey incorporate these cross checks (see Figures 3, 4, and 5).

3.2 Seismic Refraction (Phase I and Phrase II)

After completion of the data gathering from the year 2000 Seismic Refraction program, all of the geophysical data collected for both the Phase I and Phase II geophysics were combined and reprocessed in order to present a single unified interpretation of all of the data. The results of the combined reprocessing are presented in the section below, which describes the composite results of both the 1999 seismic refraction and 2000 seismic refraction programs.

3.2.1 Phase I

Appendix C presents the original Results section from the Phase I (1999) Marine Seismic Refraction Report entitled: "Draft Report of Marine Geophysical Surveys: Uniboom and Seismic Refraction", which was submitted in February of 2000. The reinterpretation of the Phase I data has been incorporated with Phase II data and is described below.

3.2.2 Combined (Phase I and Phase II)

The Seismic Refraction survey was significantly more successful in profiling bedrock characteristics at the Site, particularly in the area of critical interest along the CDF alignment. The advantage of having the sensor array and energy source directly on and in the sediment was apparent in the clear "first breaks" on the seismic records (see example instrument printouts in Appendix B) that were obtained from the areas that had proven difficult with other geophysical methods.

Profiles generated from the data, using the subsurface modeling software packages SIP2 and SeisOpt, indicate that the bedrock character in the area of interest is irregular, marked by undulations of the bedrock surface. The "highs" on the bedrock surface elevation, NGVD 29, noted in the harbor portions of the CDF are once again in the range of –40 feet (-43.1 feet on Line 11). The "lows" in the bedrock topography, noted from the data within the old CDF alignment area, is in the -70-foot range, NGVD 29, (-74 feet on Line 6, 18 feet shallower than the Phase I interpretation). The "lows" in the bedrock topography, noted from the data within the new CDF alignment area, is in the upper -60's, NGVD 29, (-69 feet on Line 23). The two maximum elevation changes within the CDF alignment are a 15-foot elevation change over 50 feet between Lines 20 & 21, and a 16-foot change over 40 feet between Lines 4&5 (Figure 5).

The shallowest bedrock encountered in the seismic data was –33.5 feet on Line 24 at the eastern end of the line. This is within approximately 500 feet of where bedrock outcrops on Marsh Island. The deepest bedrock, at –92.4 feet, is found on Line 14 in the west central part of the line. This deep spot is in the centerline of the probable relict bedrock channel delineated in Figure 9. This elevation difference, from deepest to shallowest bedrock, occurs over a distance of approximately 730 feet.

The results of the seismic refraction portion of this program are best conveyed in the cross sections and surface maps of Figures 3 through 5. The SIP2 inversion model bedrock surface is presented in Figure 3A, B, C, D and E at a scale of 1 inch equals 50 feet with no vertical exaggeration in true elevation NGVD 29. The existing boring results as interpreted from the boring logs are shown along each cross section. The borings that were used, as well as the bedrock (or refusal) elevations and rock cored, are noted in Table 1. This includes the 1999 Geotechnical Drilling Program (FD-1 through FD-51) and the 2000 Geotechnical Drilling Program (FD-101 through FD-116 and BP-D-1 through BP-D-7). Crossing points with other seismic lines are also shown. The bedrock model was calibrated so that the elevation of bedrock, at any given line crossing, is within 5 feet at the intersection point.

SeisOpt velocity model results are presented in Figures 4A, B, C, D & E at a scale of 1 inch equals 50 feet with no vertical exaggeration in true elevation NGVD 29. Since SeisOpt generates a velocity field and

not a "layer cake" model, the bedrock surface is not as immediately apparent to the untrained eye. Therefore, for presentation purposes, the SIP bedrock surface (from Figures 3A B, C, D, & E) is overlain on the SeisOpt interpretation of the profiles (Figures 4A, B, C, D, & E) for reference. The SIP2 and SeisOpt models are generally in good agreement with the overall morphology of the models being extremely similar. There are some areas where the two models do not appear to agree particularly well. This does not mean that the interpretations are incorrect, but rather that there is additional information (i.e., variation in lateral velocity field) that can be interpreted from the SeisOpt models that is not apparent in the SIP models. This additional velocity field information generated by the SeisOpt models is important because it provides additional information on the velocity field in the sediments above the bedrock, which can be a measure of sediment density or type. The relevance of this benefit becomes important when trying to assess the relative difficulty of penetrating sediments with construction objects such as piles or sheeting.

Figure 2 has the position of each hydrophone plotted as a cross with the hydrophone number, in black, posted in the above right position. The final bedrock model elevations are posted, in blue, in the below left position. These are the values, along with selected Geotechnical borings, and some added points (to reinforce trends) that were used to generate the color grid, and contour of the bedrock surface shown in Figure 5. The values posted in green, in the above left position, are the SIP model values that were overridden during data calibration. Most of the areas that were overridden fall within either bedrock low velocity zones (LVZs) or overburden high velocity zones (HVZs). These LVZs and HVZs were identified with the SeisOpt velocity inversion models (Figure 4) the locations of which are shown, in plan view, on Figure 9.

Lines 1&2 (Figure 4A) has a HVZ flanked by two LVZs. The western LVZ in the area where Lines 22 and 23 cross is not expressed in those lines. The data from Line 2 is not of high confidence, so this may just be an artifact of the data quality, but it does fall in the area where a regional fault (probable primary faulted/fractured zone on Figure 9) is thought to exist. The HVZ east of Line 5 could be due to boulders or till in the overburden, it too falls within the area of the regional fault. The LVZ east of the HVZ on Line 2 is in the area of the probable relict bedrock channel (Figure 9).

Line 24 (Figure 4A) also exhibits a similar pattern, with a smaller HVZ where Line 4 crosses, and a LVZ east of that, where the regional fault traces, which is also coincident with the probable relict bedrock channel. FD-34 is right on the centerline of the bedrock channel on Line 24, but it shows bedrock as being much shallower than the SIP model. There is only 11 feet of rock core at FD-34 with RQDs of 60 and 82, so it appears that FD-34 terminated within a boulder.

Line 3 (Figure 4A) has some of the least confident data within the model, yet it still follows the general pattern of the lines around it, with a larger HVZ on the west end of the line, and a LVZ that is on the center line of the probable relict bedrock channel within the regional fault zone.

Line 14 (Figure 4A) maintains a similar pattern with a HVZ on its west end between Lines 23 and 7, with a LVZ to the east within the regional fault zone. The LVZ on the center line of the probable relict bedrock channel is absent, however the SeisOpt and SIP model are in good agreement within the channel area and east to BP-D-3.

Line 15 (Figure 4B) has a LVZ on its western end that is also present in Line 7 (Figure 4D). These LVZs coincide with the possible secondary fault/fractured zone delineated in Figure 9. Line 15 is located further east than Lines 14 and 16, and therefore, did not pick up the HVZ that is present on the west ends of those lines. There is no LVZ associated with the probable relict bedrock channel, but the SeisOpt and SIP models are in excellent agreement.

Table 1

List of Phase I and Phase II Geotecnical Borings, Probes and CPTs

GEOTECHNICAL DRILLING NEW BEDFORD HARBOR

Exploration	Northing	Easting	Bedrock/Refusal Elevation	Rock Cored	Total Expl. Ele.
FD-1	2697618.1	814178	-53.3	10.0	-63.3
FD-2	2697607.5	814288.8	-40.7	0.0	-40.7
FD-3	2697572.5	814475.8	-48	16.3	-64.3
FD-4	2697615.7	814602.1	-51.4	20.0	-71.4
FD-5	2697671.3	814761	-55.5	5.0	-60.5
FD-6	2697527.4	814695.2	-53.4	20.0	-73.4
FD-7	2697361.2	814759.4	-60.3	0.0	-60.3
FD-8	2697223.2	814705.6	-63.5	4.6	-68.1
FD-9	2697056.5	814763.5	-76.2	13.0	-89.2
FD-10	2696917	814709	-51	15.5	-66.5
FD-11	2696789.5	814755.4	-43.6	22.0	-65.6
FD-12	2696647.2	814700	-66.7	10.0	-76.7
FD-13	2696492.9	814749.9	-72.3	10.0	-82.3
FD-18	2696322.5	814282	-67.2	14.9	-82.1
FD-19	2696353.5	814172.2	-51.02	13.0	-64.0
FD-20	2696458	814073.9	-52.88	2.1	-55.0
FD-21	2696526.5	814030.9	-35.6	2.4	-38.0
FD-22	2696654.2	814095.5	-44.22	1.5	-45.7
FD-23	2696825.4	814041.8	-48.08	13.0	-61.1
FD-24	2697050.8	814049.7	-45	2.0	-47.0
FD-25	2697209.8	814043.7	-51.31	2.0	-53.3
FD-26	2697349.6	814116.2	-39.72	3.3	-43.0
FD-27	2697480.4	814091.9	-51.73	12.8	-64.5
FD-28	2697357.3	814553.5	-66	2.8	-68.8
FD-29	2697062.2	814575	-65.7	10.0	-75.7
FD-30	2696533.2	814545.8	-66	4.5	-70.5
FD-31	2697298.2	814345.79	-59.5	11.5	-71.0
FD-32	2696749	814392.8	-62.3	5.1	-67.4
FD-33	2696779.7	814163.2	-58.4	15.0	-73.4
FD-34	2697646.5	814916.5	-47.4	11.6	-59.0
FD-35	2696890.1	814853.7	-60	-0.3	-59.7
FD-36	2696220.5	814914.5	-70.3	1.0	-71.3
FD-50	2697581.9	814307.4	-42.8	14.7	-57.5
FD-51	2697228.5	814725.2	-68.8	18.5	-87.3
OW-D2(s)	2696952.8	813899.7	-17	4.1	-21.1
OW-D2(d)	2696941.5	813898.8	-15	10.3	-25.3
FD-101	2697418.5	814321.3	-40.4	20	-60.4
FD-102	2697476.1	814636.4	-68.1	18	-86.1
FD-103	2697531.1	814770.3	-	N/A	N/A
FD-103a	2697531.3	814767.5	-66.4	15	-81.4
FD-104	2697289.4	814755.9	-67.9	15	-82.9
FD-105	2697206.8	814556.1	-	N/A	N/A
FD-105a	2697202.2	814558.4	-56.6	26	-82.6
FD-106	2696915.7	814510.2	-59.7	19	-78.7
FD-107	2696748.1	814533.6	-56.7	20	-76.7
FD-108	2696631.8	814463.9	-46.5	20	-66.5
FD-109	2696353.2	814480.0	-64.5	25	-89.5
FD-110	2696313.1	814762.6	-65.3	25	-90.3
FD-111	2696247.1	814698.7	-66.2	20	-86.2
FD-112	2696171.4	814570.1	-65.8	19	-84.8
FD-113	2696239.1	814464.0	-59.3	20	-79.3
FD-114	2696166.1	814320.7	-60.3	20	-80.3
FD-115	2696554.5	814649.8	-66.0	15	-81.0
FD-116	2696328.1	814634.7	-59.2	20	-79.2
FM-1	2698553.8	815020.5	-26.8	5	-31.8
FM-2	2698515.5	815070.0	-29.8	NA	NA

Exploration	Northing	Easting	Refusal Elevation
BP-D-1	2697661.6	815001.0	-39.8
BP-D-2	2697682.6	815274.1	-53.1
BP-D-3	2697360.0	815190.0	-62.7
BP-D-4	2697052.7	815006.3	-70.1
BP-D-5	2696822.7	815009.9	-65.4
BP-D-6	2696504.8	814989.6	-68.9
BP-D-7	2696314.3	814992.3	-70.8
CPT-D-1	2697657.0	814391.2	-47.1
CPT-D-2	2697603.4	814495.2	-56.3
CPT-D-3	2697535.2	814612.3	-36.8
CPT-D-4	2697430.2	814715.3	-50.8
CPT-D-5	2697150.9	814733.9	-55.7
CPT-D-6	2697061.6	814780.9	-61.8
CPT-D-7	2696981.8	814706.6	-56.0
CPT-D-8	2696791.4	814700.4	-34.9
CPT-D-9	2696635.3	814803.0	-45.8
CPT-D-10	2696470.1	814758.6	-48.6
CPT-D-11	2696395.1	814708.9	-50.2
CPT-D-12	2696211.8	814790.6	-55.0
CPT-D-13	2696280.3	814620.3	-49.2
CPT-D-14	2696209.2	814524.9	-54.1
CPT-D-15	2696202.9	814392.5	-47.9
CPT-D-16	2696213.2	814266.1	-36.2
CPT-D-17	2696326.1	814295.7	-38.8
CPT-D-18	2697348.1	814639.9	-57.1
CPT-D-19	2697141.6	814571.5	-48.1
CPT-D-20	2696961.8	814581.2	-47.9
CPT-D-21	2696824.3	814463.5	-50.7
CPT-D-22	2696651.6	814573.4	-50.8
CPT-D-23	2696522.1	814418.5	-39.4
CPT-D-24	2696452.4	814525.3	-38.8
CPT-D-25	2696356.4	814424.6	-44.7
CPT-D-26	2696359.0	814277.5	-42.1
CPT-D-27	2696591.4	814304.1	-24.8
CPT-D-28	2696851.2	814306.4	-27.1
CPT-D-29	2697083.1	814335.9	-25.3
CPT-D-30	2696965.8	814216.2	-24.4
CPT-D-31	2697381.7	814459.5	-23.3

Line 16 (Figure 4B) has a HVZ at its western end where Lines 22 and 23 cross. There is a minor LVZ east of that between Lines 21 and 7. The probable relict bedrock channel is broad at Line 16 and coincides with a slight LVZ that is present above the SIP bedrock surface. There is a bedrock LVZ west of this that that is thought to further delineate the trace of the possible secondary faulted/fractured zone. This line has some of the best agreement seen between the SeisOpt and SIP models. It also illustrates the effects of the overburden HVZs, and LVZs, and bedrock LVZs. The SIP model had to be shallowed beneath the overburden HVZ at the west end of the line, the higher the velocity in the overburden (or bedrock for that matter) the further a seismic wave has to travel, per unit time, than it would through a lower velocity material. Since SIP cannot take lateral velocity differences into account, the model is deepened to yield the same travel time (since SIP has assumed a slower, average velocity of the overburden). To the east in the small LVZ the SIP model follows the 9,000 to 10,000 foot per second contour as it does for the rest of the model to the east. The bedrock had to be shallowed again, but this time it was due to slow bedrock, the seismic wave traveled slower through the LVZ so SIP deepened the surface accordingly. Small perturbations in the SIP model can be seen beneath the overburden LVZ, where the SIP model is slightly raised, and below the slight overburden HVZ to the east of that where the SIP model is slightly depressed (see Illustration 2 below).

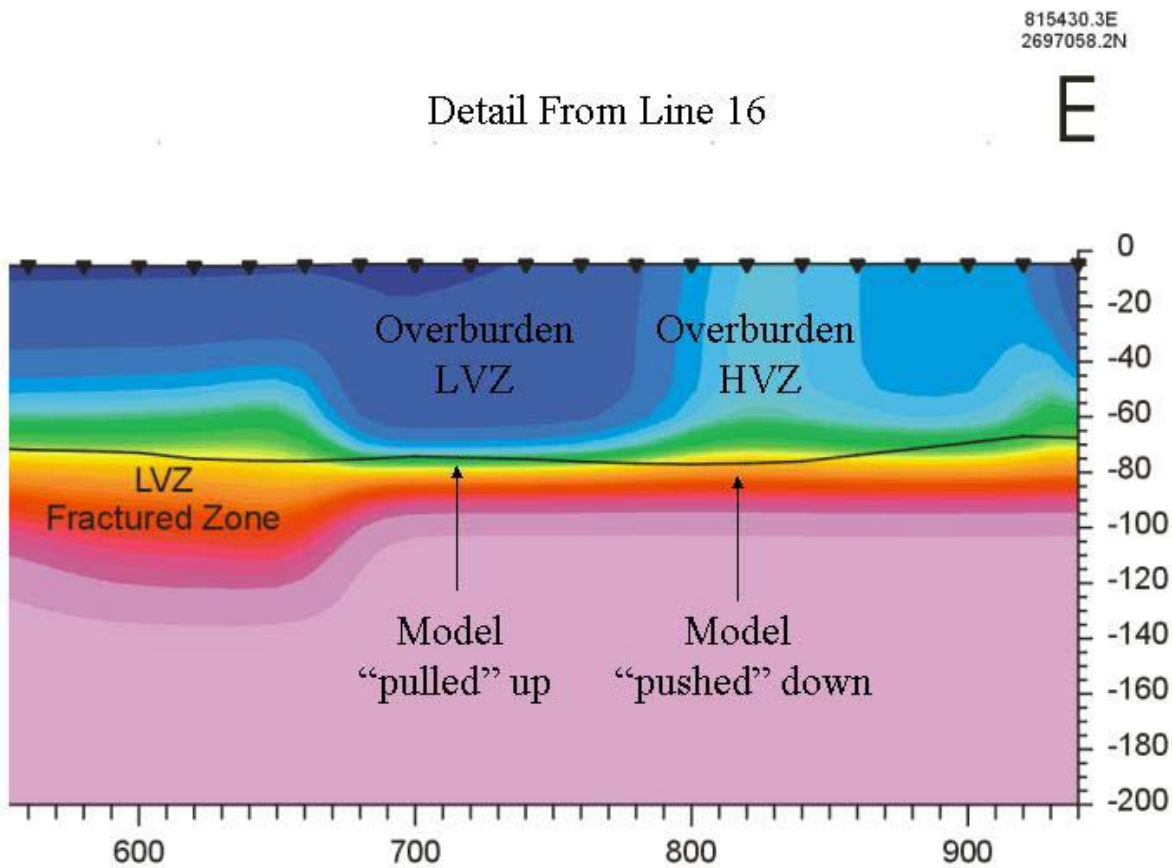

Illustration 2

Detail of SeisOpt Velocity Model From Figure 4B

Line 17 (Figure 4B) has a large LVZ at its western end. The two more closely spaced LVZs at the eastern end of the line, the western one is associated with the probable relict bedrock channel, while the eastern

one is associated with the possible secondary fault/fractured zone at its easternmost expression within this data set.

Line 18 (Figure 4C) has a HVZ at its western end, and a LVZ at its eastern end that is coincident with the probable relict bedrock channel.

Line 19 (Figure 4C) also has a HVZ at its western end, which could just be an edge effect, but it does match the trend from Line 18. There is a minor LVZ that is also expressed at the southern end of Line 9. These LVZs in the southwestern portion of the study area, are part of a larger pattern of LVZs that is delineated on Figure 9 as a probable fractured/weathered bedrock zone.

Line 13 (Figure 4C) has a HVZ from where it crosses Line 20 to the LVZ to the east. Line 13 does not have terribly high confidence, the SeisOpt model and SIP model do not match well.

Line 12 (Figure 4C), which is only 75 feet south of Line 13, has good agreement between the SIP and SeisOpt models, and borings. It would seem that the Line 13 data is just not of as high a quality as Line 12, with only 3 shot points vs. Line 12 with 4.

Line 5 (Figure 4D) has a large LVZ extending from just south of Line 2 to FD-103A. Boring FD-5 shows a large deviation from the SIP2 modeled bedrock surface. Based on these results, and the fact that FD-5 was drilled early on in the Phase I drilling program, it is believed that FD-5 may have been drilled into a boulder or an area of weathered bedrock, and that the boring did not terminate in "fresh" bedrock. This boring is in one of the probable boulders/till above bedrock zones delineated on Figure 9. The interpreted bedrock surface intersects the SeisOpt model (Figure 4D) in the 9,000 feet per second "green" region. The rest of the SIP bedrock surface, for Lines 5, 7, 9, &11 (Figure 4D) intersects the SeisOpt model in higher "yellow to pink" velocity zones (except where there are other LVZs present). There is another minor LVZ that extends from the southern end of Line 5 to south of the intersection of Line 15 (Figure 4B) with Line 7 (Figure 4D). There is a minor edge effect where Lines 7 & 9 meet. Line 9 (Figure 4D) has a broad HVZ that is probably a modeling artifact, although the SIP model is slightly (5 feet) too shallow in the area of FD-11, which supports the presence of a slightly higher velocity in the overburden. There is a small, but well defined, LVZ at the end of Line 9 in the vicinity of FD-13 at the intersection with Line 18 (Figure 4C), that is associated with a LVZ present on Line 18. Line 11 (Figure 4D) has a large LVZ that is not present in Line 10 which is 75 feet to the west of Line 11.

Line 4 (Figure 4D) has what appears to be an edge effect on its north end. The time-distance plot for Line 4 shows offsets (see Illustration 3 below) within the bedrock returns, evidence of the faulting and or fracturing associated with the LVZ at its northern end.

Line 6 (Figure 4D) was shallowed 5 feet at its northern end to match with the bedrock elevation at the Line 14 (Figure 4A) crossing (higher confidence data). There is a LVZ on Line 6 between the crossings with Lines 15 & 16 (Figure 3B). This LVZ is in a probable fractured/weathered bedrock zone (Figure 9). Line 8 (Figure 4D) has a minor edge effect where it meets Line 10. Line 10 (Figure 4D) had a minor "bump" in the SIP model removed to calibrate with FD-111. This bump was caused by a minor HVZ that can be seen in the SeisOpt model in that area.

Line 22 (Figure 4E) has a LVZ at its southern end, at FD-105, that is seen clearly in the SeisOpt model, but the SIP model seems to experience an edge effect, continuing the downward trend that is started in the LVZ. The SiesOpt model does not show such a trend. . The time-distance plot for Line 22 shows offsets (see Illustration 4 below) within the bedrock returns, evidence of the faulting and or fracturing in the area.

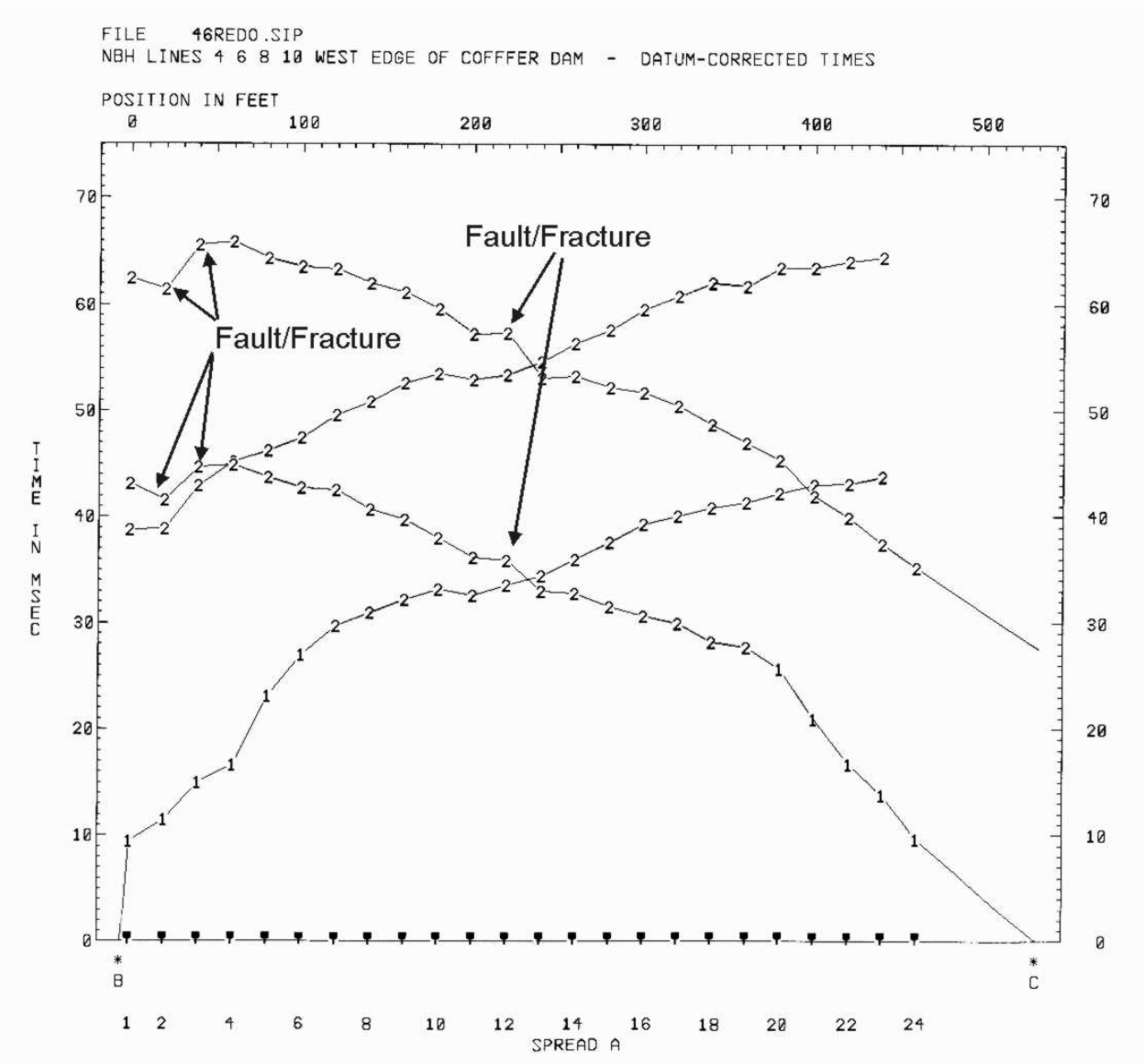

Illustration 3

Line 4 Time-Distance Plot

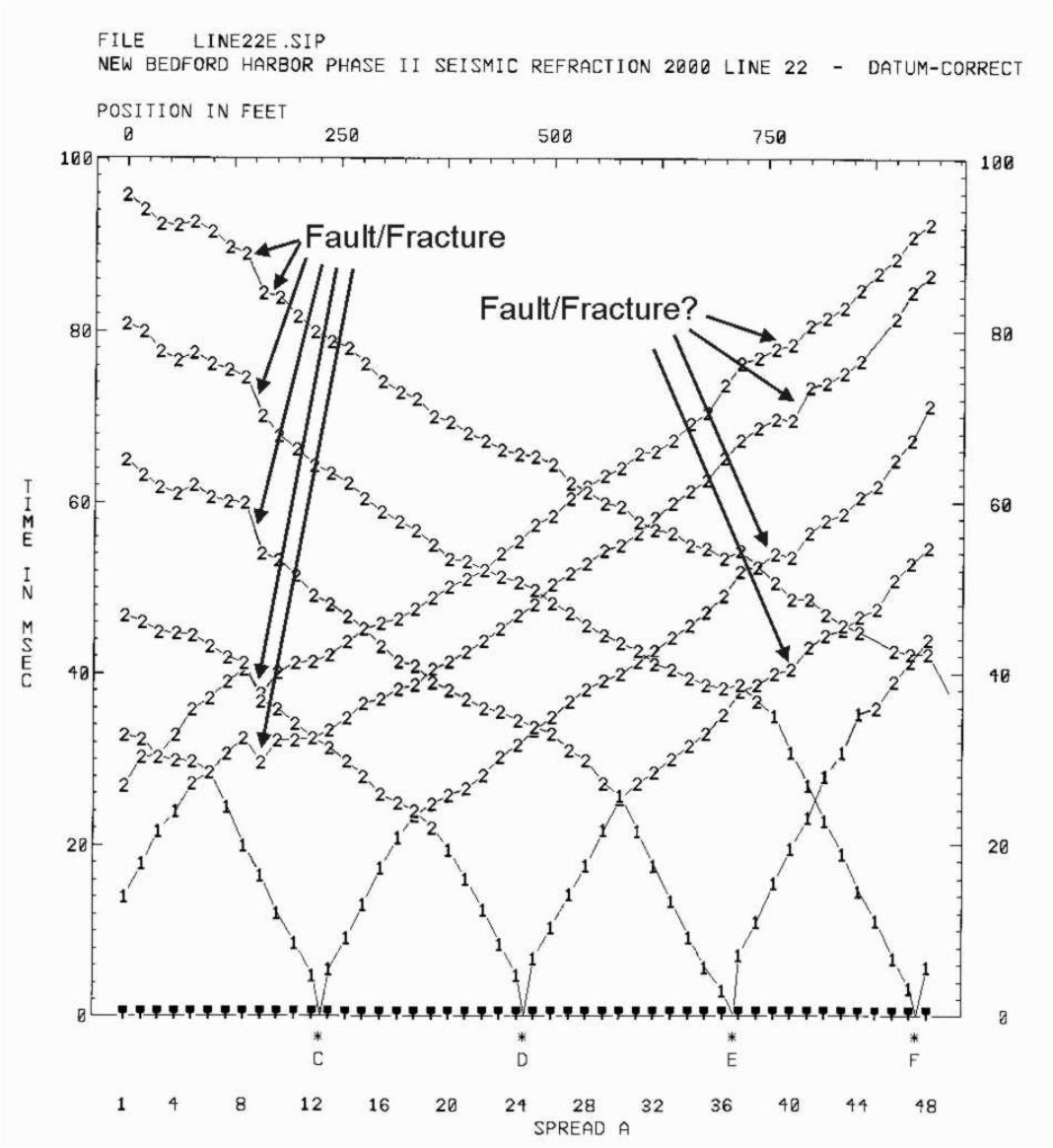

Illustration 4

Line 22 Time-Distance Plot

Line 20 (Figure 4E) had only a few small corrections (10 feet or less) made to the SIP model, one at FD-108, and a second from the intersection of Line 9 north for about 100 feet. The SeisOpt model shows an extremely flat bedrock surface, which supports the removing of these bumps from the SIP model.

Line 23 (Figure 4E) has a HVZ that could just be an artifact of the SeisOpt modeling, but it is in the same area as the HVZ of Line 3, so it might be part of the probable boulders/till above bedrock zone. To the south of this HVZ, the rest of Line 23 and all of Line 21 (Figure 4E) up to the LVZ at its southern end, the data all match well. The LVZ is also evident in the SeisOpt model.

A bedrock NGVD 29 elevation surface map is shown in Figures 5A through 5D at a scale of 1:1200. The SIP2 elevation of bedrock beneath each hydrophone was combined with all the existing boring data from CDF D to generate the bedrock elevation database. This figure illustrates the magnitude and extent of the variation in the bedrock surface.
An additional piece of important information in assessing the character of the bedrock surface that can be obtained from the seismic data is the lateral variation in seismic velocity with depth through the geologic section. As noted above, the seismic velocity (speed at which acoustic waves pass through a medium) is a measure of the properties of the material through which the seismic wave is traveling. Denser, more highly consolidated materials (such as fresh bedrock materials) will have high seismic velocities, whereas looser, unconsolidated materials (such as marine sediments) will have low seismic velocities. Locations within a bedrock material then, that display unusually low seismic velocities (for that type of material) can generally be interpreted as weathered, fractured, or faulted zones. Alternatively, locations within a soil or sediment material that display unusually high seismic velocities (for that type of material) is generally interpreted as denser till material or boulders within the sediment/soil.

One of the best ways to present lateral displays of seismic velocity information is to present color-coded maps which represent the variation in velocity laterally along a surface that is coincident with the bedrock surface. Such a map presents the information necessary to make inferences as to the character of the bedrock surface. Figure 6A (the SeisOpt Velocity Model at the SIP Bedrock Elevation) is a representation of the seismic velocity (as determined through the SeisOpt modeling process) at the inferred bedrock surface elevation. As such, areas that display lower than average velocity (blues and greens on the map), may represent Low Velocity Zones (LVZs) at the bedrock surface. LVZs may be indicative of weathered, fractured, or faulted rock.

Taking the process one step further, similar seismic velocity surface maps were generated at various levels above and below the inferred bedrock surface elevation. Figure 6B and 6C depict the seismic velocity fields at depths of 5-feet and 10-feet below the inferred bedrock surface. These maps present the seismic velocity information at levels within the presumed bedrock. They can be used in conjunction with Figure 4 (the seismic velocity cross sections) to obtain an idea of the three dimensional velocity field within the bedrock, thus indicating areas within the rock that contain weakened, weathered, or fractured zones at depth.

Figure 6D and 6E present the velocity fields at levels 5-feet and 10-feet above the presumed bedrock surface (i.e., up in the sediment above the bedrock). Lateral variations in the seismic velocity in these maps may indicate the presence of differing sediment regimes (such as the presence of a boulder field or till wedge within the sediment column). High Velocity Zones (HVZs) noted on these maps (oranges and reds) may be indicative of the presence of such features within the sediment column. Additionally, consideration of the seismic velocity surface maps on either side of the bedrock surface (above and below) is a measure of how accurate the interpretation of the bedrock surface is. If the seismic velocity surface map above the bedrock surface displays much lower velocities than the velocities noted <u>at</u> the bedrock surface, <u>and</u> the velocity surface map below the bedrock surface displays velocities that are as high or higher than those <u>at</u> the bedrock surface, then it can inferred that the seismic models have

accurately profiled the bedrock surface. Such is the case for the data presented herein. the 5-foot above bedrock velocity surfaces shows a consistently lower seismic velocity than at the bedrock surface. Additionally, the 5-foot below the bedrock velocity field displays consistent velocity values with the bedrock surface velocity surface map. These are both strong indications that the bedrock surface interpreted from the data and presented in Figure 5 are relatively accurate. The composite interpretation generated after reviewing all of the seismic velocity maps and cross sections, is presented in Figure 9.

In order to gain some measure of the depth and consistency of the Low Velocity Zones (LVZs) within the bedrock, the SeisOpt velocity field data was utilized to create "velocity slices" of the data at intervals within the geologic column. SeisOpt velocity slices were generated at 10-foot intervals from elevation -40 to elevation –90 (see Figures 7A through 7F). At the –40 foot level (Figure 7A) , the velocity slices display both low velocities associated with sediment layers in the deep bedrock areas, and high velocities (associated with the bedrock) in shallow bedrock areas. As the slice maps move down to lower depths (through the subsurface), the effects of the bedrock become more pronounced. Low velocity zones in the bedrock begin to become clearer (such as the lower velocities noted in blue on Lines 20 and 22 on Figure 7D). The bottom slice map (Figure 7F, at –90 feet), shows clearly the depth to which some of the larger low velocity zones extend. The green and blue colored patches on seismic lines 3, 17, and 18 indicate that low velocity zones extend to an elevation of –90 feet in those locations. These deep LVZs line up well with an inferred fracture zone that trends roughly northwest-southeast through the study area (see interpretation description below and Figure 9), and are additional evidence that a faulted zone mapped by other investigators (Goldsmith, 1978) on land north of the study area, continues through the study area.

Areas in the sediment column with anomalously high seismic velocities (such as those areas on Figures 4A through 4E which show velocities of approximately 10,000 feet/second or higher [orange to red colored] in the "sediments" above the bedrock surface), may be indicative of areas of higher sediment density (such as a till) or areas containing an unusually large amount of boulders and cobbles.

Additionally, the Seismic Refraction data contains several LVZs. The LVZs are anomalies in the data that occur at locations where the velocity of the energy wave traveling through the bedrock material is reduced, usually because the bedrock is fractured or severely weathered in that zone. LVZs are often indicators of faulted or severely fractured bedrock, and the locations of the LVZs noted in the data during this study are shown on the cross section interpretations in Figures 4A through 4E. While the presence of LVZs in the seismic data may indicate faulting or fracturing in the bedrock, they can also mark locations where the sediments above the bedrock may contain plucked boulders or till, the remnants of glacial processes.

Overall there is much variability in the bedrock surface present in both the SIP2 and SeisOpt models. In general the SIP2 models, which use an average velocity for each layer it models, tend to smooth the bedrock surface somewhat as compared to the SeisOpt models. The SeisOpt model bedrock surface (as shown on Figures 4A through 4E) is interpreted as being within the 9,000 ft/sec "green to yellow" color bar transition zone. The 9,000 ft/sec transition is either a transition from the overburden to weathered bedrock, or a transition into well-consolidated materials such as a till. This transition, however, at 9,000 ft/sec, is generally considered to represent an area of overlap between the velocities of a weathered rock and well consolidated (e.g., till) materials. For this reason, and for this interpretation, it is expected that the 12,000ft/sec transition (marked by a color change from red to pink on the SeisOpt profiles) is most likely the transition into truly competent rock.

3.2.3 Synthesis of Geophysics with Geotech Program

As noted above, the pre-design investigations of the CDF D area included the collection of both geotechnical boring information, and geophysical bedrock topography and character information. The geophysical data from both the Phase I and Phase II Seismic Refraction programs was processed and interpreted in concert with the geotechnical boring information collected from New Bedford Harbor. Wherever possible, seismic line data was compared to boring data in the same area. Where the seismic lines crossed directly over a boring location, the boring data was utilized to calibrate the depth of bedrock models generated as part of the seismic data processing. Borings were generally not used for calibration of seismic models if the boring data was either suspect (i.e., it was possible that the bedrock surface identified on the boring log was either a boulder or a highly weathered or fractured zone), or if the boring were located some distance from the seismic line (for this project borings located more than approximately 40-feet from a seismic line were not used in the calibration of that seismic line). In cases where borings with good bedrock information were located off of seismic lines, the depth of bedrock information from the boring was included in the bedrock surface (bedrock surface topography) model generated from all of the geophysical and geotechnical data gathered as part of the project.

Interpretation of both the geophysical data and the geotechnical data was significantly enhanced by gathering and processing the two data streams in concert. The interpretation of the seismic data was significantly enhanced through a direct comparison of that data with the geotechnical boring data, and vice versa. The geotechnical drilling campaign for the Phase II data gathering was conducted after the Phase II geophysical data was collected and initially processed. The geophysical data was then utilized to identify areas where additional geotechnical drilling data would be most effective, and the borings were located (in large measure) based upon the geophysical information. The borings were placed in areas where either the geophysical data indicated that bedrock surface conditions were unusual, or in data gap areas where the inclusion of definitive bedrock information from cored bedrock borings would significantly enhance the interpretations of either the seismic models or the bedrock surface elevation model, or both. The following paragraphs discuss the results of the geophysical program and the geotechnical boring program, focusing on areas where the interpretation of one technique benefited from information gained from the other technique.

Throughout the area investigated, geotechnical borings which reliably indicated the top of bedrock were utilized to calibrate the bedrock surface on the seismic lines. Only those borings in which confirmatory bedrock cores were collected, and in which the confirmatory cores appeared to accurately identify the bedrock surface, were utilized by the geophysical modelers in the calibration of the elevation of bedrock surface. The following borings were considered to project accurate assessments of the bedrock surface, and were utilized in the calibration of the following seismic lines (see also Figures 4A through 4E):

- Seismic Lines 1 & 2 = boring FD-50;
- Seismic Line 3 = borings FD- 6 and FD-113;
- Seismic Lines 4, 6, 8, & 10 = borings FD-6, FD-51, FD-115 and FD-111;
- Seismic Lines 5, 7, 9 & 11 = borings FD-103A, FD-104 and FD-110;
- Seismic Line 12 = borings FD-112 and FD-114;
- Seismic Line 13 = borings FD-111 and FD-113;
- Seismic Line 15 = boring FD-51;
- Seismic Line 16 = borings FD-9 and FD-29;
- Seismic Line 18 = borings FD-13 and FD-115;
- Seismic Line 19 = borings FD-110 and FD-116;
- Seismic Lines 20 & 22 = borings FD-4, FD-105, FD-106 and FD-108; and
- Seismic Lines 21 & 23 = borings FD-29, FD-102, FD-107, FD-109 and FD-113.

In particular, borings FD-109, through FD-113, and FD-101, FD-3, FD-4, FD-9, and FD-11 were considered to have significantly increased the accuracy of the seismic models, as bedrock cores from these borings were of excellent quality, and the seismic models were significantly modified after calibration to these borings.

The calibrated seismic lines and geotechnical borings having "good quality" bedrock surface information were incorporated into a single interpretation of the bedrock surface (see Figures 5A through 5D). The bedrock surface elevation was created by incorporating lines of bedrock elevation data (along the seismic lines) with spot elevation data (from the borings (listed above) which were considered to have good representations of the elevation of the bedrock surface), and gridding and contouring the resulting merged data set. Correlation of the two data sets was good over most of the study area. In the areas shown as dark blue on Figures 5A through 5D, both the seismic line data and the geotechnical boring information indicated that a channel exists in the surface of the bedrock. Likewise, in the areas shown as orange, red and pink on Figures 5A through 5D, both the seismic line data and the geotechnical boring information indicated that ridges or scarps exist on the surface of the bedrock.

In addition to using the boring information to calibrate the seismic lines and the bedrock surface plans, the boring information was utilized to correlate areas of potential fracture zones and potential boulder fields (in the unconsolidated deposits above bedrock). Rock cores from the geotechnical borings that displayed significant fracturing were correlated with LVZs on the seismic lines. Utilizing the Geographic Imaging System (GIS) technology *"3-D Vis"*, three dimensional diagrams depicting the Rock Quality Designations (RQDs) for the bedrock cores collected from the study area as part of the geotechnical drilling programs were generated. Illustration 5 (below) depicts the RQD pattern as determined from the bedrock cores drilled within the study area.

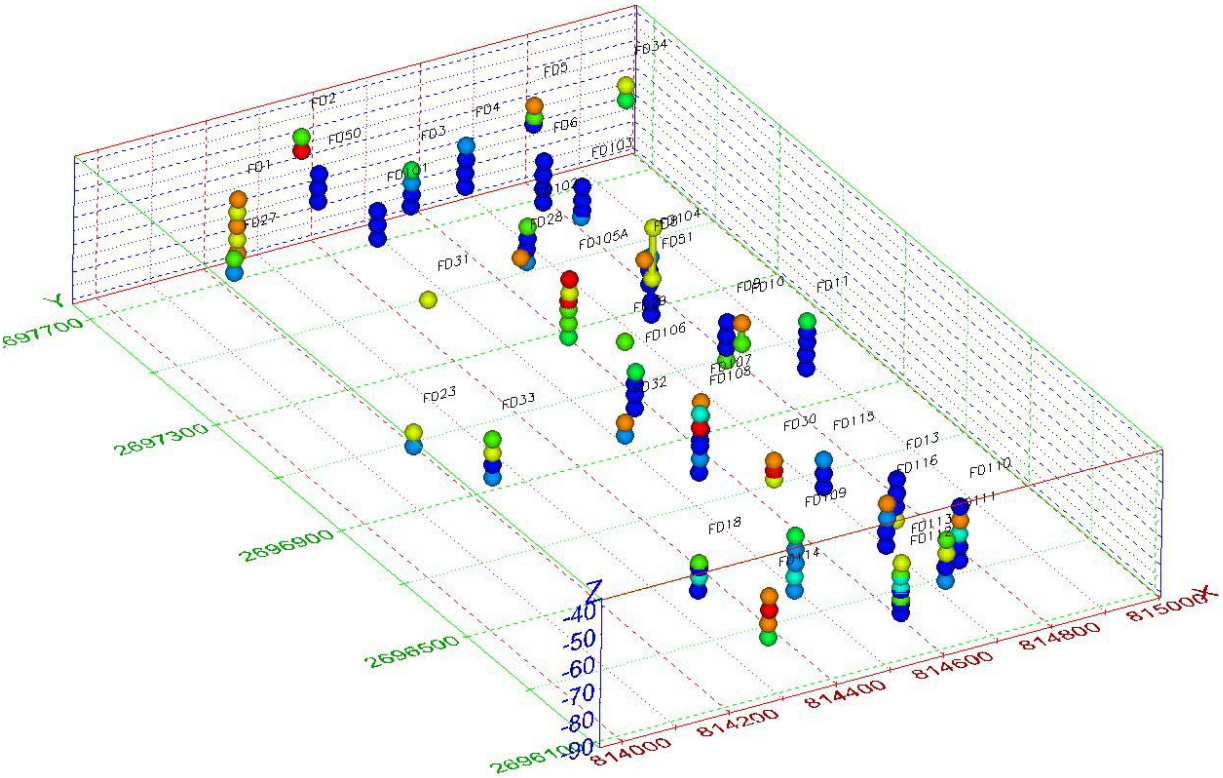

Illustration 5

3-D Vis Model of Geotechnical Borings RQDs

On the illustration, the blue colors represent the highest RQD (better than 69%), the greens to yellows depict a slightly lower RQD (between 69% and 65%), the orange, an even lower RQD (between 65% and 35%), and the lowest RQD (less than 35%) is shown as red spheres. Slices cut through the GIS model (see Illustration 6 below), clearly show the patterns of low RQD within the study area.

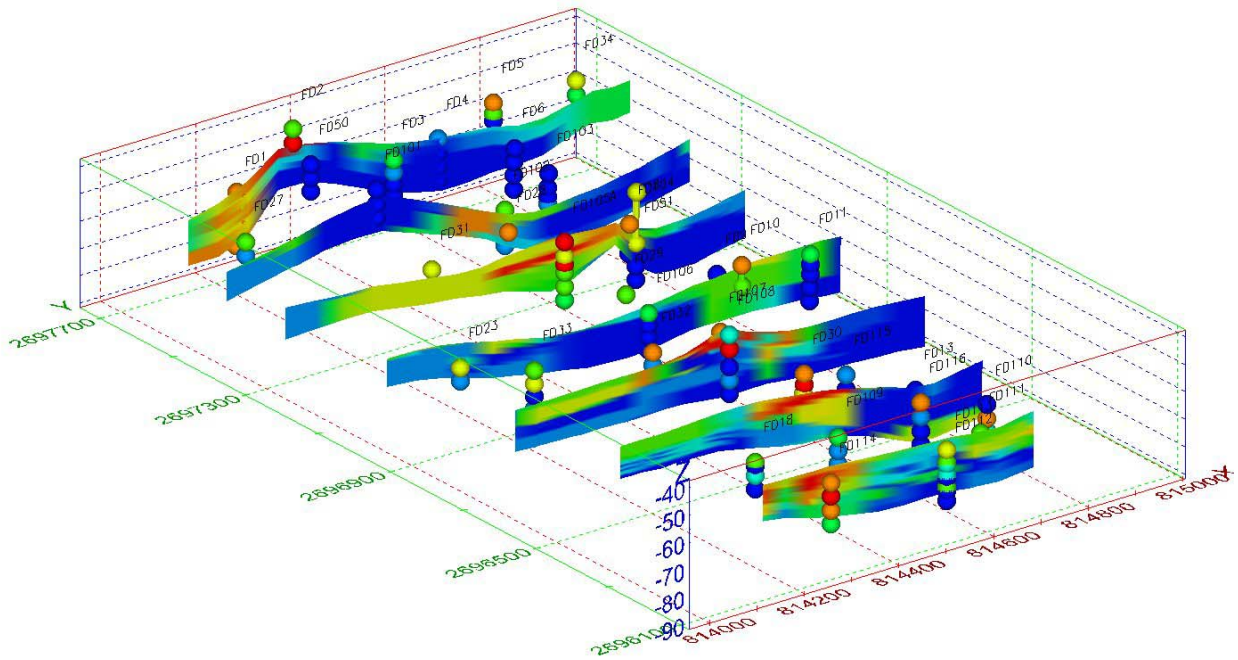

Illustration 6

Slices Through the 3-D Vis Model of Geotechnical Borings RQDs

From cross-sectional slice plans such as these, the low (orange and red) RQD areas were identified, and RQD trends in the bedrock were noted and compared with the results of the seismic refraction data. In many instances, bedrock core information indicated that heavily fractured and jointed rock correlated directly with areas on the seismic lines which indicated that LVZs existed in the bedrock. Examples of borings and seismic lines where fractured rock could be correlated with LVZs are listed in the following bullets:

- LVZs on Seismic Lines 4, 6, 8 & 10 = borings FD-51 and FD-111;
- LVZ on Seismic Lines 5, 7, 9 & 11 = boring FD-5, where core barrel drops in the boring correlate with a significant LVZ in the seismic data;
- LVZs on Seismic Lines 5, 7, 9 & 11 = borings FD-13 and FD-104;
- LVZ on Seismic Line 15 = boring FD-51;
- LVZ on Seismic Line 18 = boring FD-115;
- LVZ on Seismic Line 19 = boring FD-116;
- LVZ on Seismic Lines 20 & 22 = boring FD-105; and
- LVZ on Seismic Lines 21 & 23 = boring FD-109.

Additionally, once the boring data and seismic line data showing fractured rock locations and low seismic velocity zones were plotted on maps of the study area, fracture patterns in the bedrock began to emerge. Figure 9 (Interpretation Map) shows areas where fractured bedrock and low velocity zones line up with

probable geologic features such as faults and fractured bedrock areas. The most obvious of these features (shown on Figure 9) are a primary fractured/faulted zone which runs north-south through the study area, and a possible secondary faulted fracture zone, which likely represents a local fault zone. The synergy between the seismic data and the boring data is shown most dramatically in relation to this later feature, where extremely fractured rock in borings FD-1, FD-28, and FD-51 line up extremely well with LVZs on seismic lines 22, 6, 7, 16, and 17, indicating the presence of a faulted zone. Additionally, this feature also lines up extremely well with a shift in the regional trend identified in the bedrock topography (the shift in the bedrock channel that occurs between seismic lines 14 and 16). This is further evidence that a faulted feature exists in the bedrock trending roughly northwest-southeast across the area of interest. In the southern portion of the study area, a number of borings displayed fractured and faulted structures as well, which correlated with LVZs on seismic lines 9, 18, 19, 20, and 21. The pattern of these fractured rock borings and LVZs do not appear to form a lineation, and may be related more to local fracturing due to folding in the bedrock structure rather than faults or linear fracture zones noted in other portions of the study area.

Correlation of HVZs with borings where boulders or till material were encountered in the overburden above the bedrock was also conducted. Again, good correlation was found in a number of areas. These areas are indicated on the Interpretation Map (Figure 9) by light blue dashed outlines. The following bullets list the seismic lines HVZs and the corresponding boulder or till identifications from the boring data:

- HVZs on Seismic Lines 2, 3, 5, 6, 7, 22, and 23 = borings FD-5, FD-104, and FD-105; and
- HVZs on Seismic Line 20 = borings FD-106, FD-18, and FD-114.

There are a few places in within the study area where the seismic information and the boring information do not match. Shown on Figure 10 (the Confidence Map) as low confidence areas, these zones represent locations where the interpretations presented are of lower confidence than in other portions of the map. One such area is located near the northern end of the study area, where portions of seismic lines 3 and 24 do not agree well with the boring information gathered from boring FD-34.

4.0 CONCLUSIONS

Marine geophysical investigations were conducted in the CDF D area of New Bedford Harbor as part of the pre-design and design activities being undertaken in support of the design of the Confined Disposal Facility (CDF D) in the middle portion of New Bedford Harbor. Uniboom sub-bottom profiler data was collected initially in an attempt to obtain detailed stratigraphic and bedrock information within the study area of interest. Due to the interfering effects of biogenic "gas" pockets in the organic sediments of the harbor bottom in the study area, the Uniboom data was only marginally successful in meeting the necessary objectives. Seismic Refraction surveying was commenced in the study area after it was determined that the Uniboom data would not yield all of the information necessary to support the design effort. Two successive mobilizations (fall of 1999 and summer of 2000) were undertaken in the collection of the necessary seismic refraction information. The seismic data collected was significantly more successful in characterizing the bedrock surface below the critical portions of the CDF D project area than was the Uniboom method. The seismic data was augmented by two geotechnical drilling programs (summer 1999 and fall 2000). The information gained form the geotechnical drilling program was used to calibrate the data profiles generated from the seismic refraction data, and the seismic data was utilized in the selection of boring locations and to assist in the interpretation of the geotechnical drilling information.

The following sections present conclusions generated from the results of all of the data streams noted above. Conclusions centered around the geophysical data only are presented in Section 4.1 (Geophysics Program) below. Section 4.2 (The Big Picture) presents conclusions and interpretations (for the CDF D study area) synthesized from all of the data sources collected for the area. It should be noted that this synthesis of information is based upon the data available at the present time, and the appropriate level of care should be exercised in utilizing the synthesized interpretation for specific information needs.

4.1 Geophysics Program

Foster Wheeler conducted a focused multi-phase geophysical survey of a portion of the Lower Harbor at New Bedford Harbor, Massachusetts. The survey was conducted in and around the CDF D cell, adjacent to several properties along the banks of the harbor. Two geophysical survey instruments were utilized: a Uniboom seismic reflection profiling system; and a Seismic Refraction exploration seismograph system. Both systems were deployed in an attempt to obtain information on the bedrock surface within the area anticipated to contain CDF D. The following issues were relevant to the data collection and interpretation for this survey:

- These techniques were undertaken because previous geophysical methods had been attempted, and while useful for other purposes, were not particularly successful in achieving the desired result for the particular geotechnical design parameters required;
- Biogenic gas in the sediment (remnants of decaying organic matter), precluded other methods from successful implementation for bedrock profiling. This survey was designed in an attempt to overcome the "gas" issue;
- Vibrational background "noise" (from the fishing fleet and on-land machinery working adjacent to the harbor) was common at the south end of the survey area, complicating the data processing and interpretations rendered in that area; and
- The large amount of derelict vessels and other debris in the water adjacent to the former Herman Mellville Shipyard hampered data collection activities in that area.

Both the Uniboom and Seismic Refraction surveys were undertaken to collect necessary information in an area that is hostile to geophysical surveying (i.e., contains sediments with biogenic "gas" which inhibits signal penetration). The Uniboom system, which utilizes in-water sensors and an in-water source towed behind a vessel, had limited success. The Seismic Refraction system, however; with on-bottom sensors and in-bottom source generation, was significantly more successful at generating usable data.

Uniboom

Even with the power source turned to maximum, and pulsing at optimum frequencies, the amount of energy that penetrated into the subsurface using the Uniboom system was not sufficient to produce clear images of the bedrock surface. Some images of the bedrock were obtained, but mostly in areas east of the CDF wall where the information was not as critical. Much of the Uniboom data collected within the actual CDF D walls was obscured by impenetrable gas pockets within the organic sediments. Therefore, the Uniboom information was less useful than the Seismic Refraction data in terms of profiling bedrock character within the critical areas of the site (within the CDF D facility).

Seismic Refraction (Phase I and Phase II)

Appendix D presents the original Seismic Refraction Conclusions section from the Phase I (1999) Marine Seismic Refraction Report entitled: "Draft Report of Marine Geophysical Surveys: Uniboom and Seismic Refraction", which was submitted in February of 2000. The reinterpretation of the Phase I data has been incorporated with Phase II data and is described below.

The Phase I seismic program had been focussed on collecting data along the outer wall of the conceptual CDF. The Phase II data was collected in order to assess the bedrock beneath a modified outer CDF wall alignment (further to the west than the Phase I alignment), and to assess the bedrock elevation beneath the area to the east of the CDF where potential dredging for a channel may be required. The results of the Phase II Seismic Refraction program significantly improved the interpretations of the bedrock surface, both in areas where Phase I data had been collected, and in areas where data gaps had existed. This was in part due to the added density of seismic data afforded by including the Phase II data with the Phase I data, and in part due to the fact that the Phase II data was afforded more accurate calibration through the inclusion of the Phase II geotechnical boring information. The final results of the combined seismic program indicate that the Phase II seismic data filled in several critical data gaps.

Profiles generated from the data using subsurface modeling software indicate that the bedrock character in the area of interest is irregular, marked by undulations of the bedrock surface. The "highs" on the bedrock surface noted in the study area are approximately at elevation -33 feet (NGVD29). The lowest elevation in the modeled bedrock surface is approximately at elevation -92 feet (NGVD29). In some places the bedrock surface elevation varies, by as much as 16 feet of elevation change over 40 feet of lateral change (or approximately a 40% slope), indicating that there are some fairly sharp bedrock topographic variation in the area.

The Phase II seismic data was also very useful in clarifying the location and orientations of the "Low Velocity Zones" (LVZs) detected at the site. These anomalies in the data occur at locations where the velocity of the energy wave traveling through the bedrock material is reduced, usually because the bedrock is fractured or severely weathered in that zone. LVZs are often indicators of faulted or severely fractured bedrock, and the locations of the LVZs noted in the data during this study are shown on the cross section interpretations in Figures 3A through E and 4A through E. Correlation of the LVZs detected in the data with low RQD information from the boring program resulted in a composite interpretation which suggested of the location of several fracture and fault zones within the study area (see Figure 9). While the presence of LVZs in the seismic data may indicate faulting or fracturing in the

bedrock, High Velocity Zones (HVZs) noted in the seismic data at several locations within the study area in the sediment above the bedrock surface probably indicate areas where boulders or dense till materials may exist in the subsurface above the bedrock.. It appears that such a phenomenon may be occurring in the northeastern corner of the CDF (along Seismic Line 5), where boring information and seismic information are not consistent, and it is likely that the boring encountered highly brecciated and weathered rock or boulders, whereas the Seismic data denotes the "fresher" bedrock surface. The HVZs in the overburden were interpreted from the cross sections of Figures 4A through 4E and are shown in plan view on Figure 9.

In addition to processing the Seismic Refraction data with standard reduction programs, the data was run through an advanced program (SeisOpt), which analyzes the seismic wave velocity field in the subsurface using a "monte-carlo" approach (Figures 4A through 4E). This was conducted in order to: 1) provide additional information on lateral velocity changes in the bedrock so that better "SIP" computer models of the bedrock surface could be generated; and 2) to provide information on the velocity field in the sediments above the bedrock, which can be a measure of sediment density or type. The relevance of the latter can become important when trying to assess the relative difficulty of penetrating sediments with construction objects such as piles or sheeting. Areas in the sediment column with anomalously high seismic velocities (such as those areas on Figure 4 which show velocities of approximately 10,000 feet/second or higher [orange colored] in the "sediments" above the bedrock surface), may be indicative of areas of higher sediment density (such as a till) or areas containing an unusually large amount of boulders and cobbles.

4.1.1 Data Confidence Levels

As can be expected when multiple types of data are collected during various field campaigns under differing and sometimes onerous situations, not all of the data presented in this report is presented with the same degree of confidence. However, it was thought that all of the data collected during the multiple geophysical campaigns conducted at New Bedford Harbor should be presented in this report; partially for completeness, and in order to ensure that the most appropriate and complete interpretations were made. The following paragraphs describe the various confidence levels that were generated by the geophysicists interpreting the data.

The data was divided into three confidence levels: that data which the geophysicists felt they had the highest degree of confidence; data with which the geophysicists felt they had a moderate (or medium) level of confidence; and that data which the geophysicists considered to be of relatively lower quality.

The relative confidence levels of the various data points were then superimposed on the map of the area of interest, resulting in a data confidence plan (Figure 10) of the survey area. The purpose of the confidence map is to provide future decision-makers with a relative measure of the confidence with which interpretations can be made based upon the data collected to date. It should be noted that in general, a higher degree of confidence was assigned to places where data was collected, and lower confidence levels were presented in areas where data was not collected.

The first step in producing such a map was defining the various terms that were to be used to differentiate the data levels. The following bullets provide a basis of definition for the three confidence levels designated and depicted on the confidence map (Figure 10):

1. **High Confidence**: was designated for data regions on the map where:

    - Interpretations from various data sets all match (i.e., data points from different sources resolve to the same interpretation);

- There is a fairly high degree of confidence in the accuracy of the seismic data and the boring data (i.e., the geophysicists are fairly comfortable with the results of the seismic and the boring data); and
- There is a reasonable density of data (i.e., the data is spaced closely enough that lateral variations in the data are thought to have little effect on the overall interpretations rendered).

2. **Moderate Confidence:** was designated for data regions on the map where:

   - Multiple interpretations from different data sets did not match, but were within approximately 10 feet;
   - There was a fairly high level of confidence from one data set but a lower level of confidence in another data set in the same area (i.e., areas where the level of confidence of the seismic data was not as good as in other areas, but that the interpretations rendered based upon the boring data were considered fairly accurate, or vice versa); and
   - The data density was not as closely spaced as for the high confidence, and the interpretations based upon data spaced thusly could not be considered with extremely high confidence.

3. **Low Confidence:** was designated for data regions on the map where:

   - Multiple interpretations from different data sets did not match up well (and were not within 10-feet);
   - Both the interpretations rendered from the seismic data and the boring data was considered to be questionable;
   - There was no data or very sparse data; and
   - Edge effects were evident (i.e., areas at the edges of data collection lines where computer models begin to have difficulty because mathematical routines such as moving averages suddenly run out of data to calculate, and begin to project trends that have no basis on reality).

As is evident from the above listed definitions, the selection of the data confidence regions on the map is somewhat relative. It should be noted that there is now a considerably higher degree of confidence in the overall interpretation of the character of the bedrock beneath the harbor than prior to these investigations. It should also be noted that by the nature of interpretive techniques and the relative accuracy of computer models, there is a higher degree of confidence associated with the data in the center of the study area than there is with data collected from around the edges of the study area.

4.2 The Big Picture

The discussions presented above have thus far concentrated upon providing interpretations of the data sets collected within the study area during the previous two field seasons. The following paragraphs attempt to present the results of the geotechnical and geophysical investigations conducted at CDF D within the context of the larger geological setting of New Bedford Harbor. This section represents a synthesis of all of the information collected and presented as part of this program, coupled with the available historical geologic information and interpretive insights obtainable. The interpretations presented are summarized

on Figure 9 (the Interpretation Map). The interpretations presented should be assessed in relation to the Confidence Map provided as Figure 10, and decisions made based upon any interpretations rendered herein should be tempered with the relative amount of certainty as implied by Figure 10.

An overall assessment of the bedrock surface topography is presented in Figures 4A-E and 5A-D. The results of the geotechnical and geophysical investigations are generally consistent with the findings of regional geological investigators (Zen, et. al., 1978), with a few unexpected surprises. The geologic map of the area indicates that the geologic setting in the vicinity of the study area is dominated by a Gneissic terrane. The literature makes frequent reference to the fact that the New Bedford Harbor region experienced both glacial, fluvial, and marine influences from the period known as the Pleistocene (glacial period) until the present. The bedrock geology is characterized by several large fold structures that have been mapped in the vicinity of the study area, having relatively symmetrical synclinal limbs and east-west to northeast-southwest trending axes. According to the Geologic Map of Massachusetts (Zen, 1978), the study area lies between two such fold structures: one just to the north with its axis at the headwaters of the Harbor near the Acushnet-Fairhaven boundary; and one to the south with its axis trending from the southernmost tip of New Bedford toward South Dartmouth. The study area at CDF D lies in a zone of granitic gneiss that lies between the two folds, but primarily along the outermost limb of the more southerly of the two folds in the region. The Geologic Map (Zen, 1978) also depicts regional faults that run through the area. One of the regional faults mapped in the area appears to trend through the study area. This fault is mapped as a north-south trending fault extending from East Freetown (to the north of Acushnet) down to and into New Bedford Harbor (with its trend coinciding with the shape of the harbor from approximately the Middle Harbor southward).

The geologic inferences presented in the literature, and noted above, are supported by the geotechnical and geophysical information collected as part of this program. The bedrock surface topography, as modeled from the seismic line and geotechnical boring data, shows great evidence of the glacial and post-glacial fluvial/marine period that predates the current period of marine induration. Looking at the contour map of the bedrock surface elevation (Figures 5), the feature that is most immediately recognizable is the "relict" channel cut in the bedrock (indicated by blue colors on the contour plan). This lineal feature is approximately 150 to 300 feet wide and runs through the study area from north to south between 150 and 600 feet to the east of the current dredged channel in the floor of New Bedford Harbor. At its deepest point, the bedrock channel may extend down to as low as elevation –92 feet. This relict channel likely developed as part of the preglacial drainage pattern in the area, or as a result of syn- or post-glacial meltwater action, and was probably scoured by high energy stream action, which cut through the tough granitic gneiss found in the area by following weaknesses in the rock (faults and fracture zones).

The seismic and boring information obtained from the study area strongly supports this inference, as fractured rock and low velocity zones are noted in rock cores and on seismic data in patterns that coincide with the overall trend of the relict channel. The presence of a broad fault zone (depicted on Figure 9 as yellow-colored zone) mapped as running through the study area, is supported by the pattern of low velocity zones and fractured bedrock found on seismic lines and in bedrock cores within the study area. This north-south trending fault zone probably defined the location of the bedrock channel that runs through the area, and ultimately led to the shape of the entire harbor. One feature of the inferred bedrock channel that is interesting is an east-west "jog" in the trend of the channel. At approximately even with the south side of Marsh Island, the detected bedrock channel (inferred from the data collected during this investigation) has an east-west "jog" in its trend that "offsets" the north-south trend by approximately 400-feet. The trend of this "offset" appears to line up well with low velocity zones identified in the seismic refraction data, and with highly fractured rock cores collected during the geotechnical drilling campaigns, all evidence that a secondary fault (one having a roughly west-northwest by east-southeast trend) exists in the area. This inferred secondary fault is depicted on Figure 9 as a dashed line.

In addition to the two large fractured/faulted trends noted above, the bedrock in the vicinity of both the south end and north of the study area, appears to contain numerous fractures. Low velocity zones noted in the seismic data are mapped as magenta ovals on Figure 9. Fractured bedrock is also found in cores from the area. A cluster of these LVZs and fractured rock at the north end and the south end of the study probably represent fractured rock areas, which may relate to the regional structural content of the area. These features may represent strain relief fractures that formed in response to the severe folding that occurred in the region.

In addition to the two large fractured/faulted trends noted above, the bedrock in the vicinity of both the south end and north of the study area, appears to contain numerous fractures. Low velocity zones noted in the seismic data are mapped as magenta ovals on Figure 9. Fractured bedrock is also found in cores from the area. A cluster of these LVZs and fractured rock at the north end and the south end of the study probably represent fractured rock areas which may relate to the regional structural content of the area. These features may represent strain relief fractures that formed in response to the severe folding that occurred in the region.

In addition to the channel identified in the bedrock surface, the seismic and geotechnical boring data collected as part of this program indicates that the former channel was bounded on either side by steep-sided bedrock scarps and mounds, which overlooked the central river channel. The highest bedrock elevation identified within the study area is located along the top of these scarps near the eastern and western study area borders (at the very edges of the harbor), and is found at around –33.5 feet. The bedrock topographic map of the study area, generated from the seismic refraction and geotechnical boring information collected as part of this program, also suggests that several east-west trending minor channels which fed into the main north-south channel, were cut into the bedrock bottom of the harbor. The secondary channels appear as green to light blue linear blobs on the color contour plan of the bedrock topography of New Bedford (see Figures 5). These channels most likely fed post-glacial melt-waters from the highlands surrounding the harbor into the main river channel prior to marine induration of the area.

Several areas were noted as containing boulders or a cobbley till in the deeper portions of the unconsolidated overburden, just above the bedrock surface (see Figure 9). Several of the boulders identified were quite large, ranging up to 5 or 6 feet in diameter as determined from the boring data. The boulders noted in several of the geotechnical borings were also located within areas noted HVZs on the seismic refraction data (identified on Figure 9 as gray ovals). These HVZs are interpreted as being indicative of either dense glacial till deposits or groupings of boulders in the subsurface (i.e., "boulder fields").

In summary, the data gathered as part of this program was intended to provide detailed information on the character of the bedrock within the study area (CDF D area). Both the geotechnical and geophysical data collected enhanced existing ideas as to the general geologic structure and bedrock character within the study area. Major features such as a channel cut into the bedrock surface, and one major and one minor fault/fracture zone, were identified as part of this effort. A contour plan of the bedrock surface was prepared utilizing the calibrated seismic refraction data supplemented by geotechnical drilling data. The bedrock elevation surface plan shows the variations in the bedrock surface that can be expected within the study area, and will prove very useful to anyone designing structures which require a knowledge of the elevation and character of the bedrock surface.

5.0 LIMITATIONS

The following limitations apply to all geophysical surveys conducted by Foster Wheeler Environmental Corporation it's subsidiaries and subcontractors. Every attempt has been made to conduct this survey to maximize the quality of the data collected and the interpretations rendered. However, a geophysical investigation is an indirect method of subsurface exploration whereby subsurface characteristics are inferred or interpreted from measurements collected at the ground or water surface. Many variables may affect these measurements. Due to the indirect, interpretive nature of geophysics, findings are generally considered precursory and subject to verification by more direct methods of investigation such as test borings or test pits. The following limitations are considered when evaluating geophysical data:

1. Subsurface features can be interpreted from the appropriate geophysical methods only insofar as they produce a discernible geophysical signature. They must have adequate homogeneity, size, and appropriate physical or chemical properties sufficient to contrast with the surrounding medium and be within reasonable proximity to the sensors. Additionally, their signature must be distinguishable from and not masked by background noise or interference.

2. Lithologic data inferred on the basis of geophysical data nay not be identical to geologic or hydrogeologic data. Lithologies are generally interpreted from some geophysical signature (e.g., velocity differences) that may be the result of many factors (including density, susceptibility, angle to the sensors, amount of weathering, etc.). Lithology divisions based upon seismic velocity for example may not necessarily be identical to lithology changes identified by drilling. The discrepancy is generally related to formation density and/or compaction (i.e., a dense till may have a higher density than a weathered bedrock, and the difference can be difficult to resolve with seismic data).

3. Complex geological configurations may be impossible to resolve with surface geophysical methods. The resolution of geophysical data is limited by the spatial geometry of sensors, strength of signal, and distance of the object or layer of interest from the energy source and the sensor array used. Resulting interpretations are rendered by modeling geophysical response to known or presumed geometric relationships. The complexity of the relationships that can be modeled is limited by the resolution allowed by the method and geometry of equipment layout used, and the limitations of the software used.

4. Foster Wheeler is not responsible for data quality in areas having excessive "background noise" which affect the specific physical parameters of the subsurface that are being measured by a particular geophysical technique. Examples of background noise include: heavy traffic on a nearby roadway which induces vibrational energy into the ground which in turn interferes with seismic data collection; heavy machinery (i.e., boat, sand-blaster, or torch) operation adjacent to or in the water near a marine seismic survey line; or underground utilities (such as electric lines, tunnels, sewers, etc.), which can interfere with seismic instrumentation.

No guarantee or warranty (other than that stipulated in the contract under which this work was promulgated), expressly stated or implied, is given concerning the data and interpretations rendered in this report. All information is presented as "for information only." Foster Wheeler Environmental Corporation, it's parent company or any subsidiary, is not liable for any losses resulting from the misuse, misrepresentation, or misinterpretation of any information presented in this report by any person or entity.

6.0 REFERENCES

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Koteff, Carl, and Cotton, J.E., 1962, Preliminary results of recent deep sea drilling on Cape Cod, Massachusetts, Science, vol. 137, no. 3523, p. 34.

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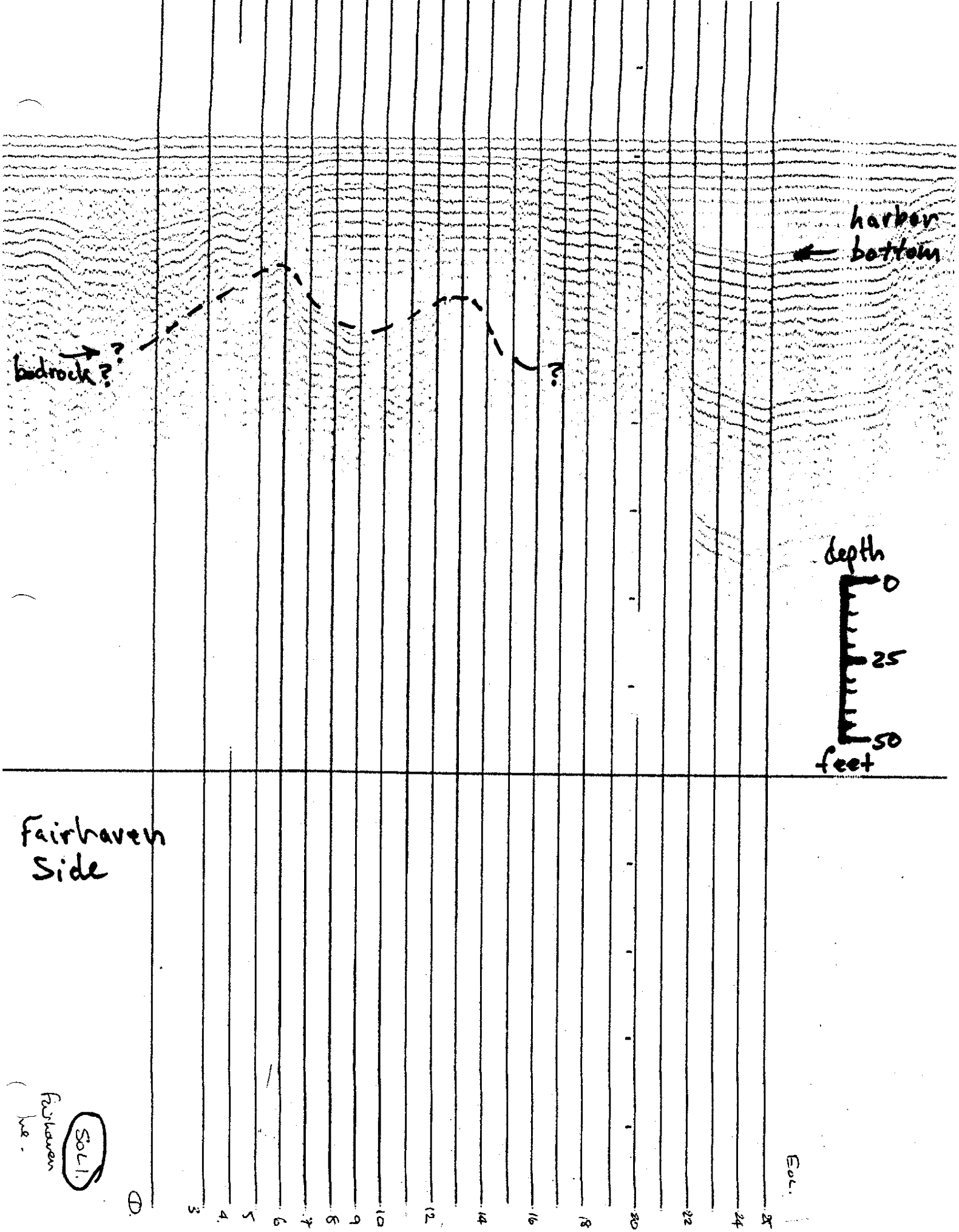
Weed, E.G.A., Minard, J.P., Perry, W.J., Rhodehamel, E.C., and Robbins, E.I., 1974, Generalized pre-Pleistocene geologic map of the northern United States continental margin: U.S. Geological Survey Miscellaneous Investigations Series Map I-861, 8p.

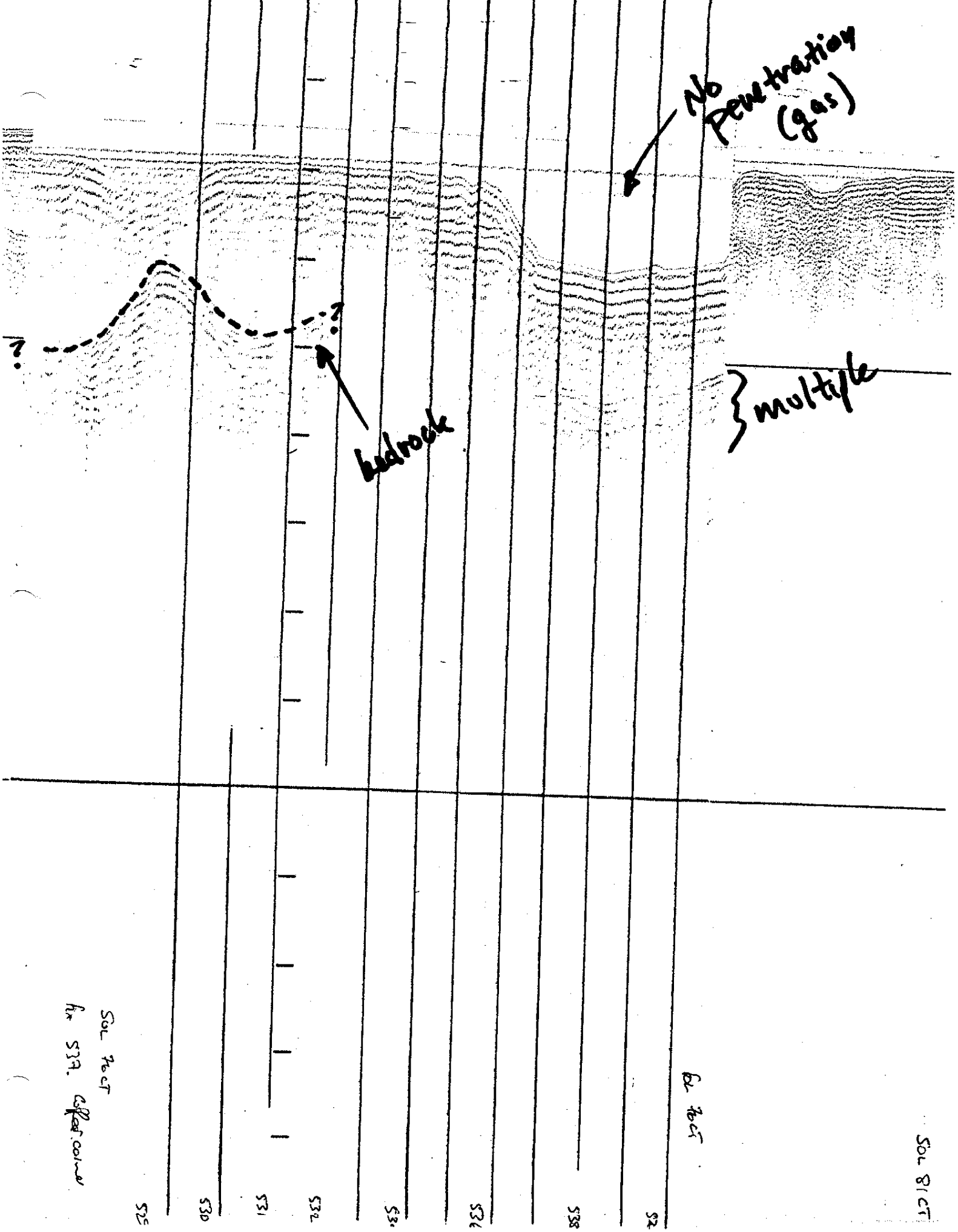
Williams, J.R., and Wiley, R.E., 1973, Bedrock topography and texture of unconsolidated deposits, Taunton River basin, southeastern Massachusetts: U.S. Geological Survey Miscellaneous Investigations Series Map I-742.

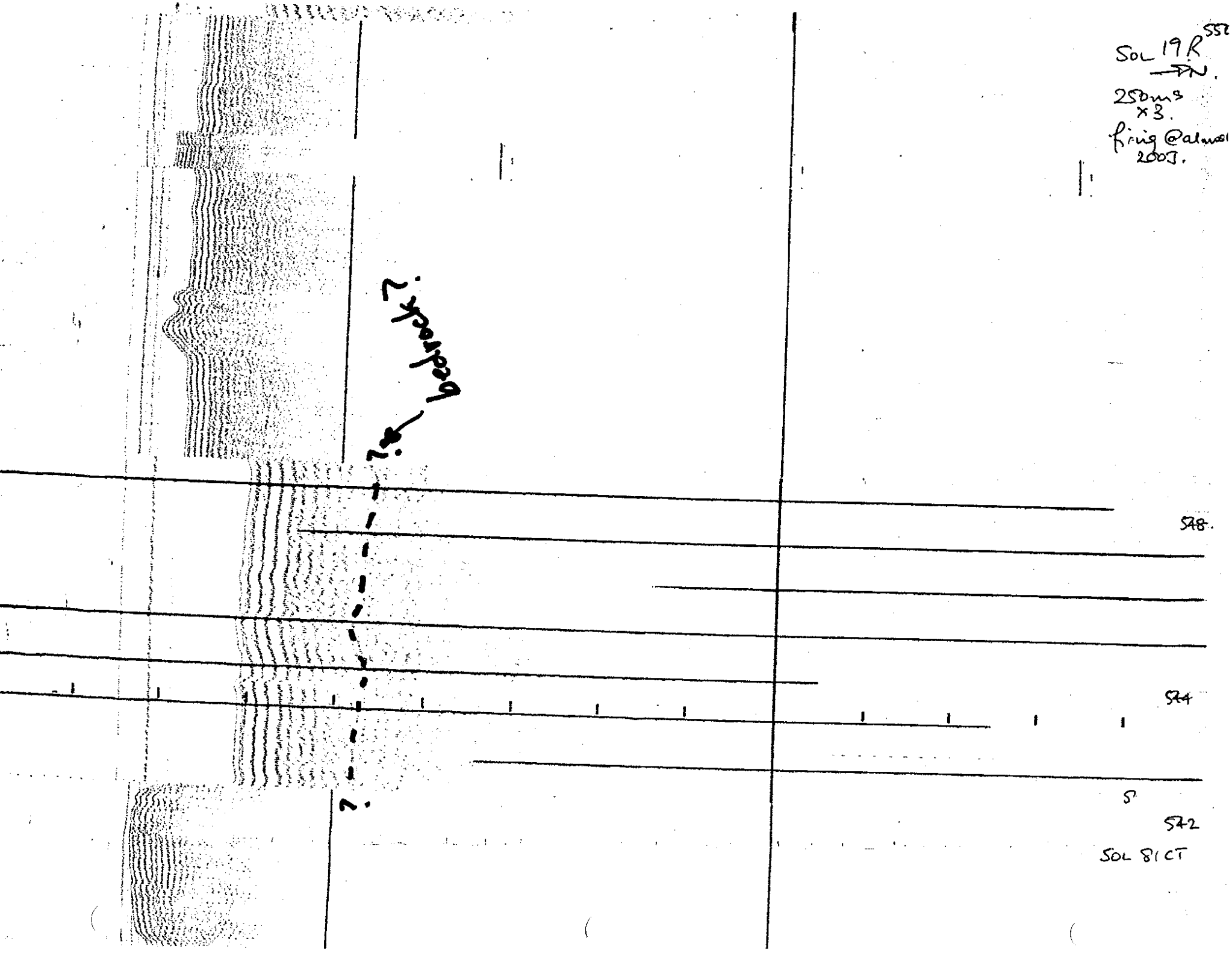
Zen, E-an (editor), 1983, Bedrock Geologic Map of Massachusetts (3 sheets), state Bedrock Geologic Maps publication of the U.S. Geological Survey, U.S. Department of the Interior, U.S. Geological Survey, publications center, Lakewood, CO.

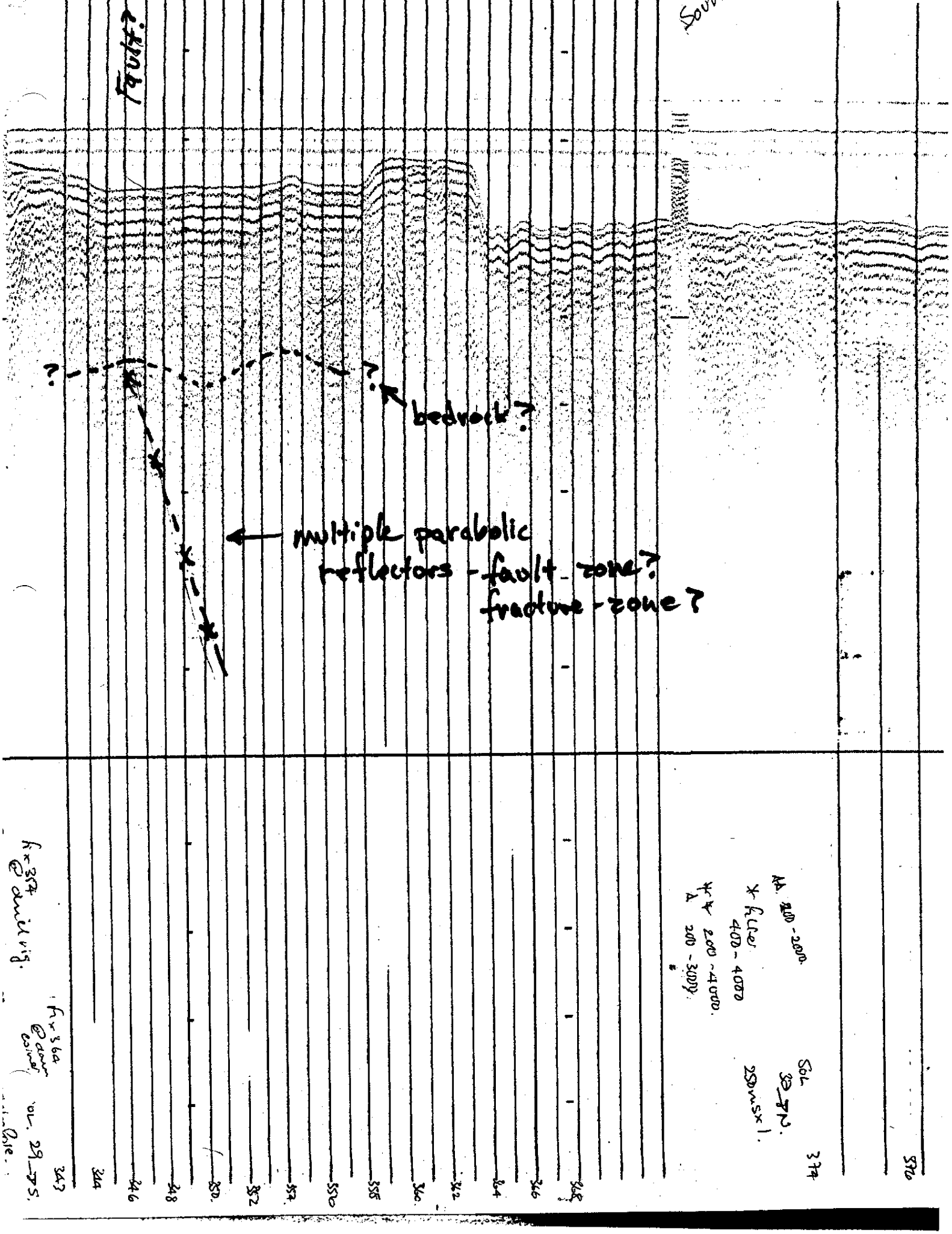
APPENDIX A

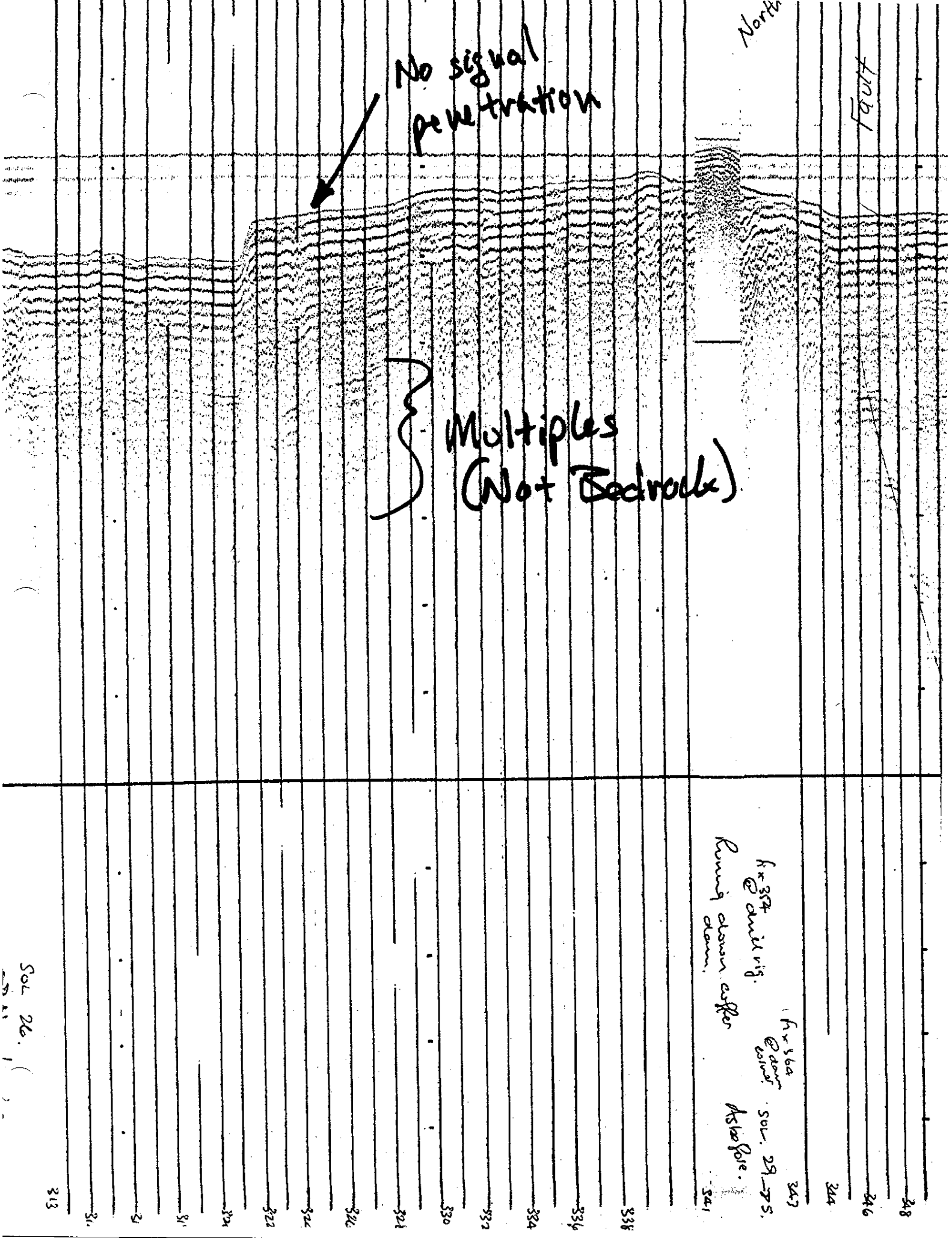
Example Uniboom Records


harbor bottom
bedrock ?
?
depth
0
25
50
feet
Fairhaven Side
Fairhaven Ave.
SOL 1
Eol.
3
4
5
6
7
8
9
10
12
14
16
18
20
22
24
25

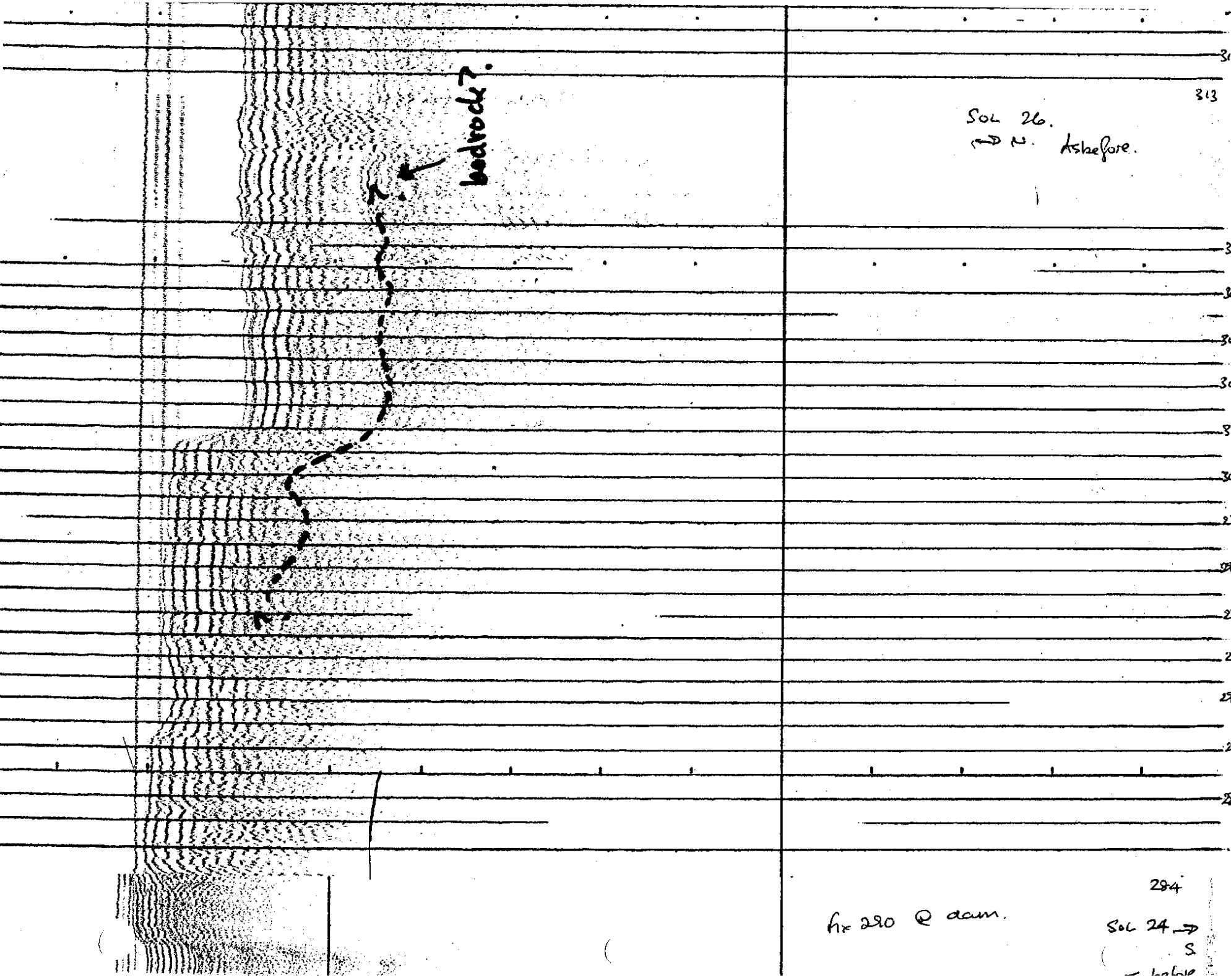

No penetration (gas)
?
?
bedrock
multiple
SOL 7OCT
SOL 8 OCT
S29
S30
S31
S32
S38

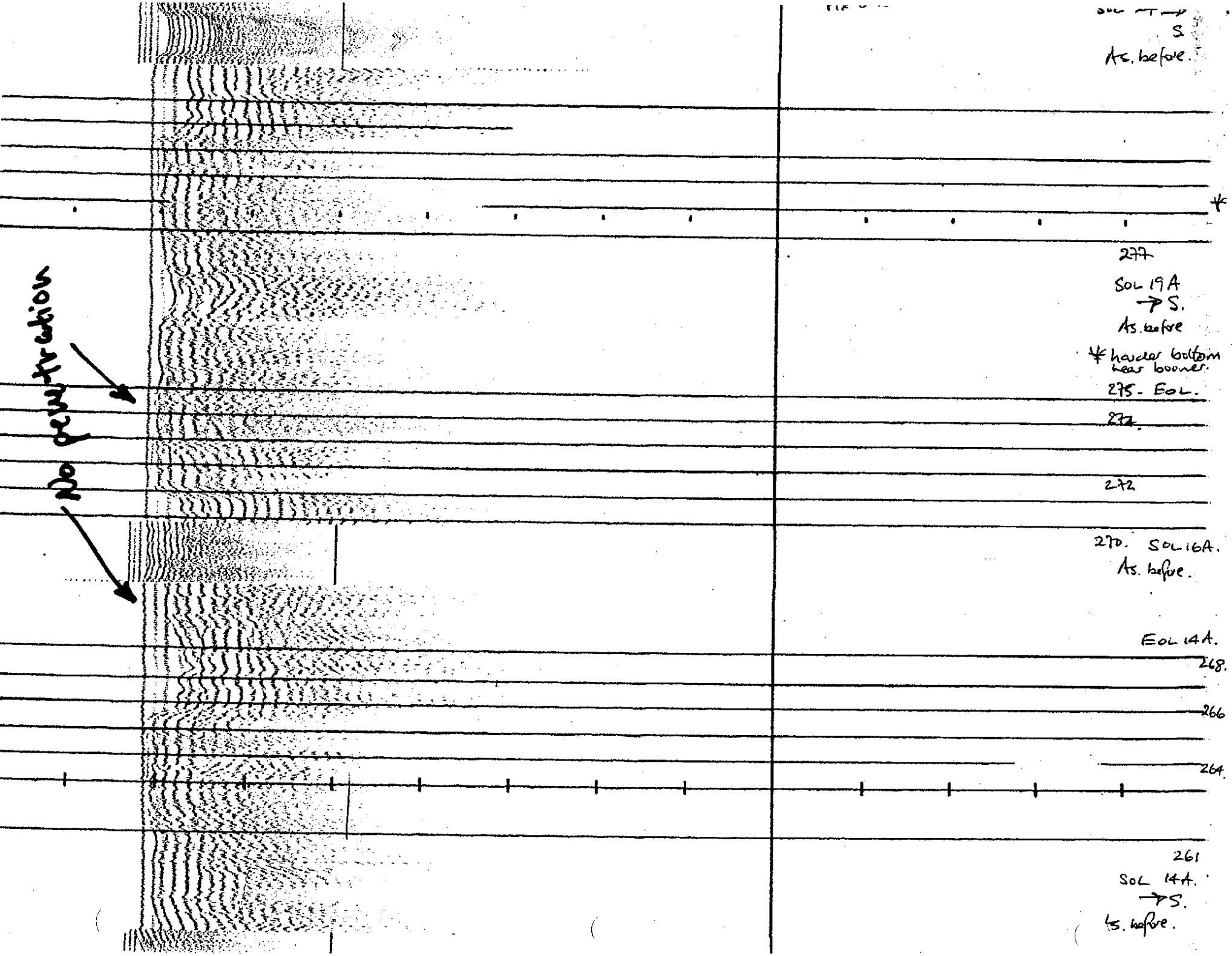

SOL 19R 552
→N.
250ms
x3.
firing @almost
200J.
bedrock?
?
548.
544
S
542
SOL 81CT

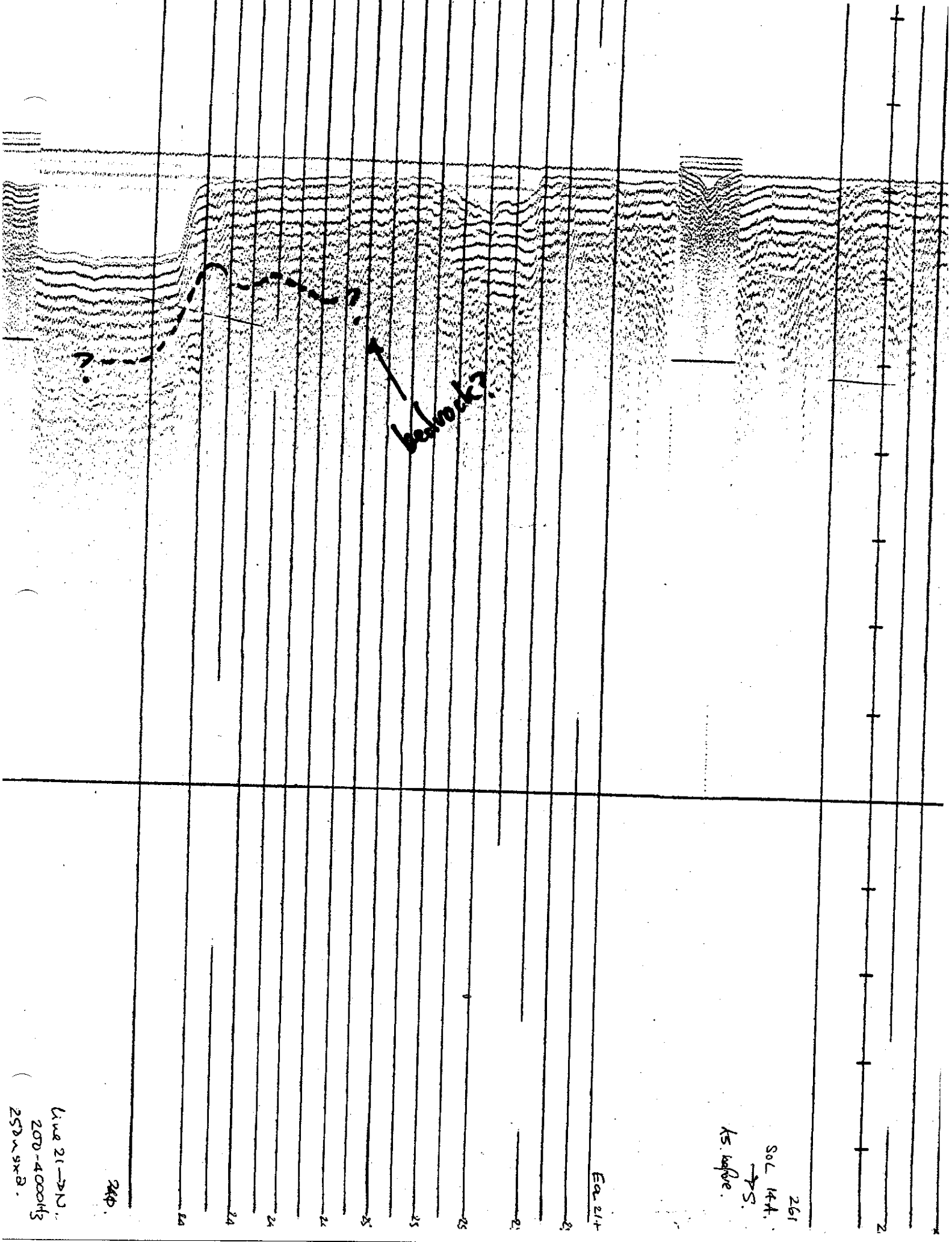

Fault?
bedrock?
multiple parabolic reflectors - fault zone?
fracture - zone?
AA 200 - 2000
* filter 400 - 4000
** 200 - 4000
Δ 200 - 3000
SOL 33 → N.
250msx1.
fix 354 @ drill rig.
fix 364 @ down corner
343
344
346
348
350
352
354
356
358
360
362
364
366
368
374
376

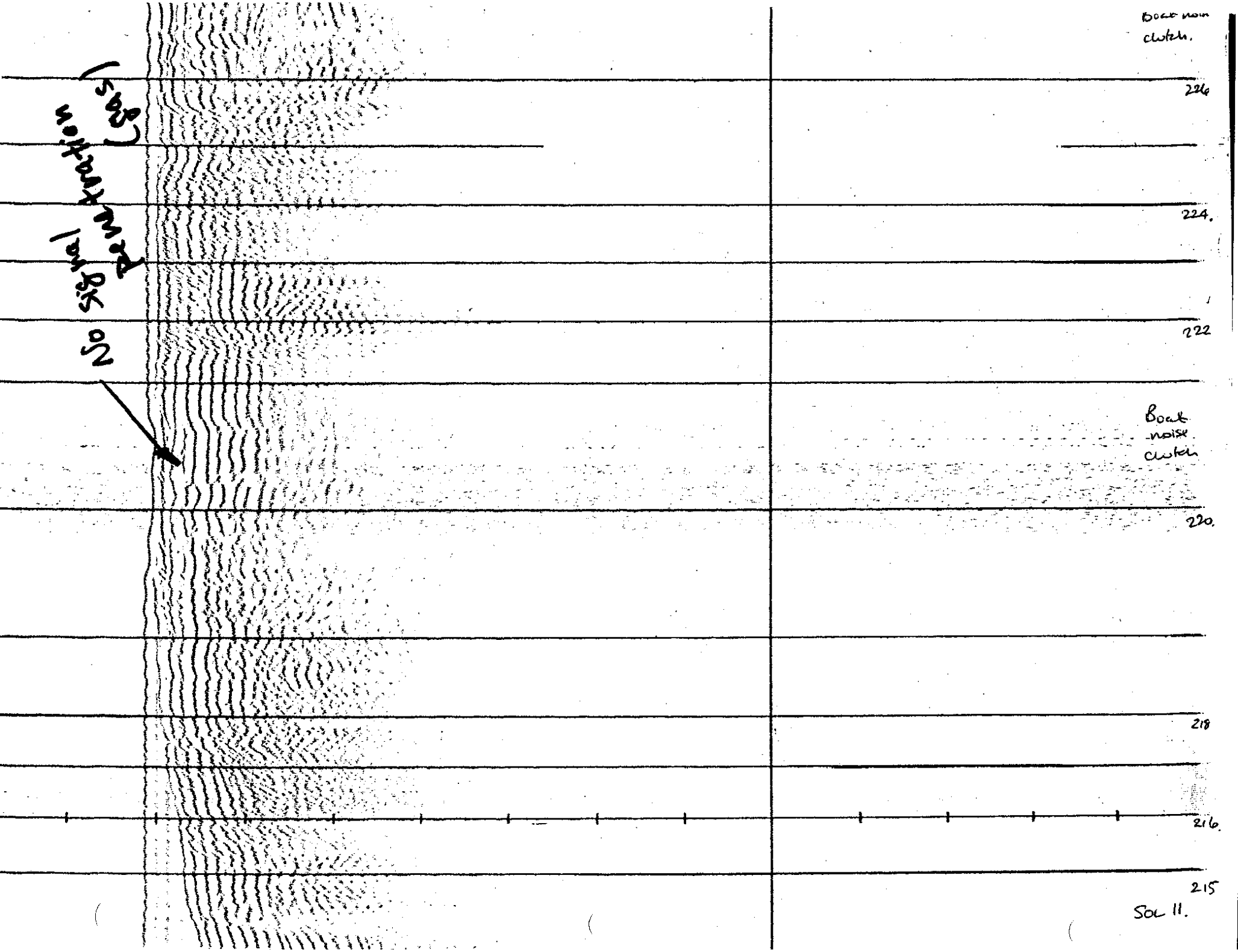


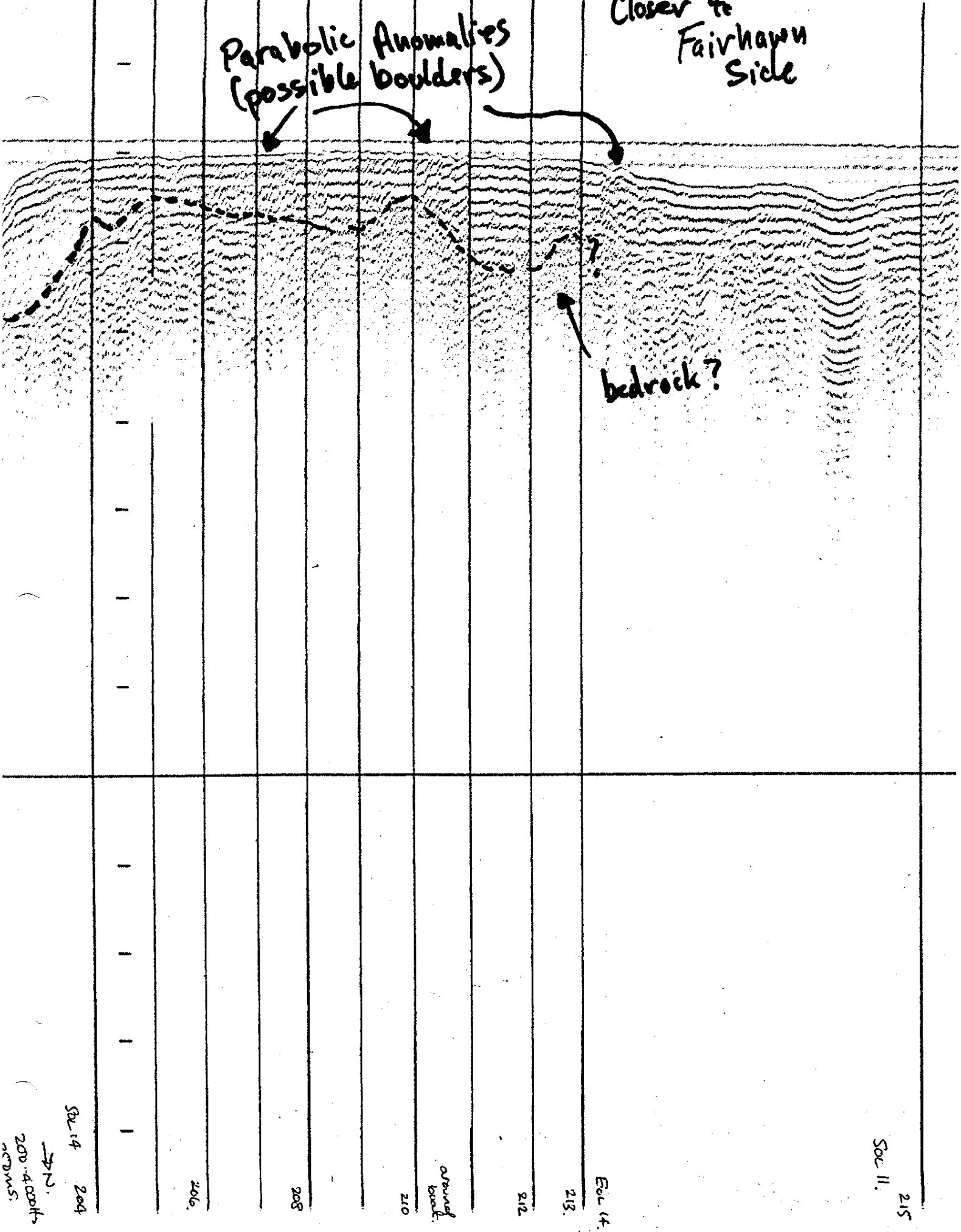
No signal penetration
Multiples (Not Bedrock)
North
Fault
Fx 354 @ drill rig.
Running down coffer dam.
Fx 364 @ dam corner.
SOL. 29-75.
Ashofore.
SOL 26.
313
341
347
344
346
348

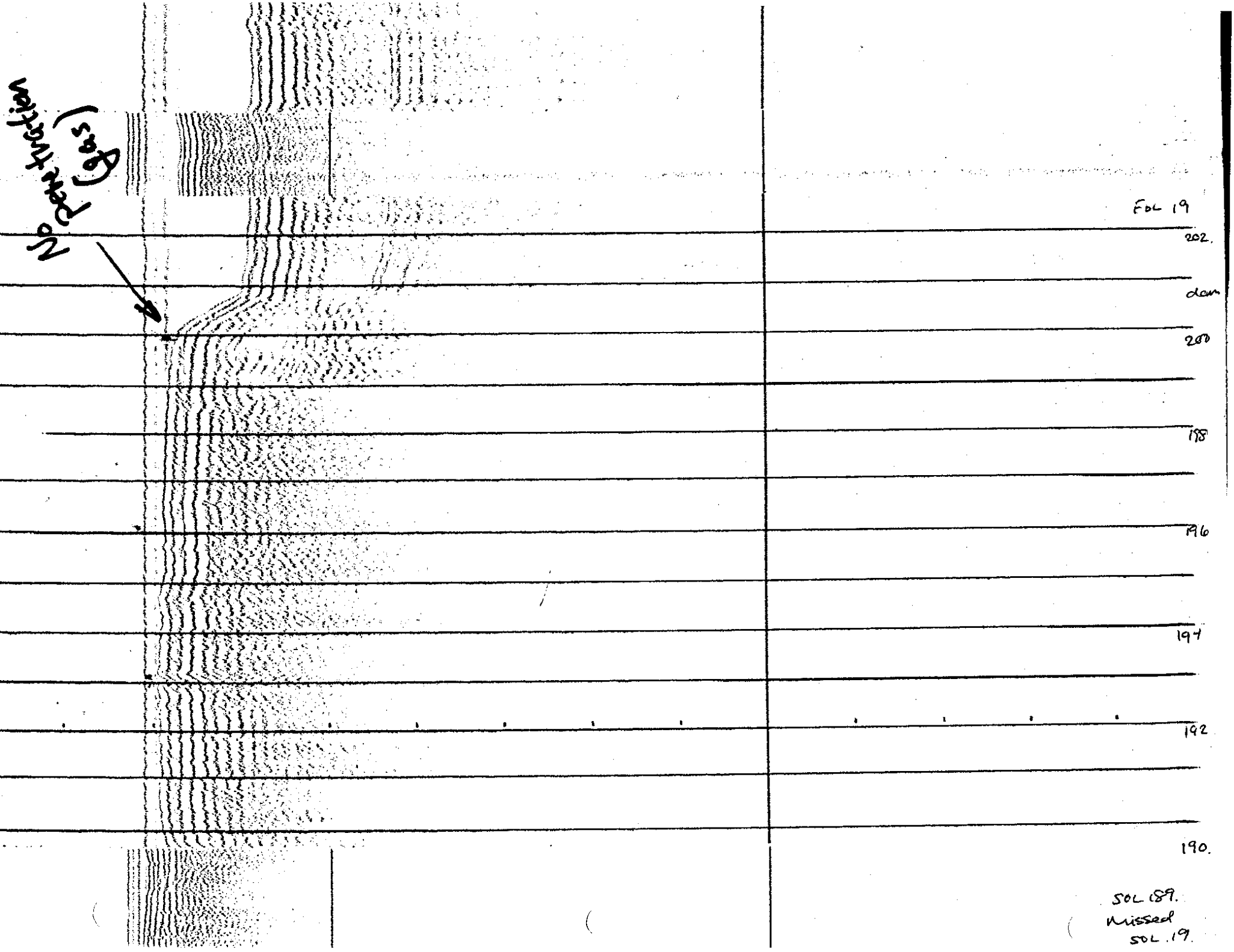

bedrock?
314
313
Sol 26.
N. Ashelfore.
310.
308
306
304
302
300.
298
296
294
292
290
288
286
284
fix 290 @ dam.
Sol 24
S

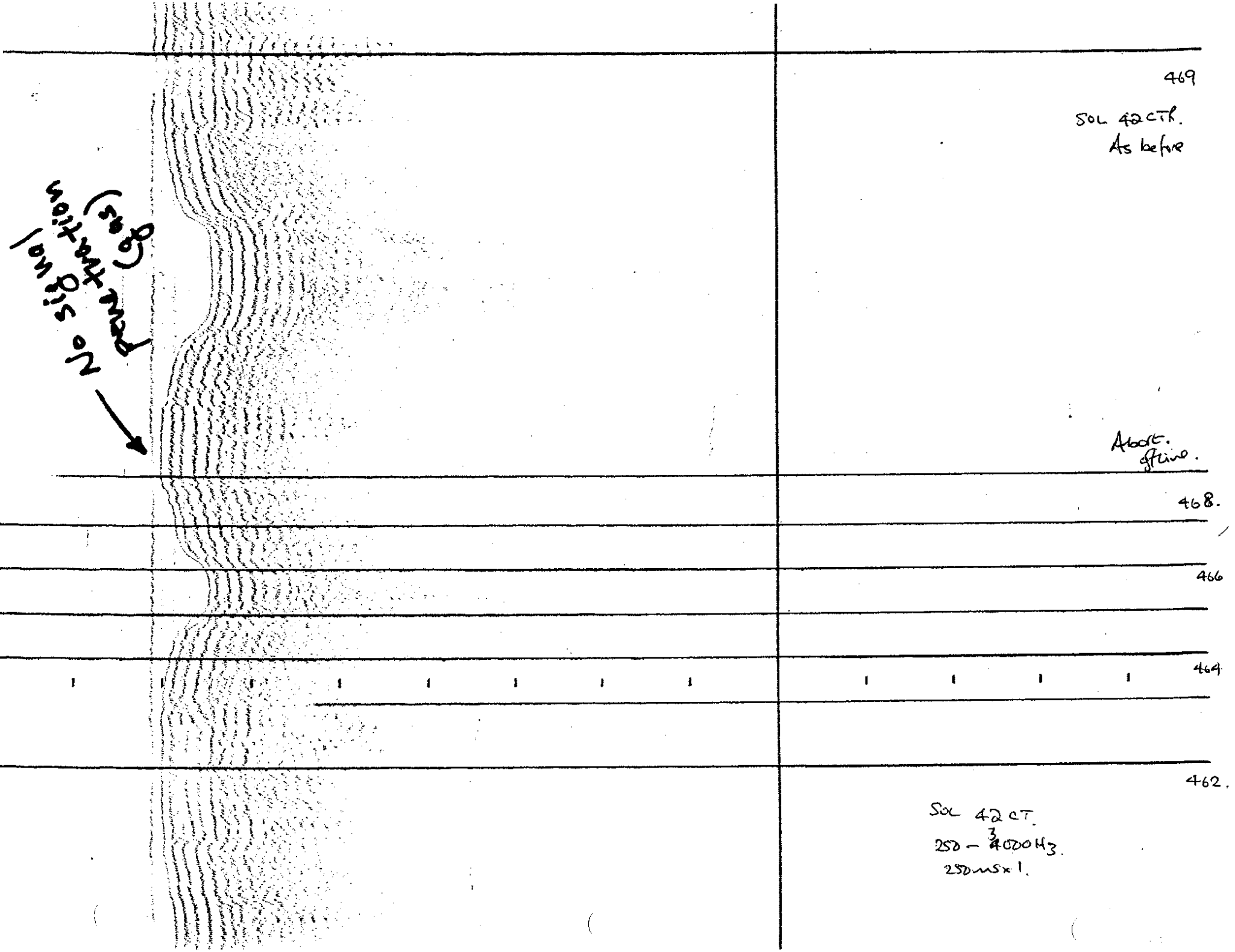

No penetration
S
As. before.
*
277
SOL 19A
→ S.
As. before
* header bottom near boomer.
275 - EOL.
274.
272
270. SOL 16A.
As. before.
EOL 14A.
268.
266
264.
261
SOL 14A.
→ S.
As. before.

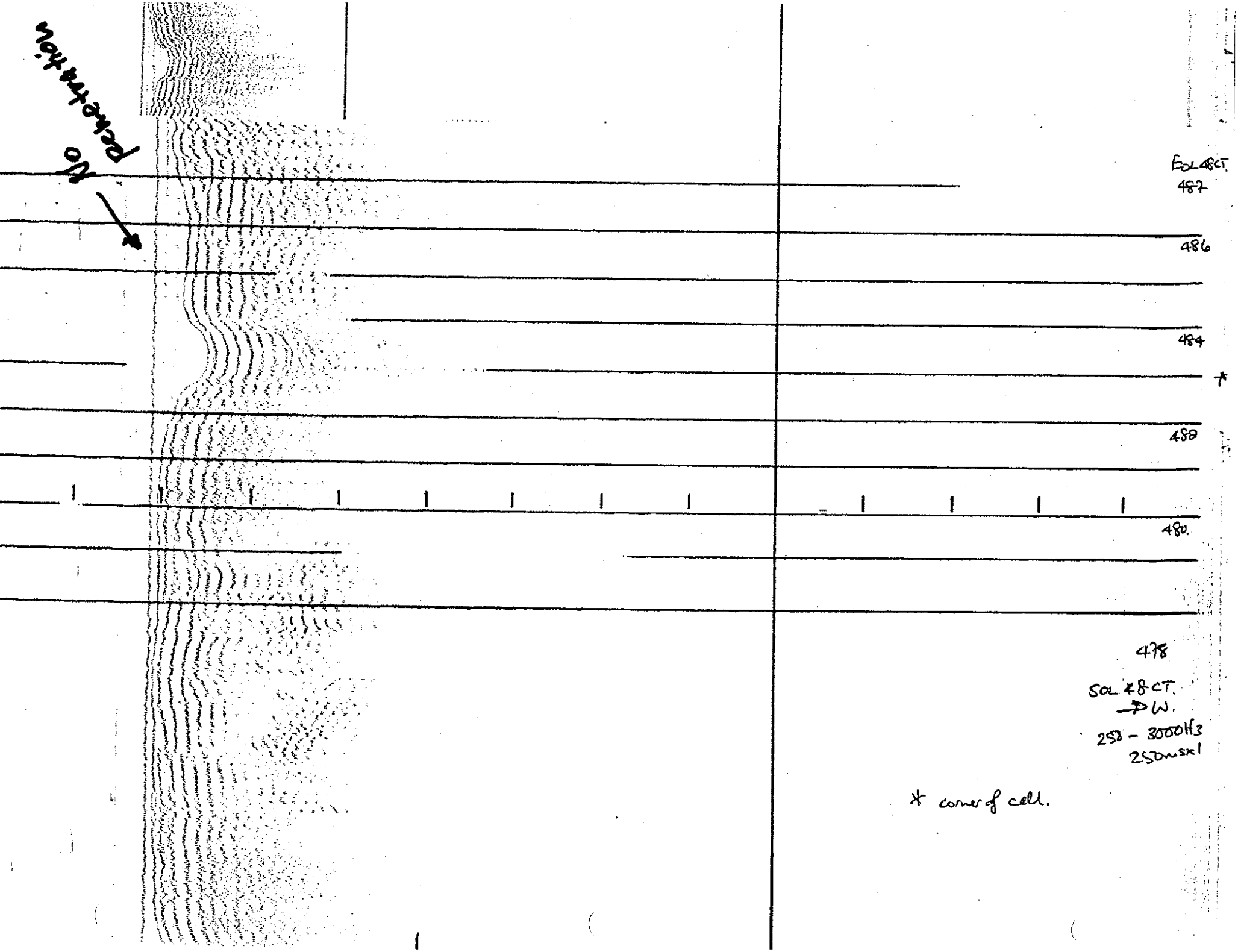

bedrock?
?
?
Line 21 → N.
200-4000Hz
25 ms x 8.
240.
Eq. 21+
SOL 14A.
→ S.
K5. before.
261

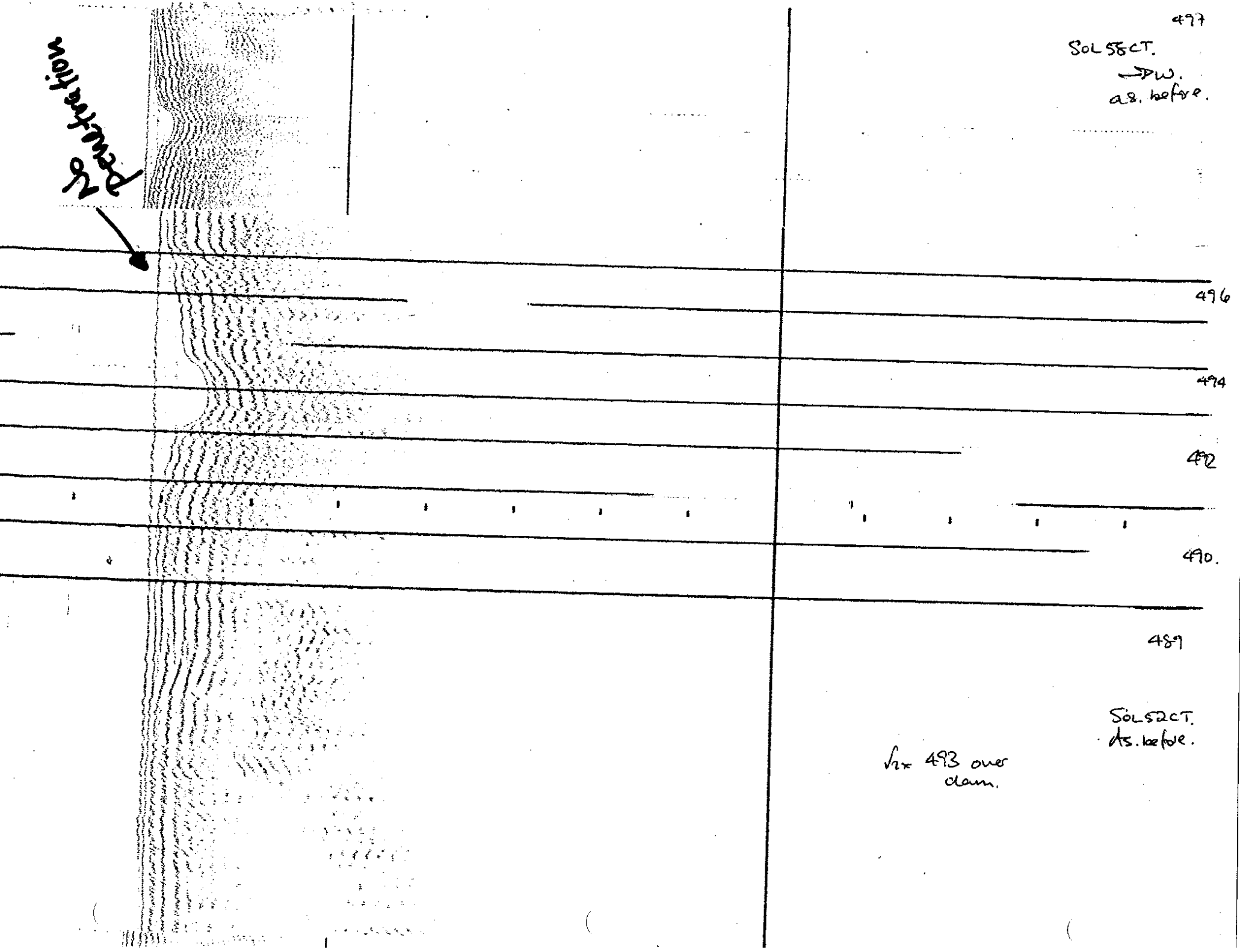

No signal permutation (gas)
Boat noise clutch.
226
224.
222
Boat noise clutch
220.
218
216.
215
Sol 11.

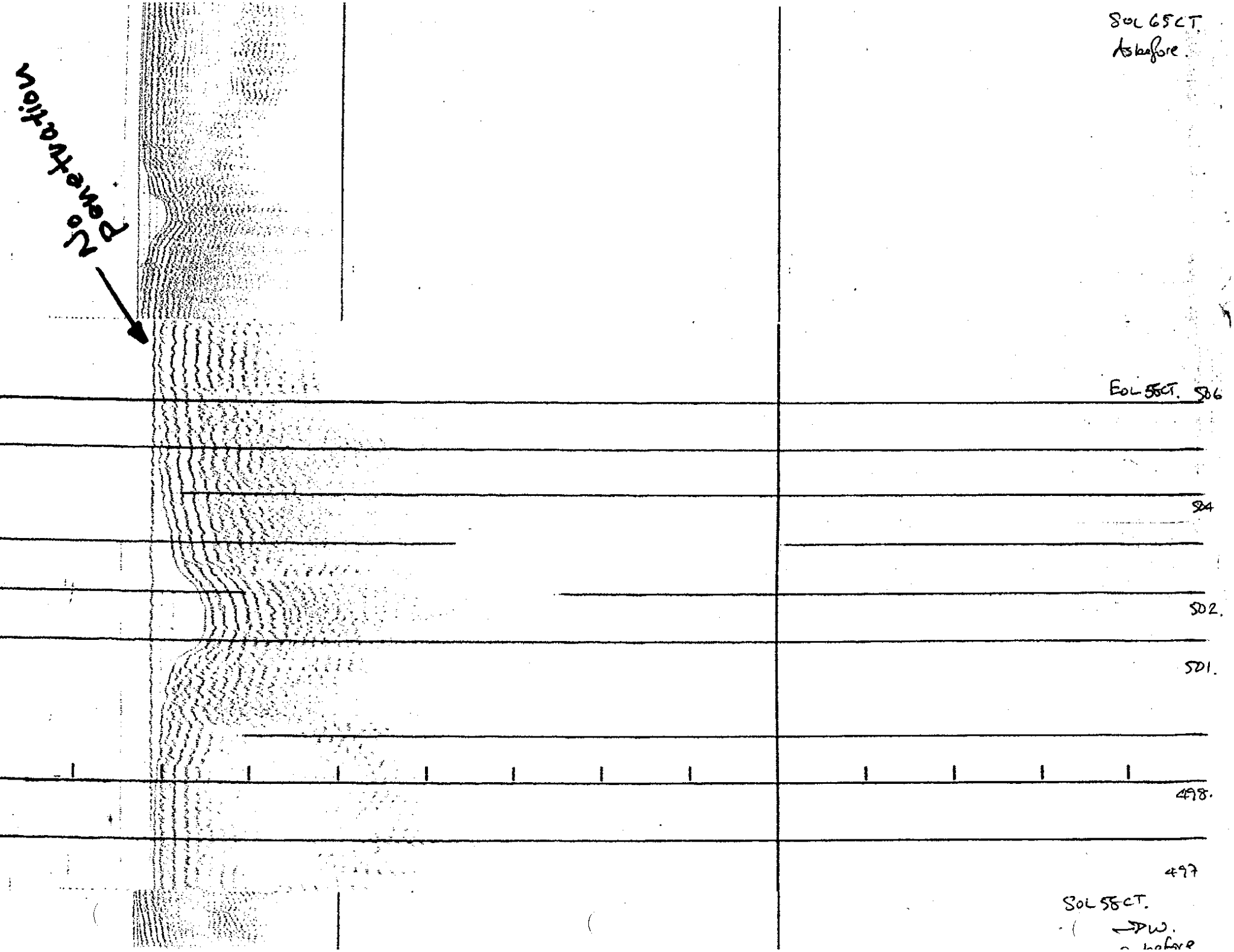

Closer to Fairhaven Side
Parabolic Anomalies (possible boulders)
?
bedrock?
Sol 14
204
206.
208
210
around boat.
212
213.
Eol 14.
Sol 11.
215

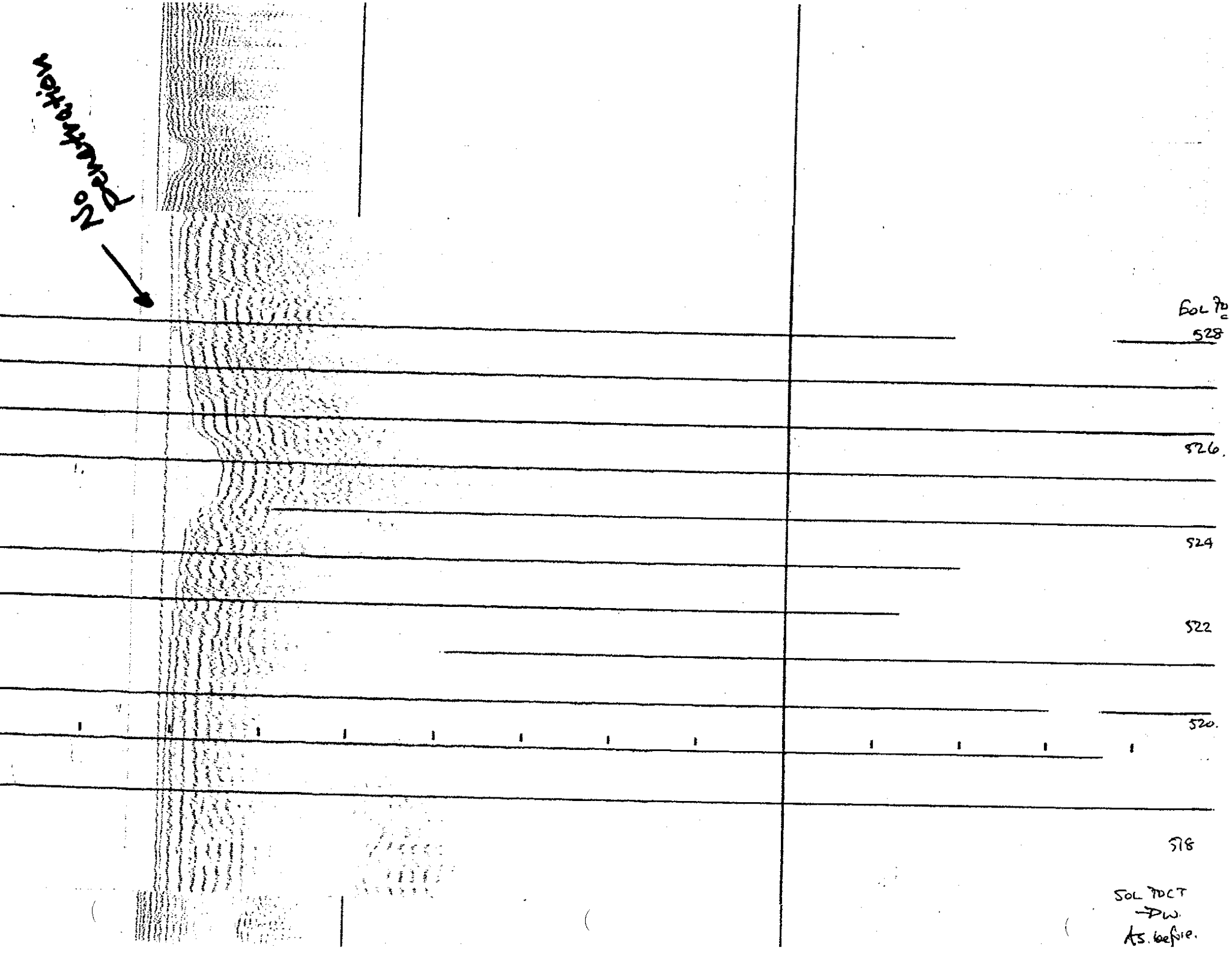

No penetration (gas)
FOL 19
202.
dam
200
198
196
194
192
190.
SOL 189.
Missed
SOL 19.

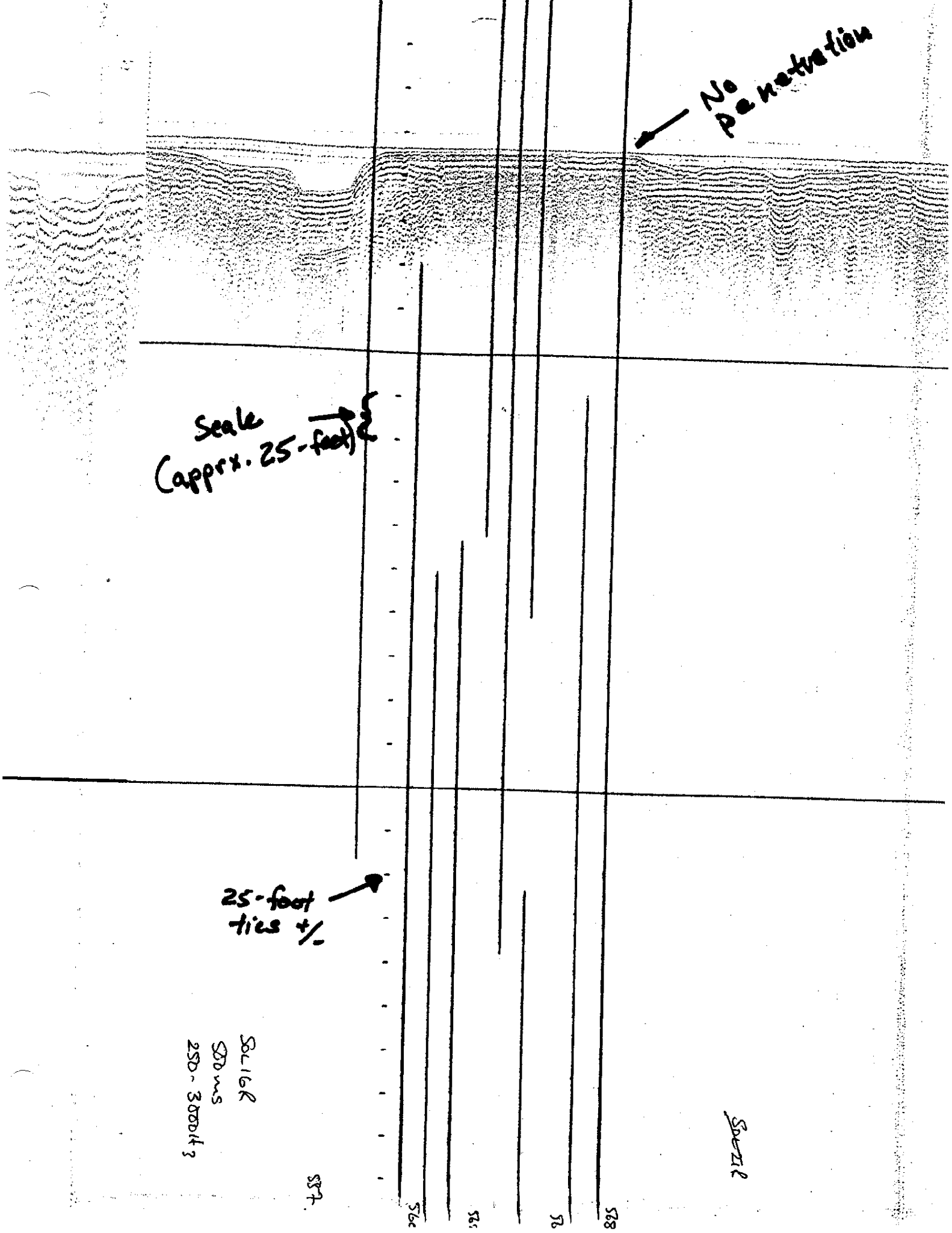

No signal penetration (gas)
469
SOL 42 CTR.
As before
Abort. off line.
468.
466
464
462.
SOL 42 CT.
250 – 3 4000 Hz.
250 ms x 1.

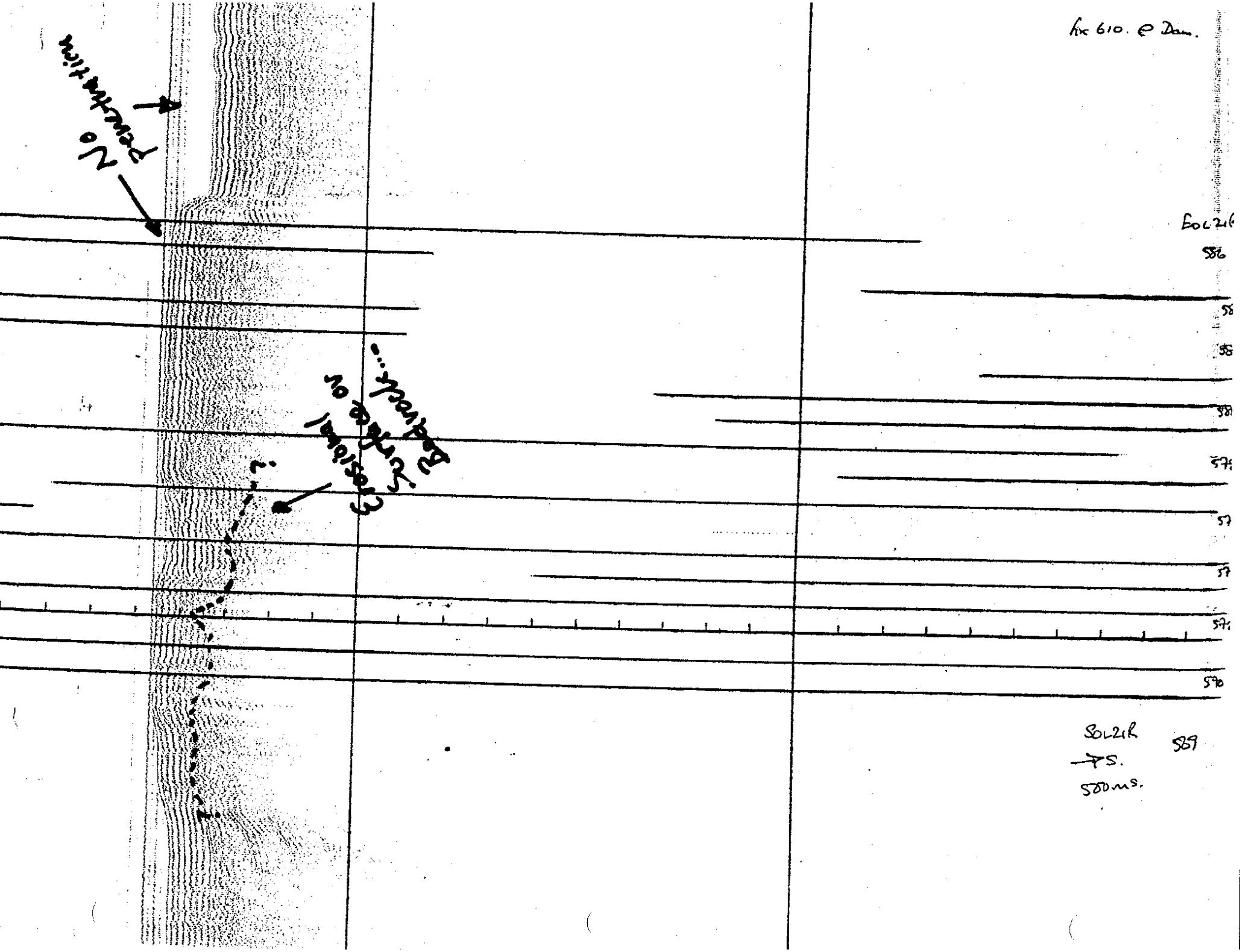

No penetration
EOL 48CT.
487
486
484
*
480
480.
478
SOL 48CT.
→ W.
250 - 3000Hz
250msx1
* corner of cell.


No penetration
497
SOL 58CT.
→W.
as. before.
496
494
492
490.
489
SOL 52CT.
As. before.
√2x 493 over
dam.

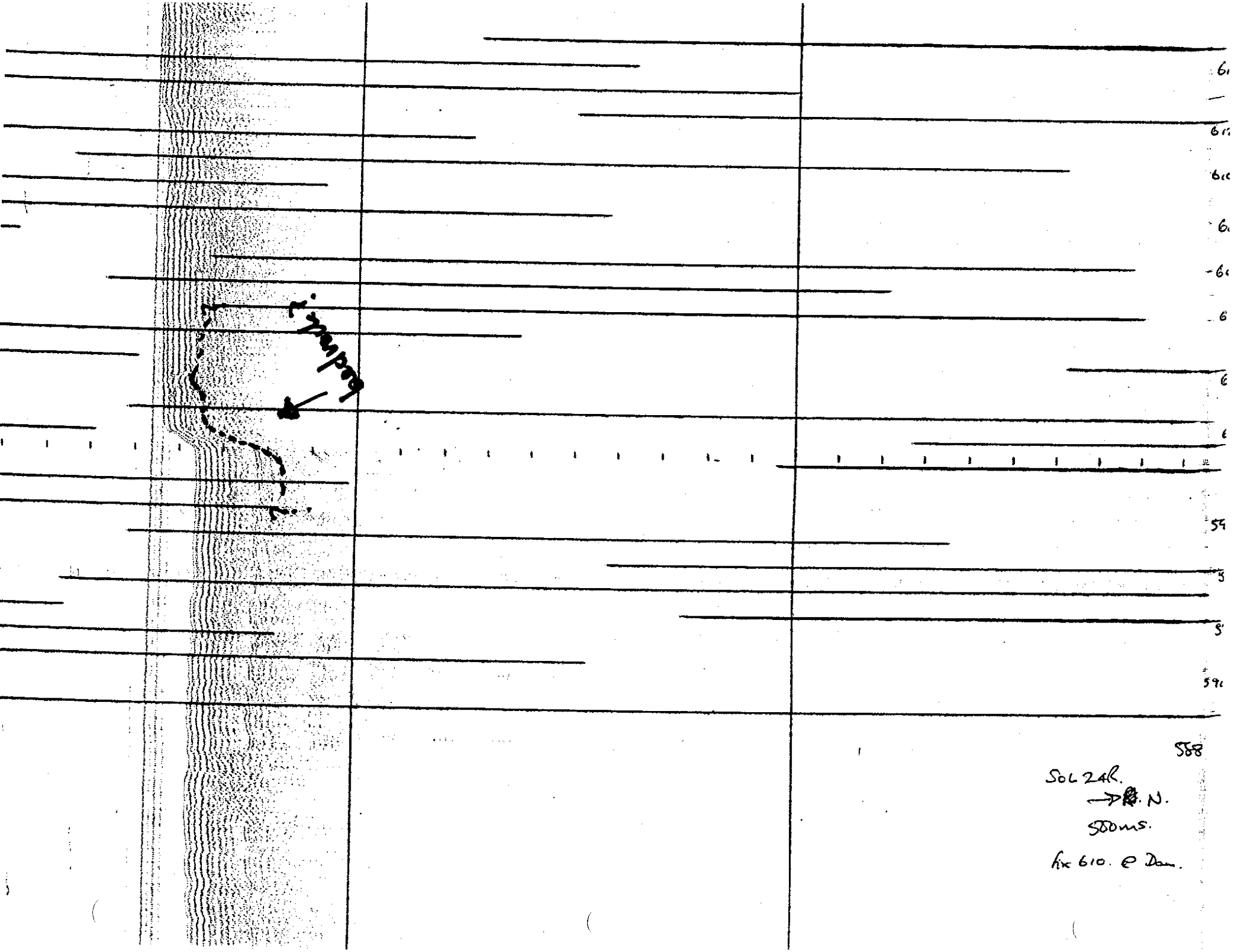

No penetration
SOL 65CT.
As before.
EOL 55CT.
506
504
502.
501.
498.
497
SOL 58CT.
→ PW.
as before

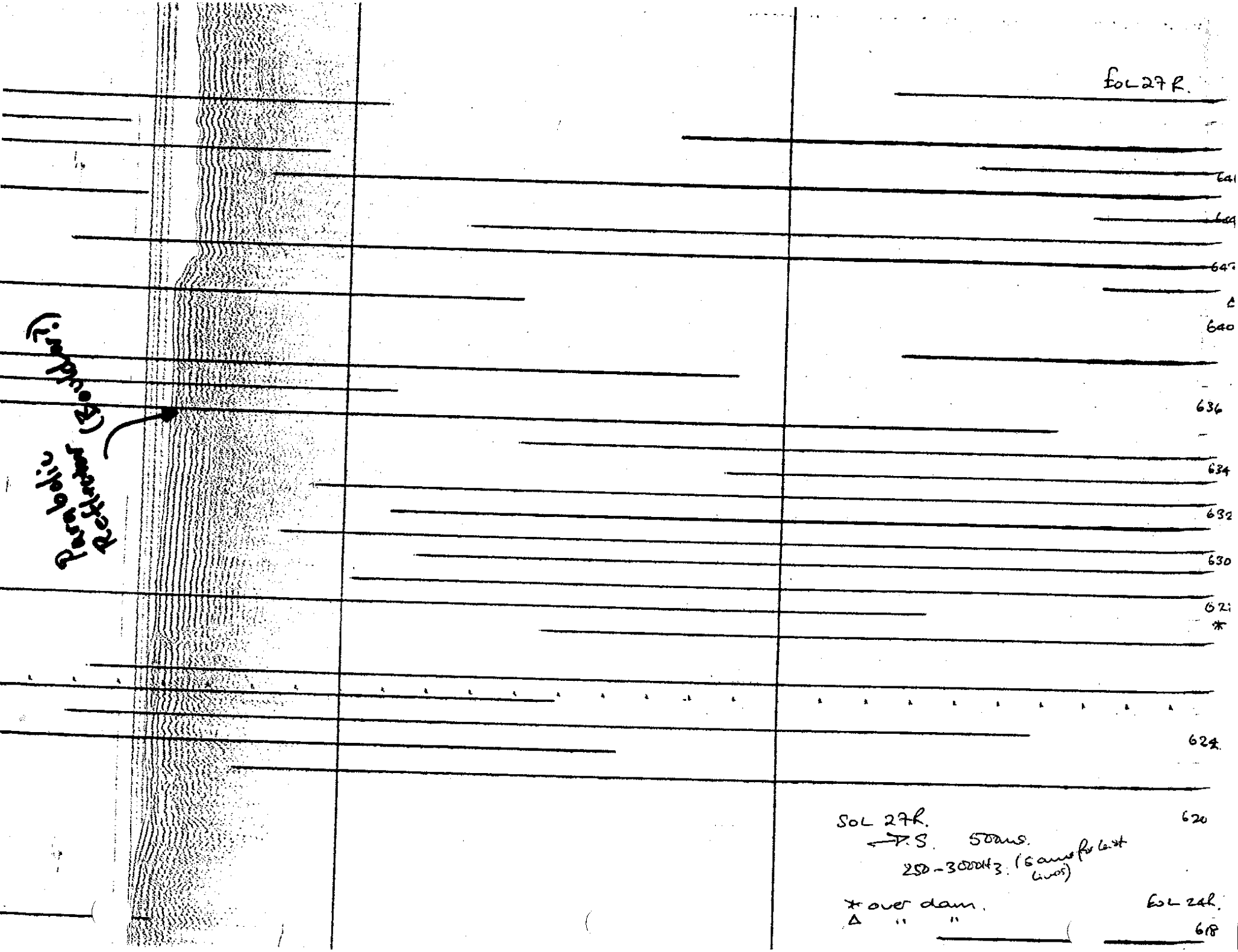

No Penetration
SOL TOC
528
526.
524
522
520.
518
SOL TOCT
→ DW.
As before.


No penetration
Scale (apprx. 25-foot)
25-foot ties +/-
SOLIGR
500ms
250-3000Hz
SOLZIR
557
568

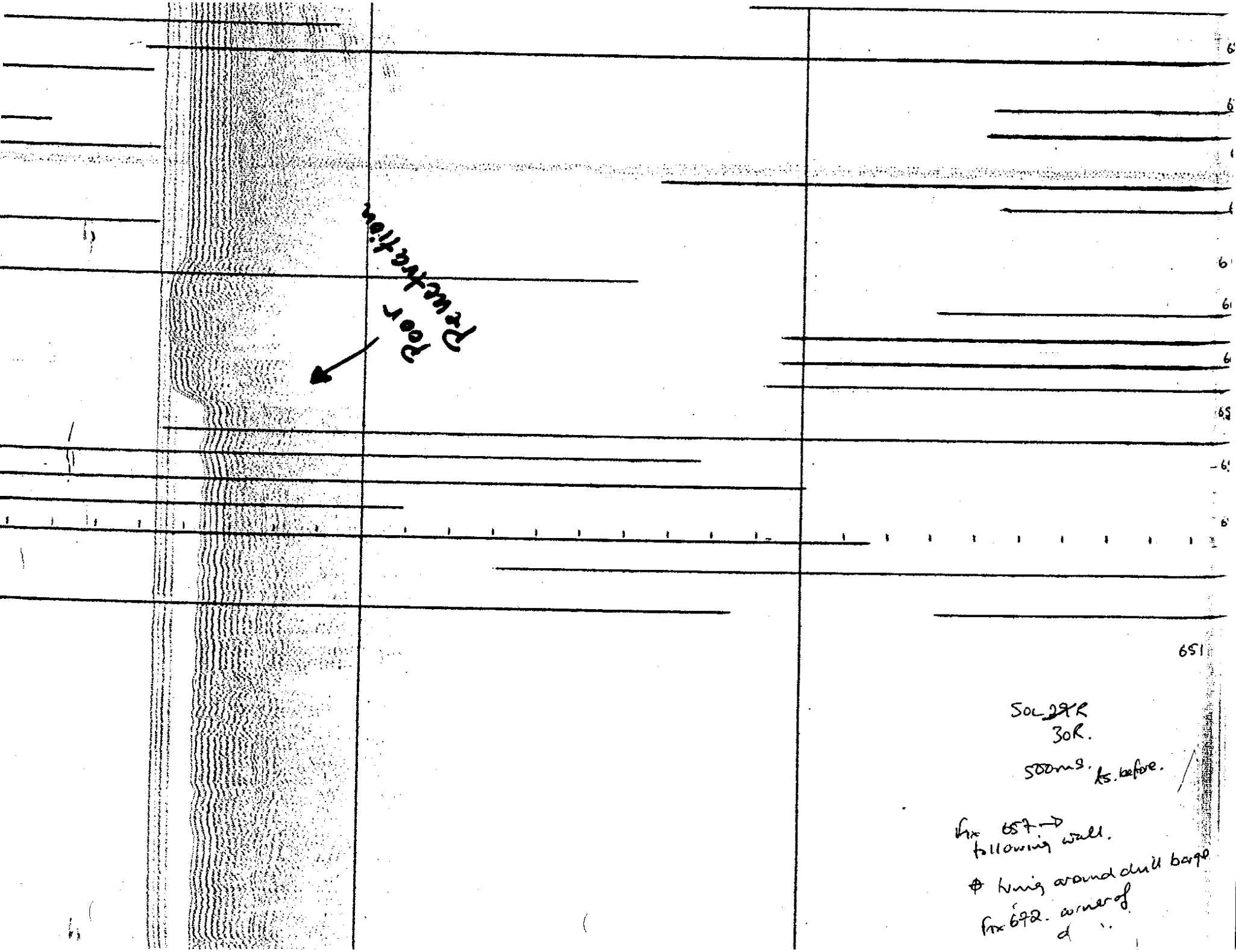


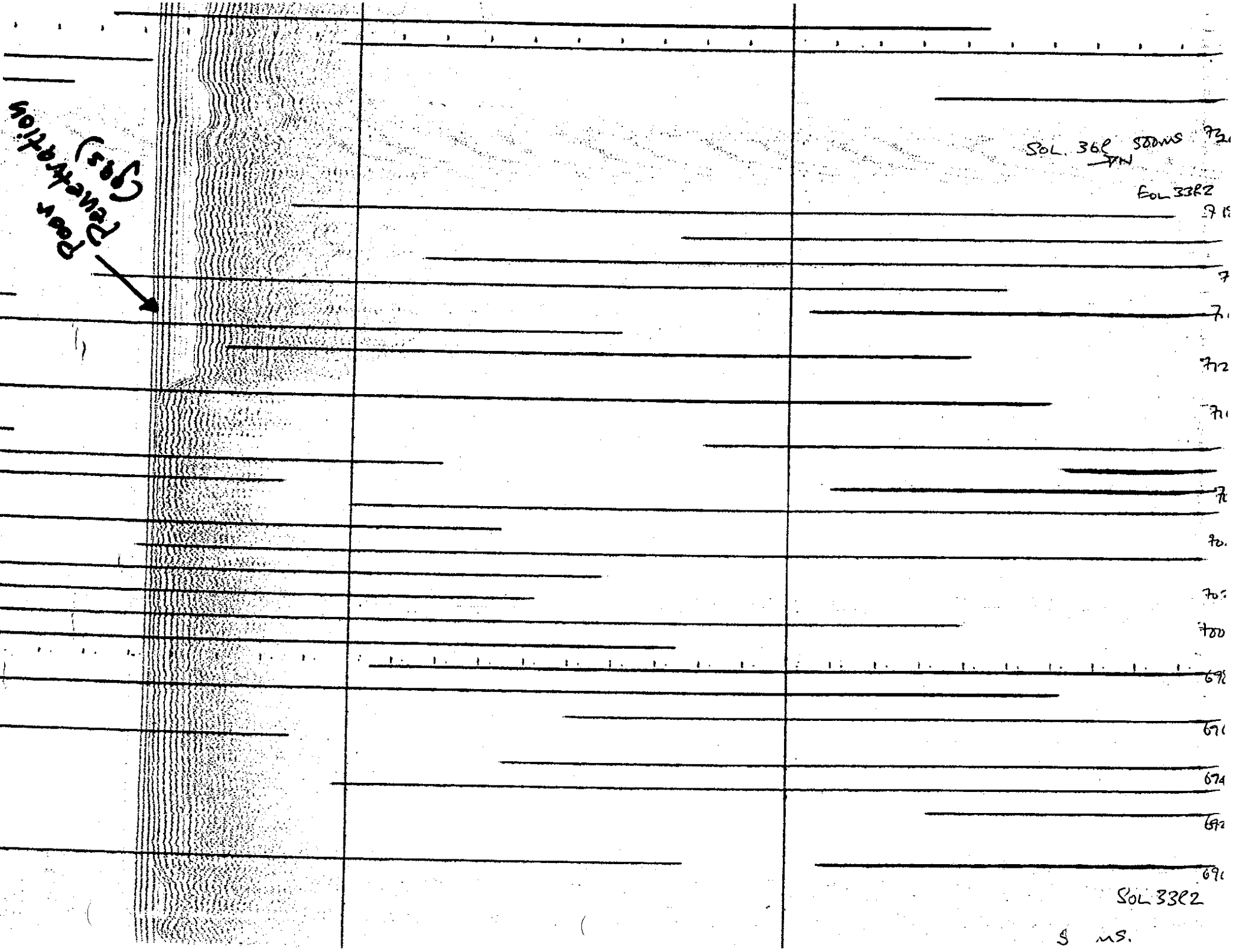
fix 610. @ Dam.
No Penetration
Erosional Surface or Bedrock...
?
EOL21
586
570
SOL21R
589
→S.
500ms.

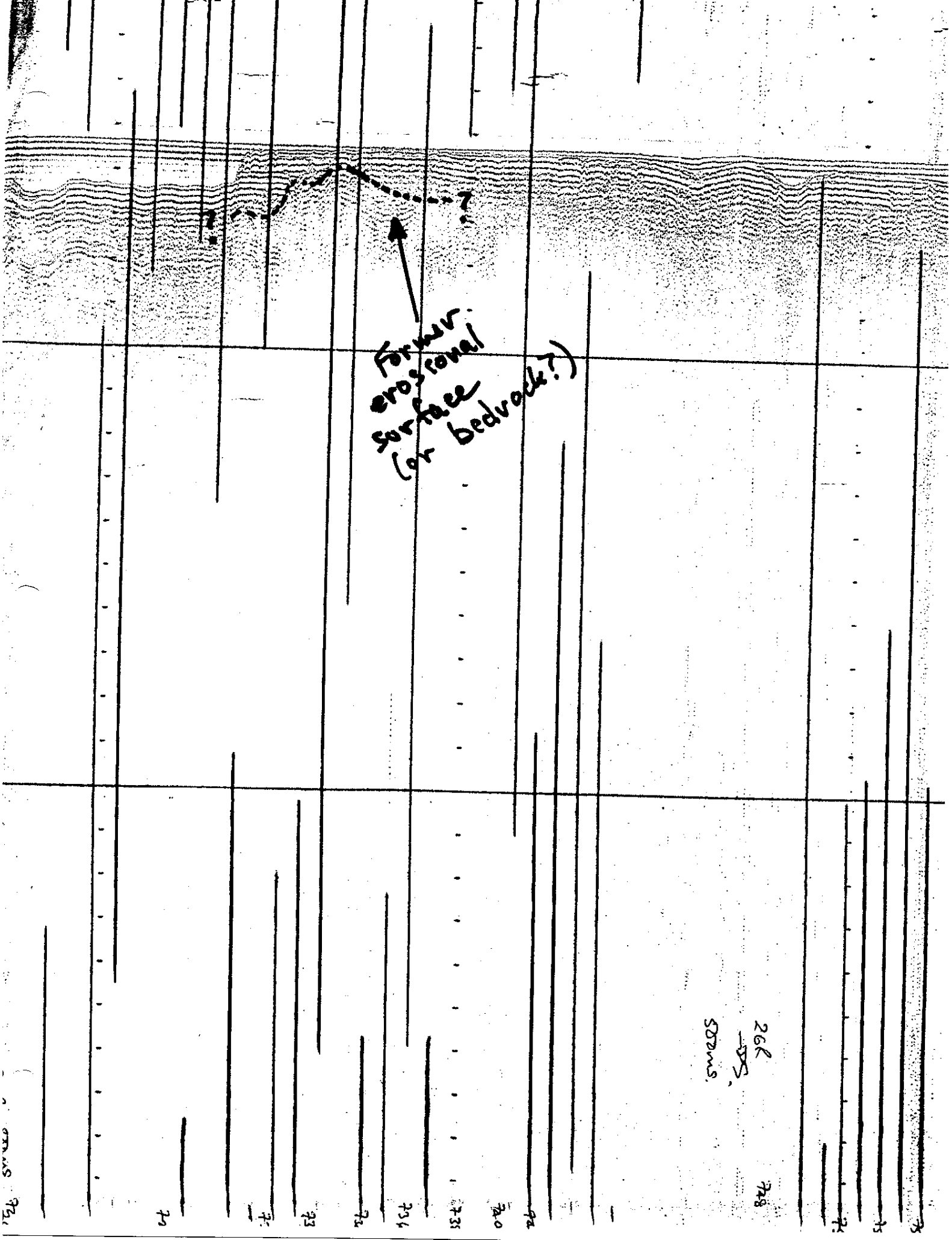

588
SOL 24R.
→ N.
500ms.
fix 610. @ Dam.



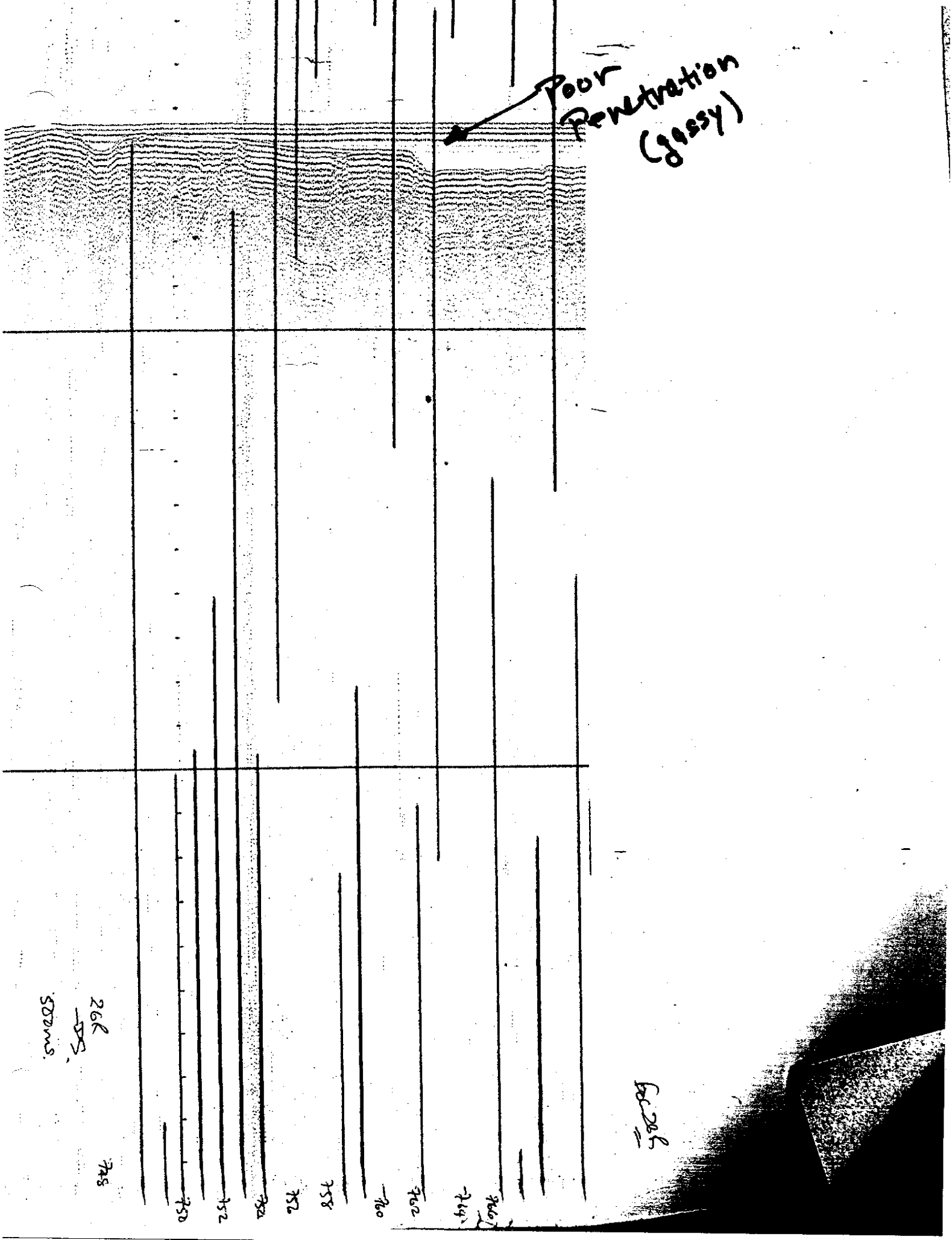
Parabolic Reflector (Boulder?)
SOL 27R.
640
636
634
632
630
624
620
SOL 27R.
→ S. 500ms.
250-3000Hz. (same for last lines)
* over dam.
Δ " "
SOL 24R.
618


Poor Penetration
651
SOL 29R
30R.
500ms. As. before.
fix 657 → following wall.
⊕ turning around drill barge
fix 672. corner of
d


Poor Penetration (gas)
SOL. 36R 500ms
SOL 33R2
SOL 33R2
5 ms.



?
?
Former erosional surface (or bedrock?)
26R
500ms.


Poor Penetration (gassy)
26R
500ms.
748
750
752
754
756
758
760
762
764
766

APPENDIX B

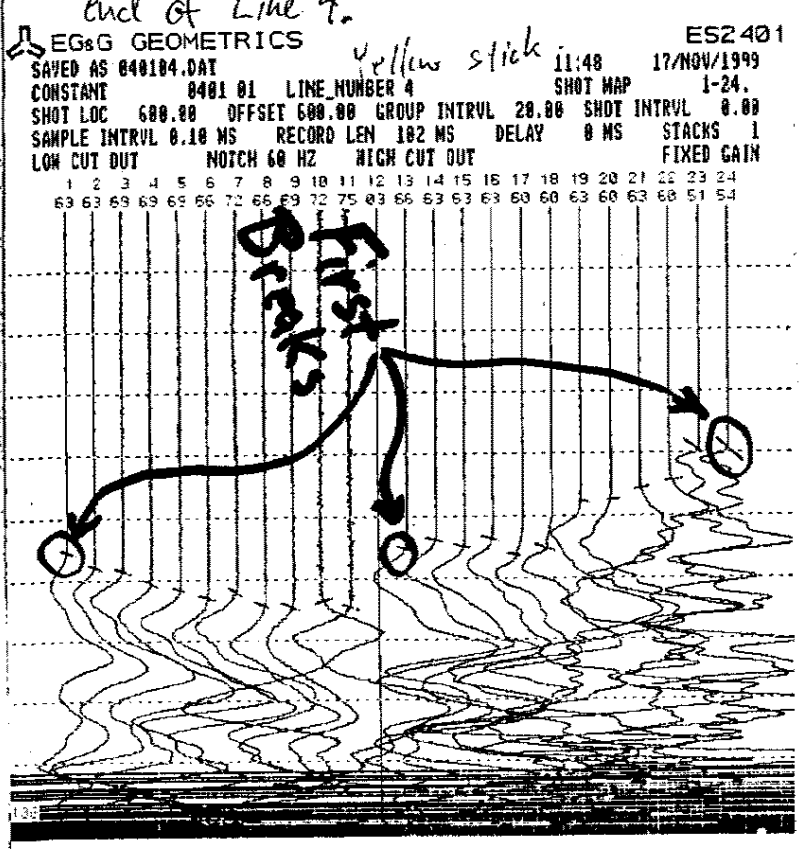
Example Seismograph Records
Time-Distance Plots
SeisOpt@2D "hit plot"

11/17/99
1148

Line 4

040104

Offend shot = shot pt about 200 feet north of the north end of Line 4.

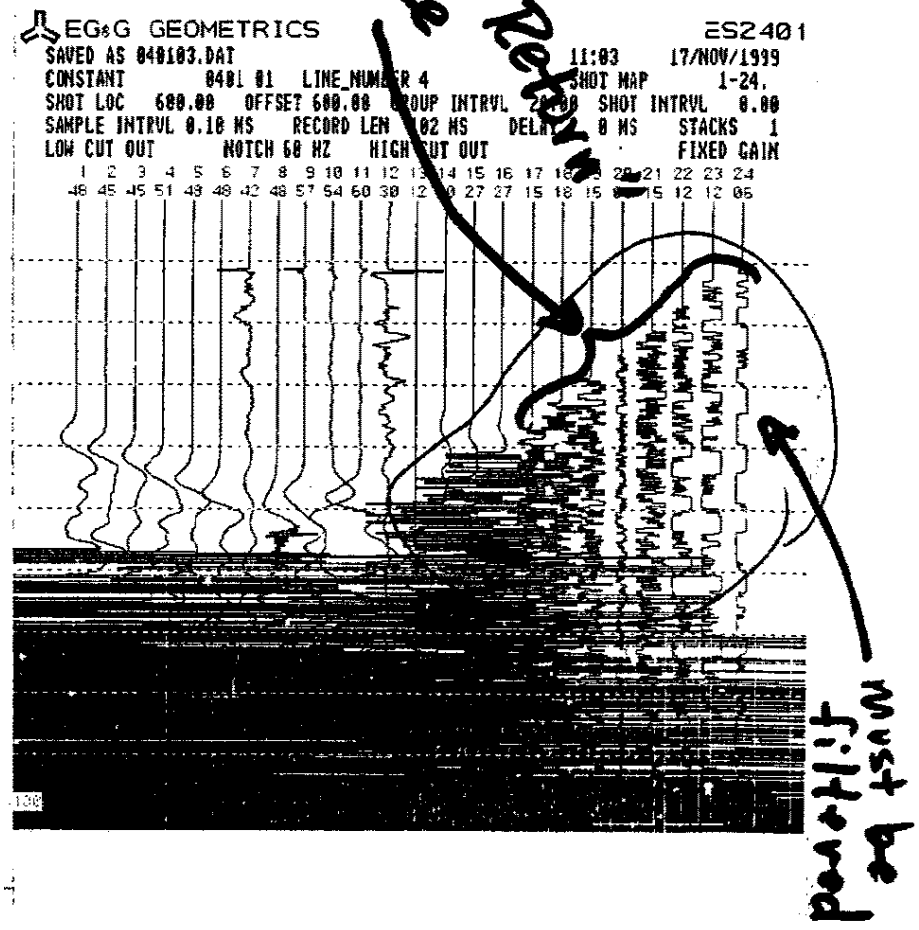


Line 4
(yellow stick)

end shot
EOL - N

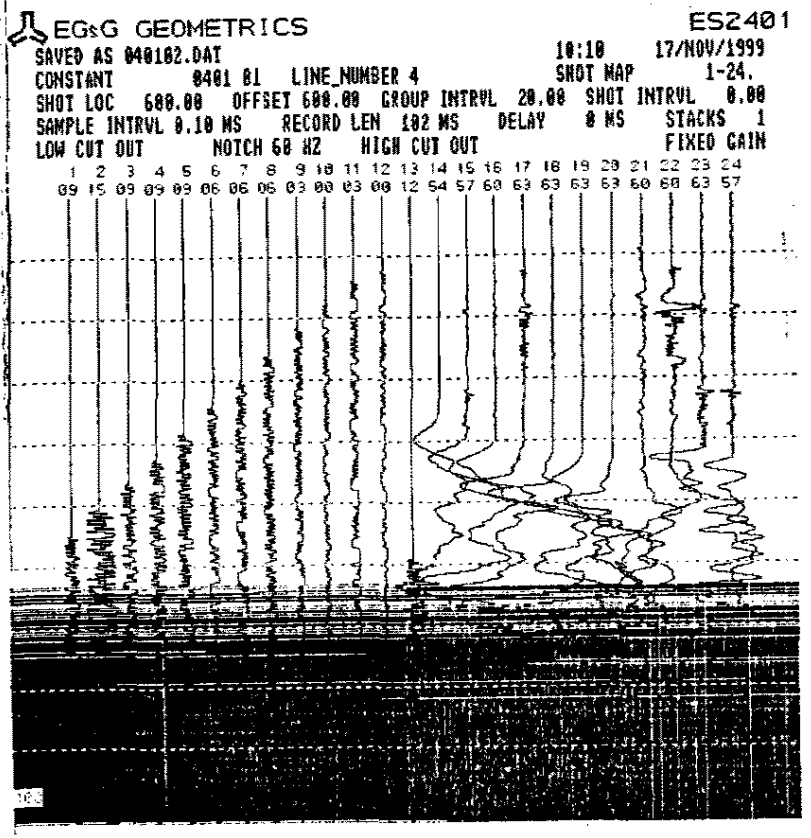
11/17/99

red end of cable



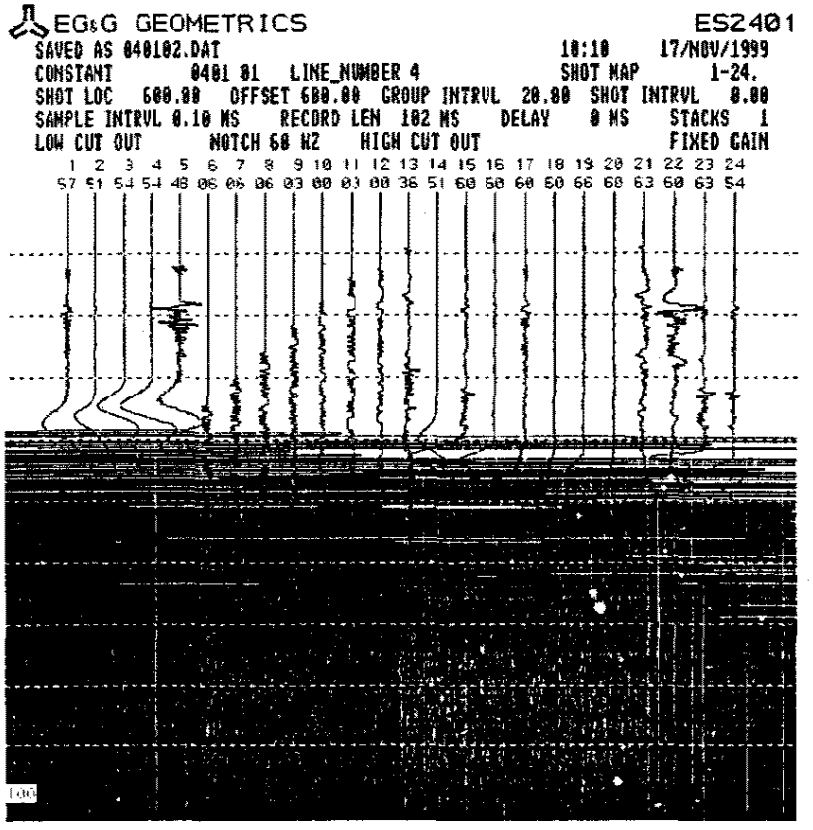
Line 4 End shot 11/17/99

Yellow shot EOL-S red end of cable



Line 4 end shot 11/17/99

yellow shot EOL-S red end of cable

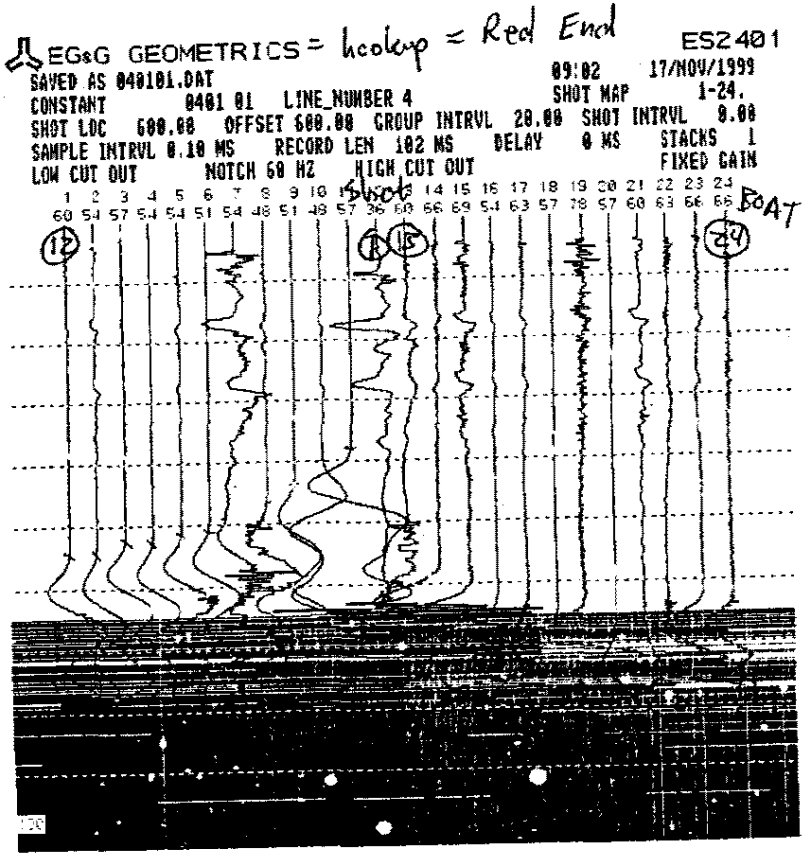


040101

Line 4

11/17/99
0902

Off-end shot ~ 100-200' south of south end of Line 4.

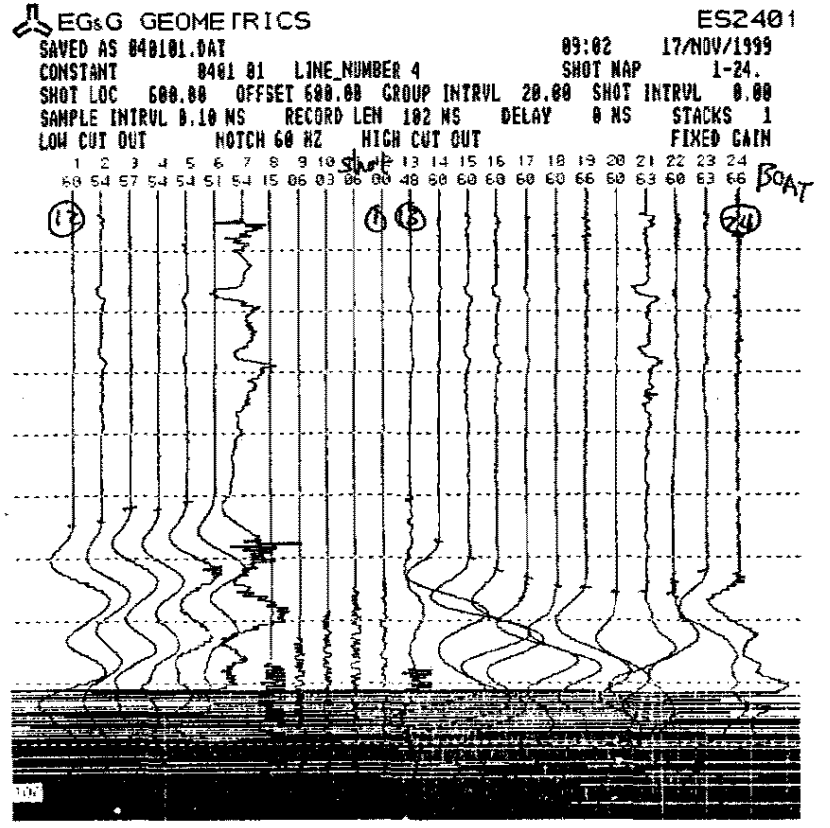


040101

Line 4

11/17/99
0902

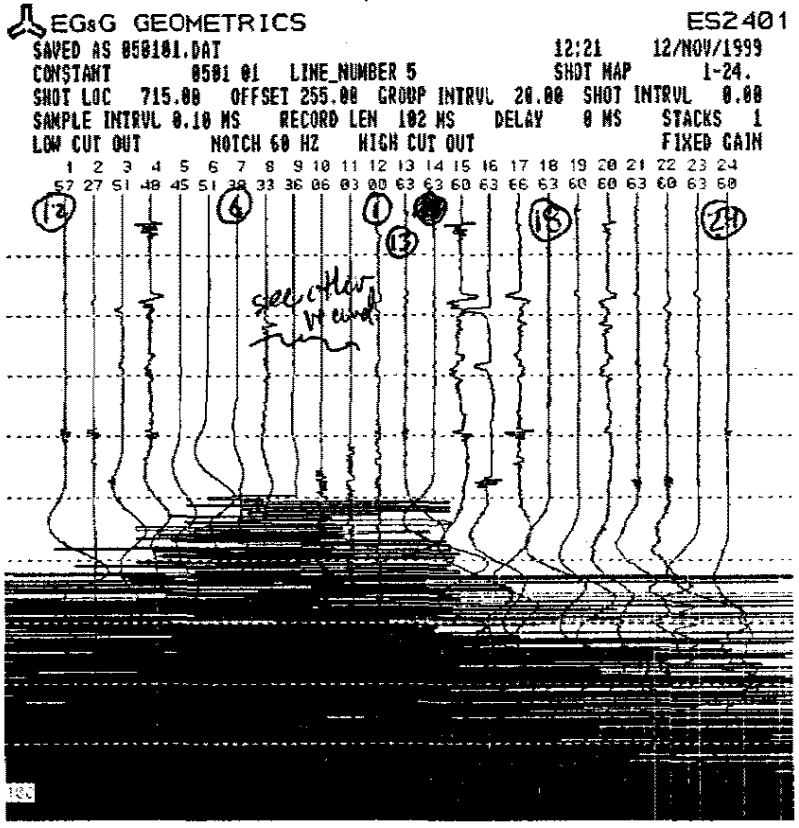
Off-end shot ~ 100-200' south of end of Line 4.



Yellow Cable / Line 5 — 11/12/99 ~1225 PM

Line 5 is the eastern edge of outer wall at north end of CDF "D"

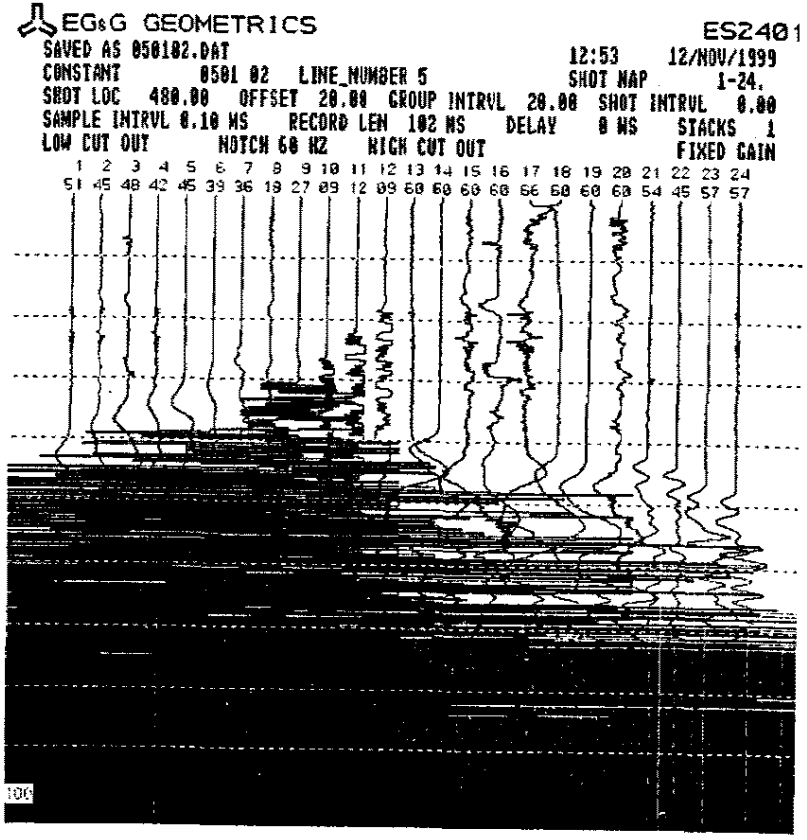
$\boxed{050101}$ offend shot ~ 250' south of the south end of Line 5



Line 5 — End Shot - South end — 11/12/99 ~1255 PM

050102

Yellow

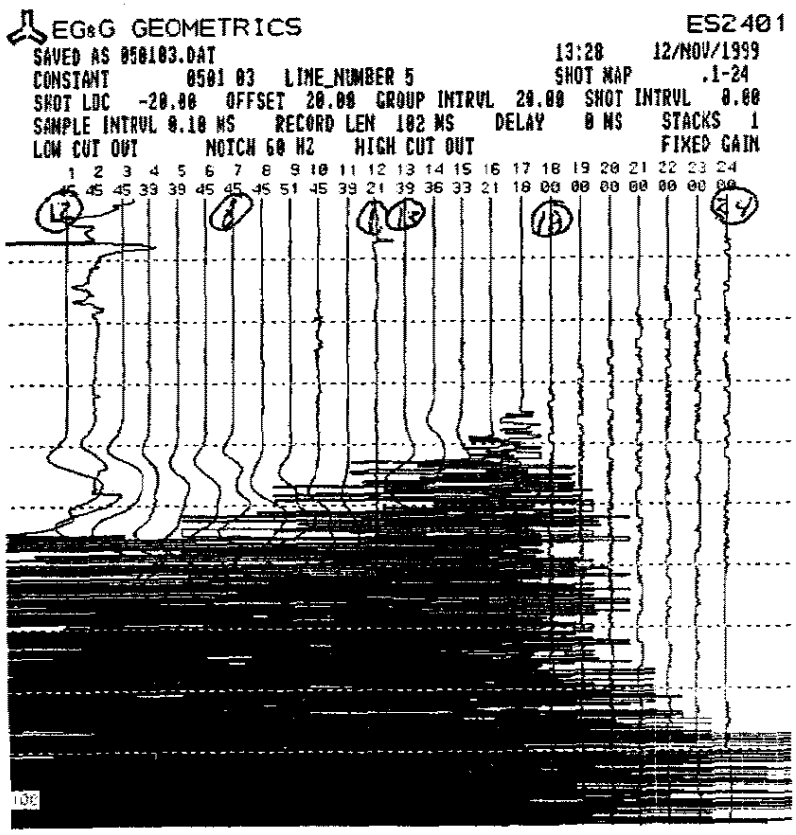


Line 5

11/12/99
~1328

$\boxed{050103}$ End shot at North end of Line 5

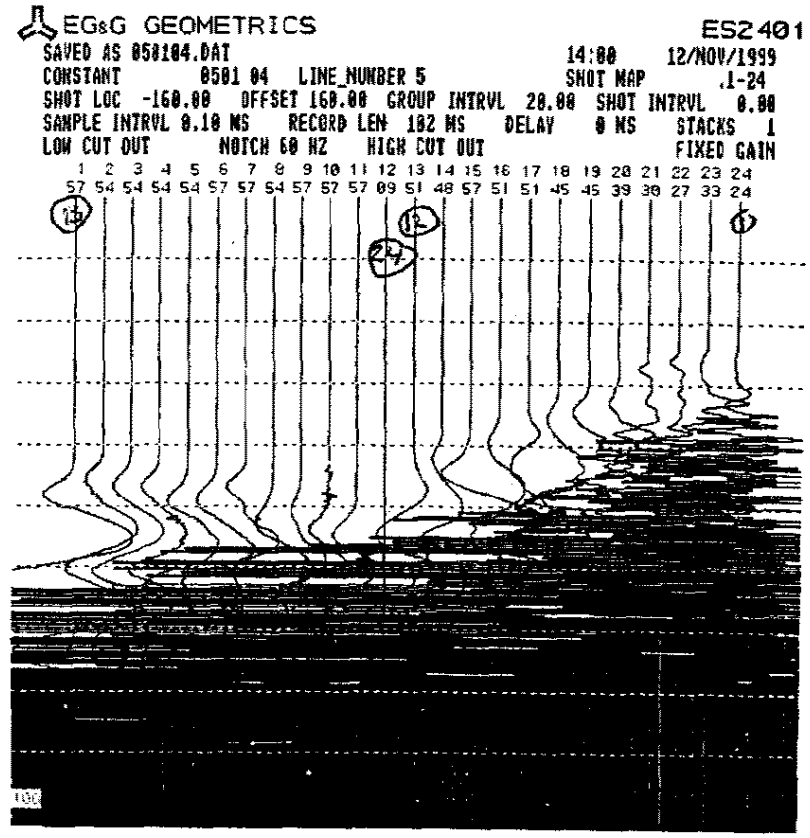
Yellow End



Line 5

11/12/99
~1400

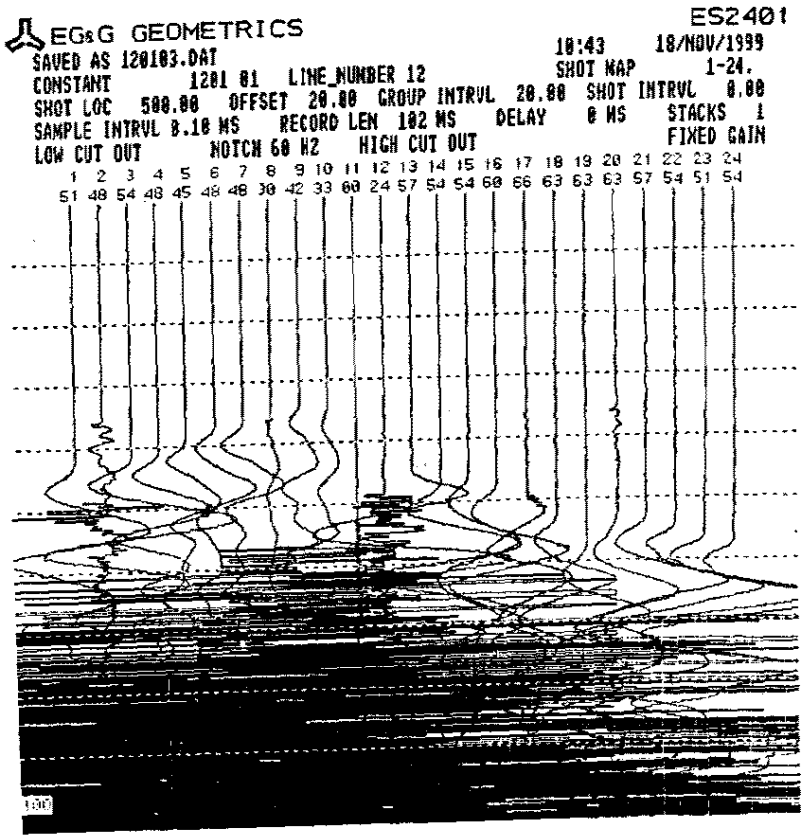
050104 off end shot about 120 feet north of north end of Line 5



120103 off end shot Line 12

off end shot ~ 100 feet [illegible] of line

yellow stake yellow cable

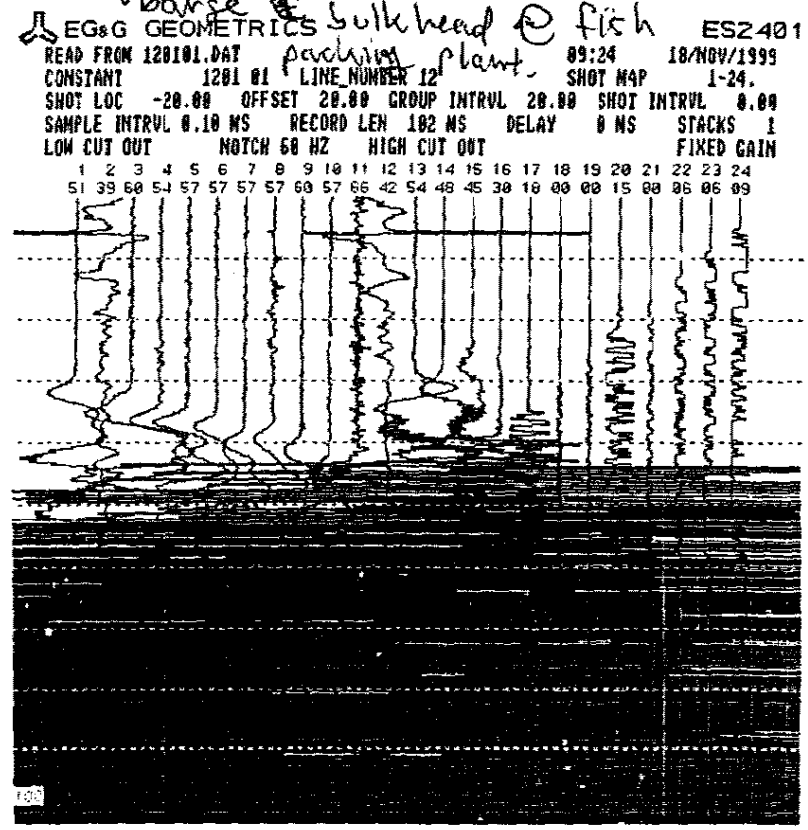


11/18/99
9:24

Line 12

120101

End shot ~ 30' west of the west end of Line 12. Up against bulkhead @ Packer; between barge & bulkhead @ fish packing plant.

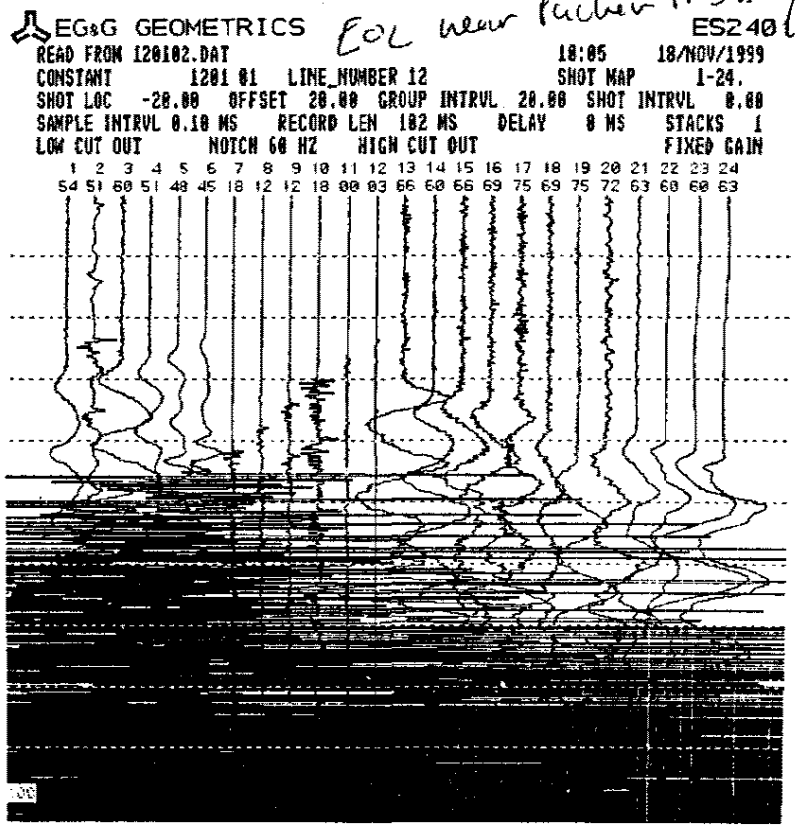


120102

Live 12

11/18/99
1005

End shot ~30' east off east end of Live 12. Yellow stick. EOL near Pucker #3 buoy

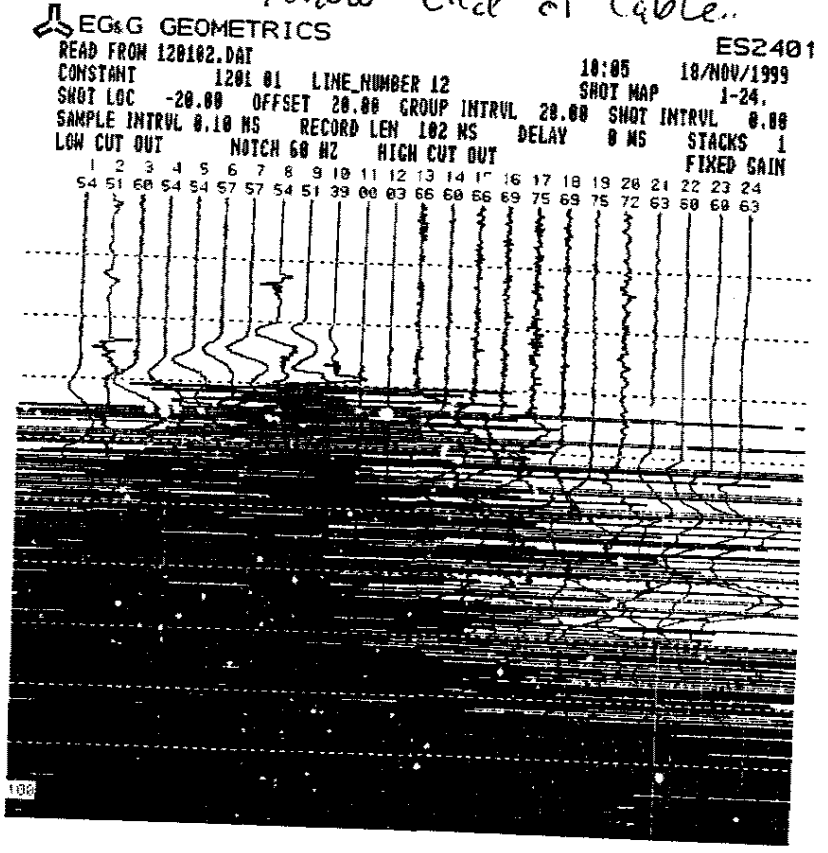


120102

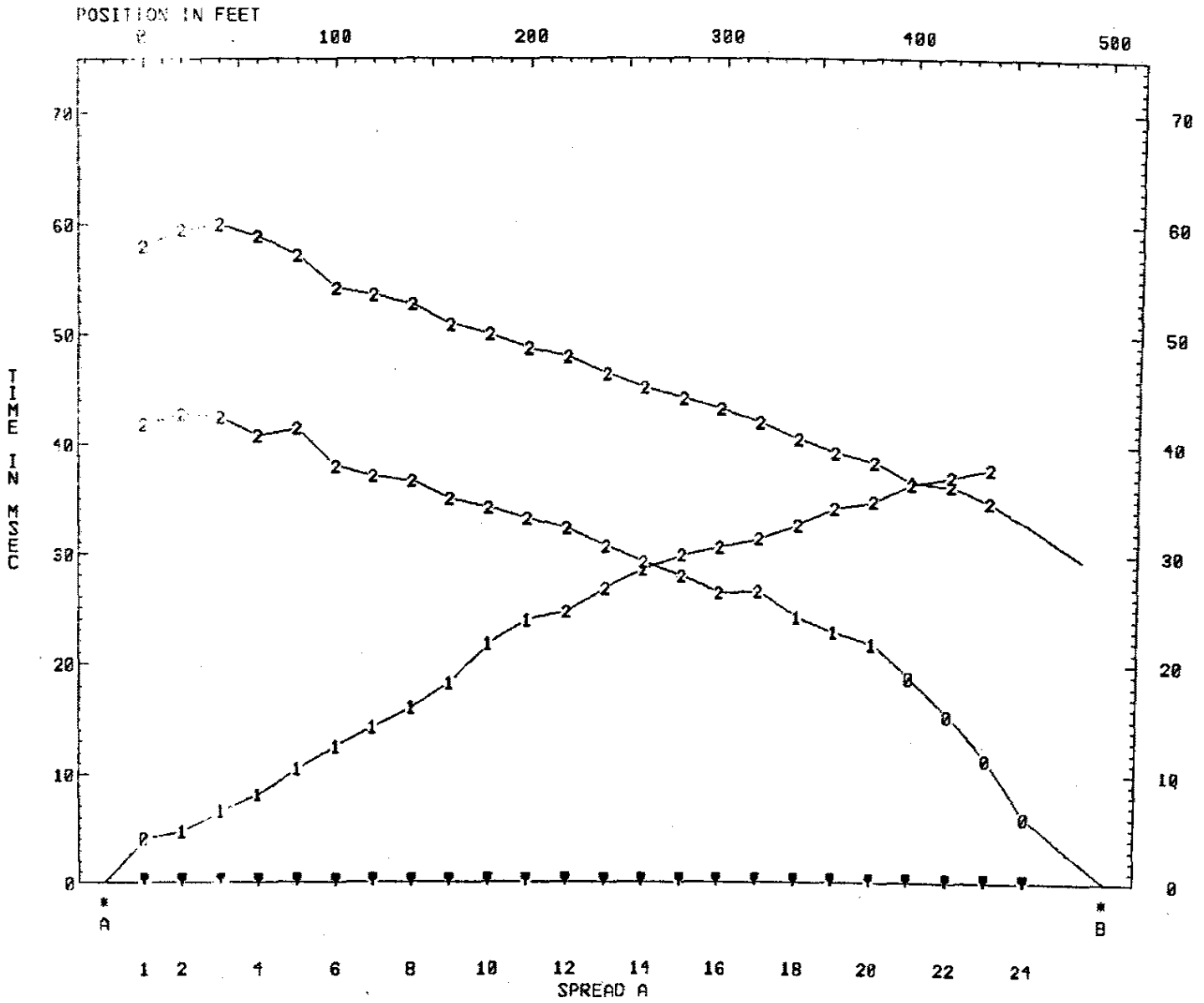
Live 12

11/18/99
1005

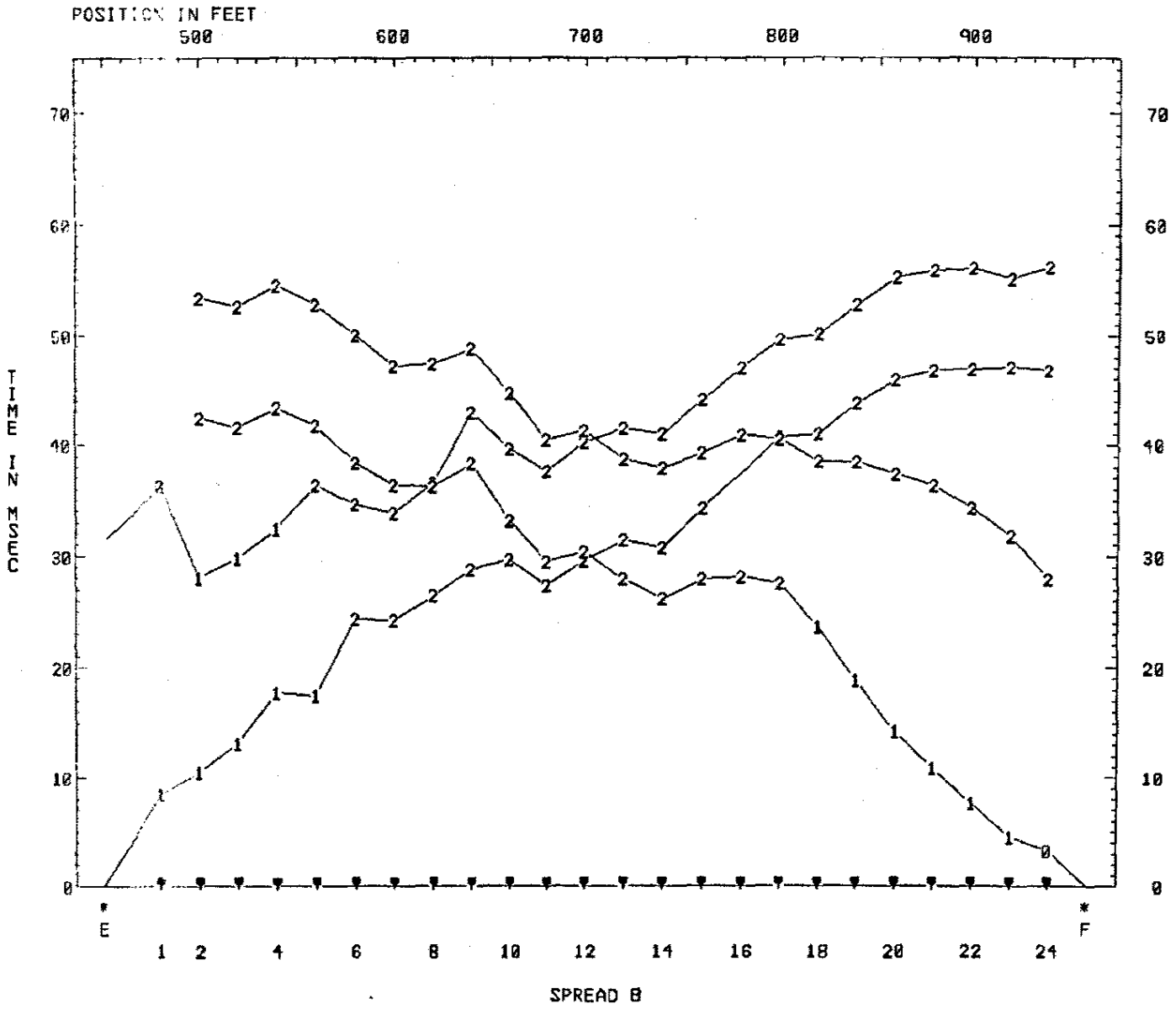
End shot ~30' east of east end of Live 12. Yellow Stick. Yellow End of Cable.



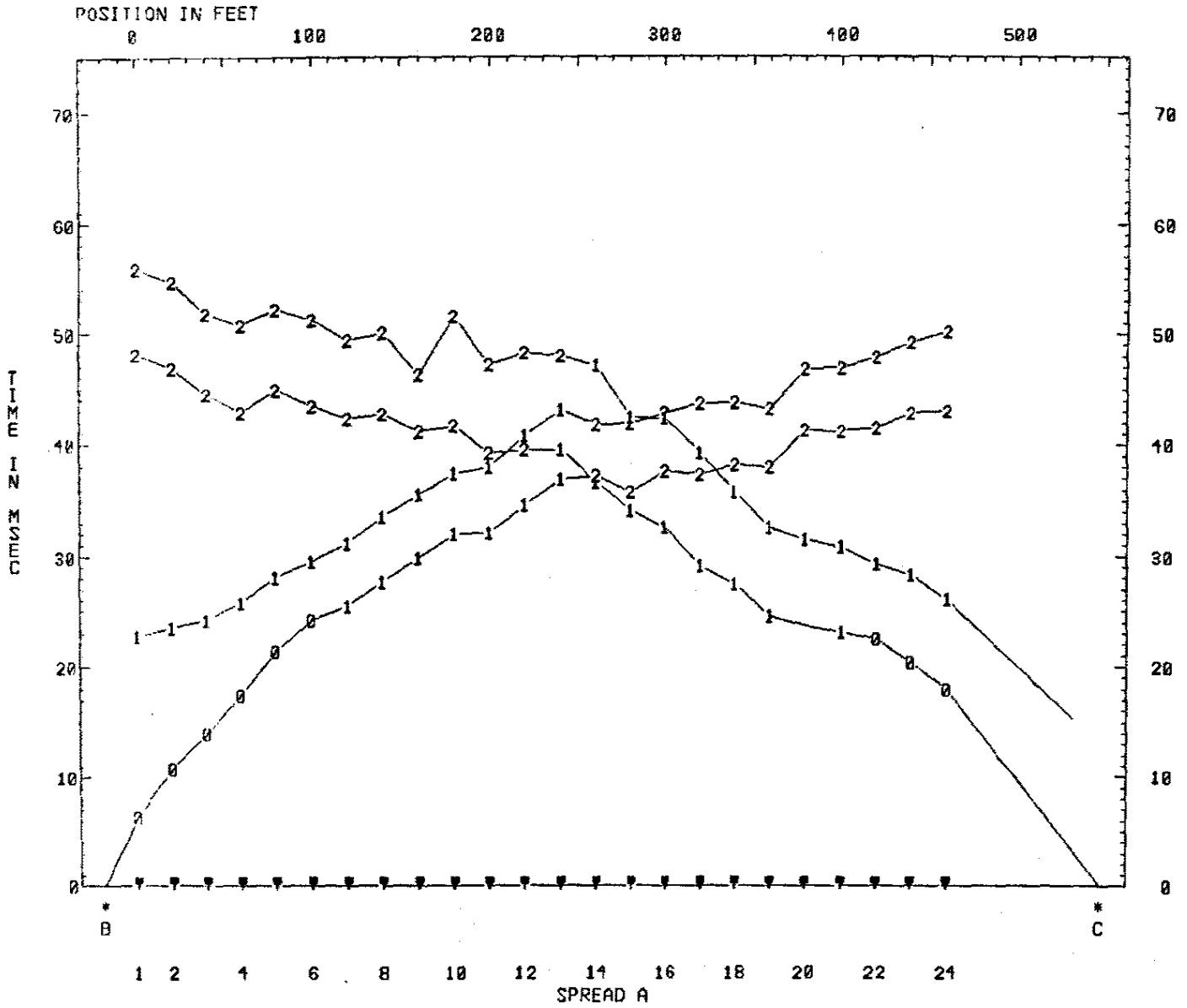
FILE ONETWO.SIP
NBH 1 2 - DATUM-CORRECTED TIMES



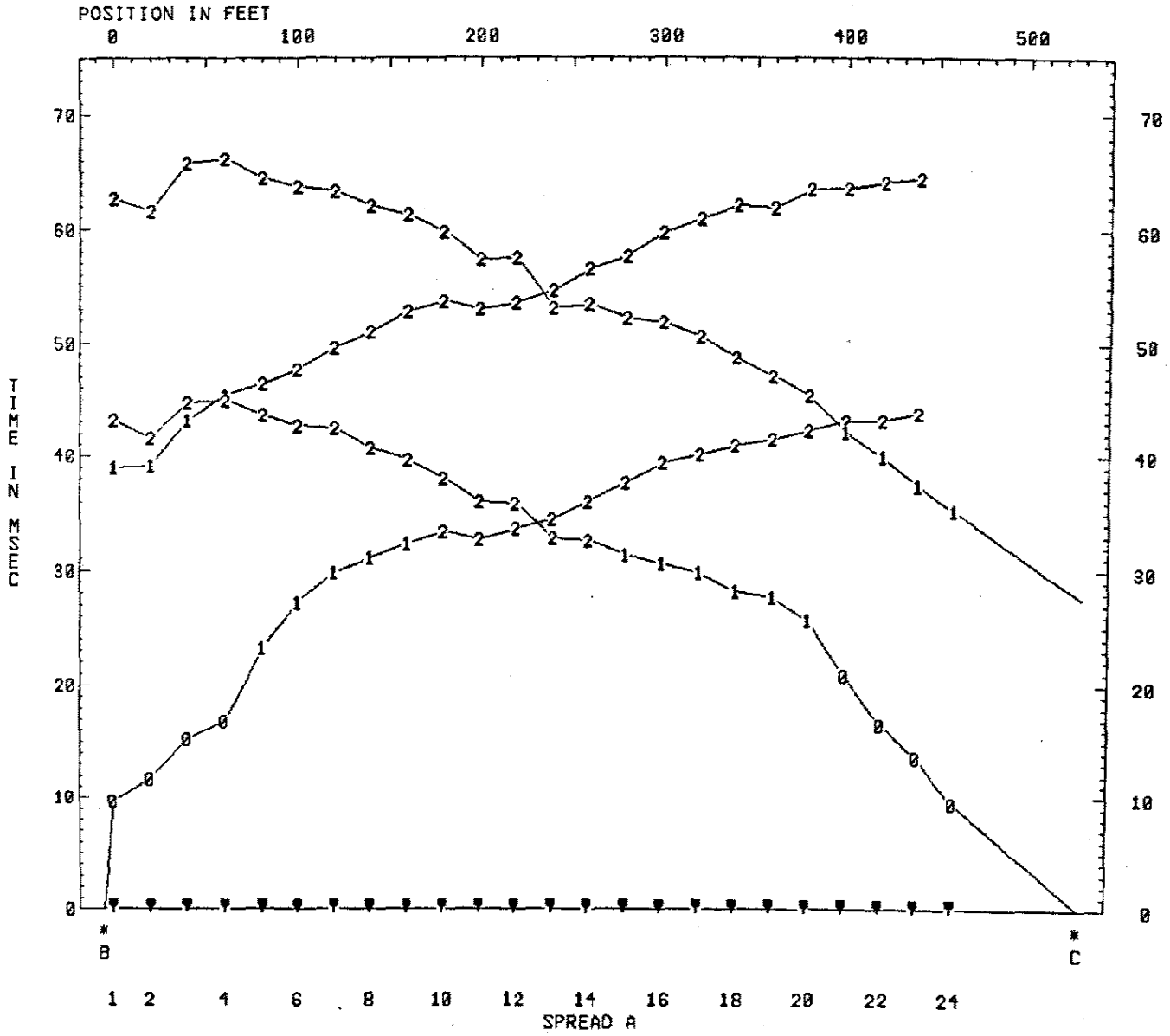
FILE ONETWO.SIP
NBH 1 2 - DATUM-CORRECTED TIMES



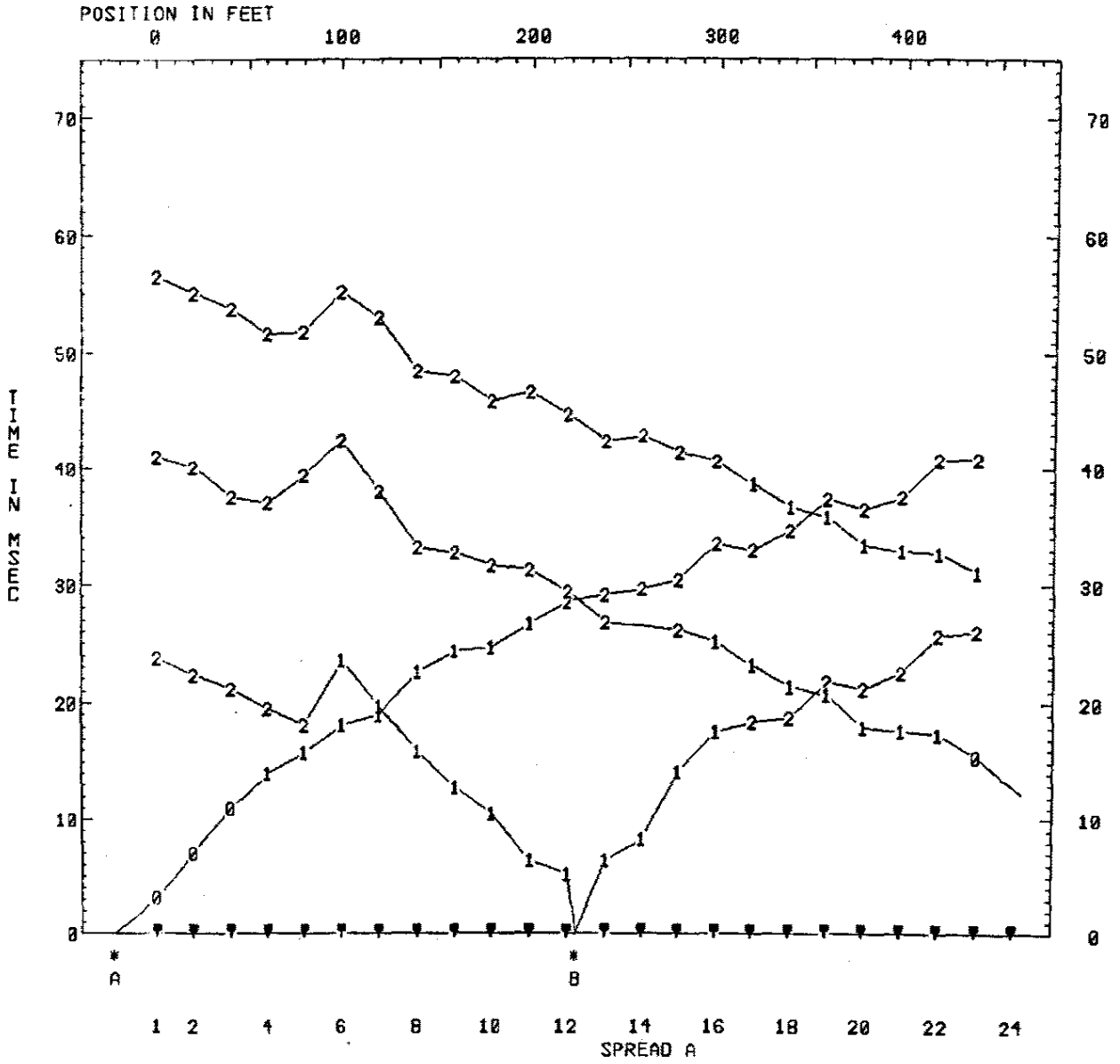
FILE 57911.SIP
NBH 5 7 9 11 - DATUM-CORRECTED TIMES



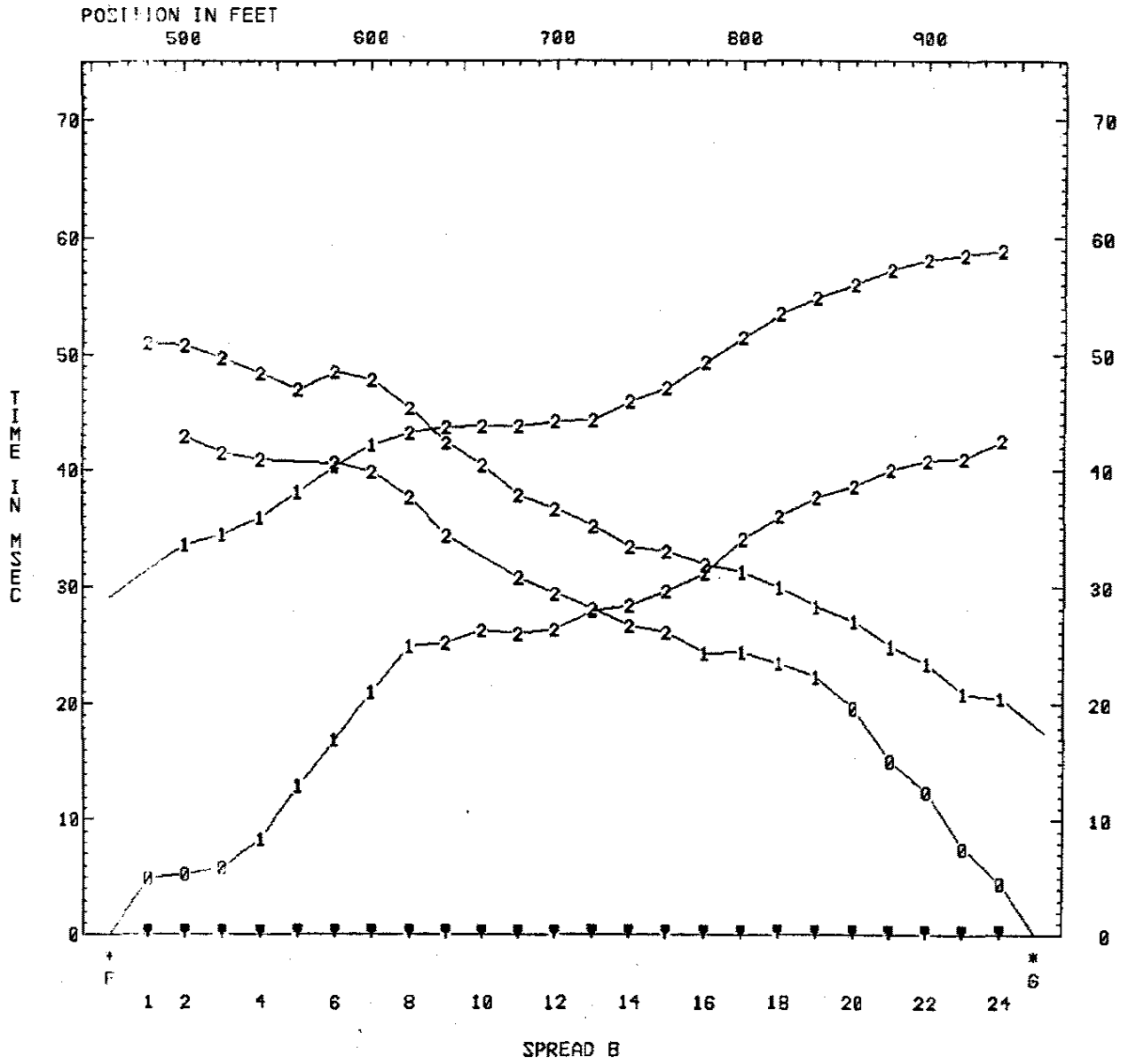
FILE 46810.SIP
NBH LINES 4 6 8 10 WEST EDGE OF COFFFER DAM - DATUM-CORRECTED TIMES



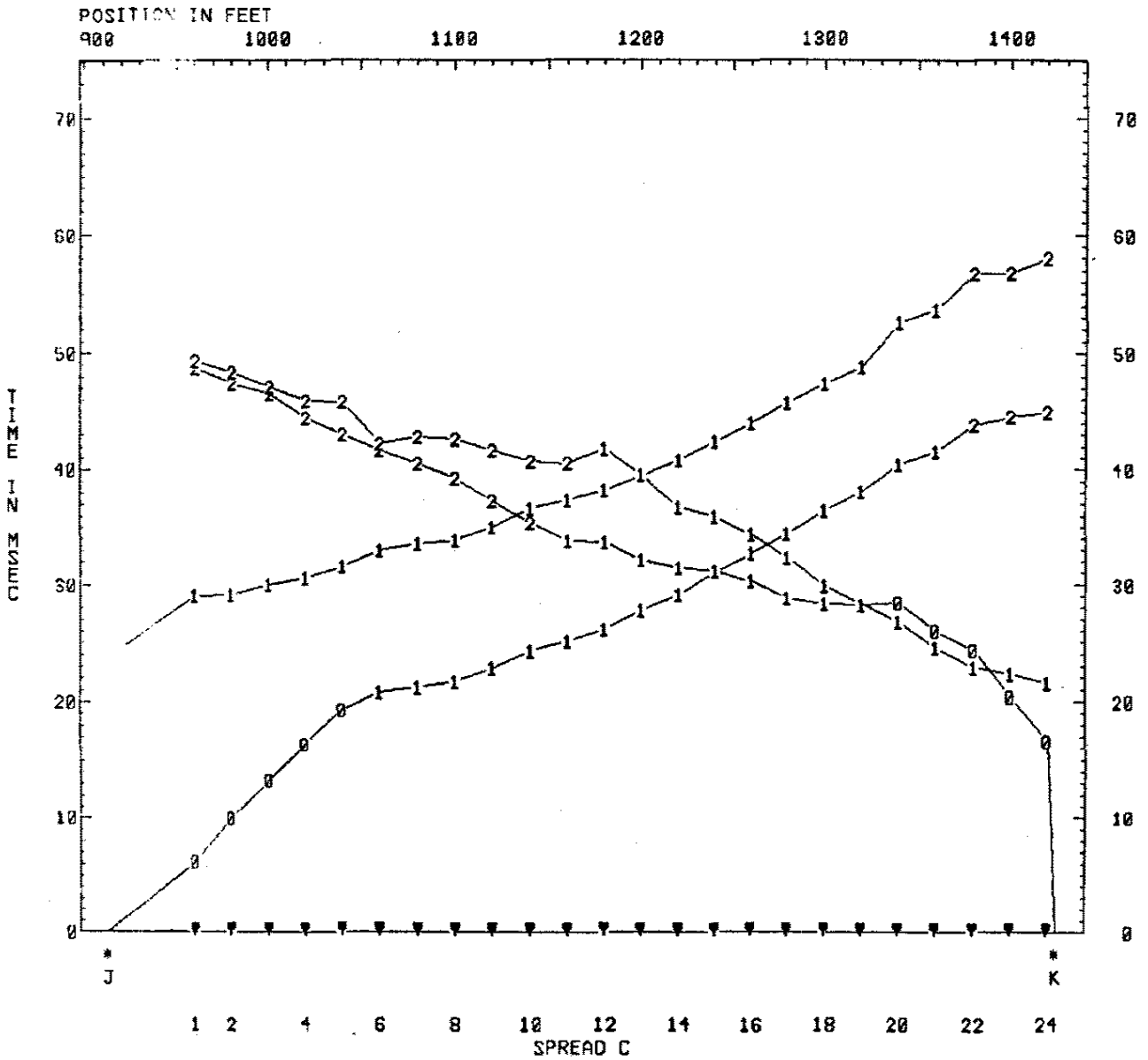
FILE LINE12.SIP
NBH LINE 12 - DATUM-CORRECTED TIMES



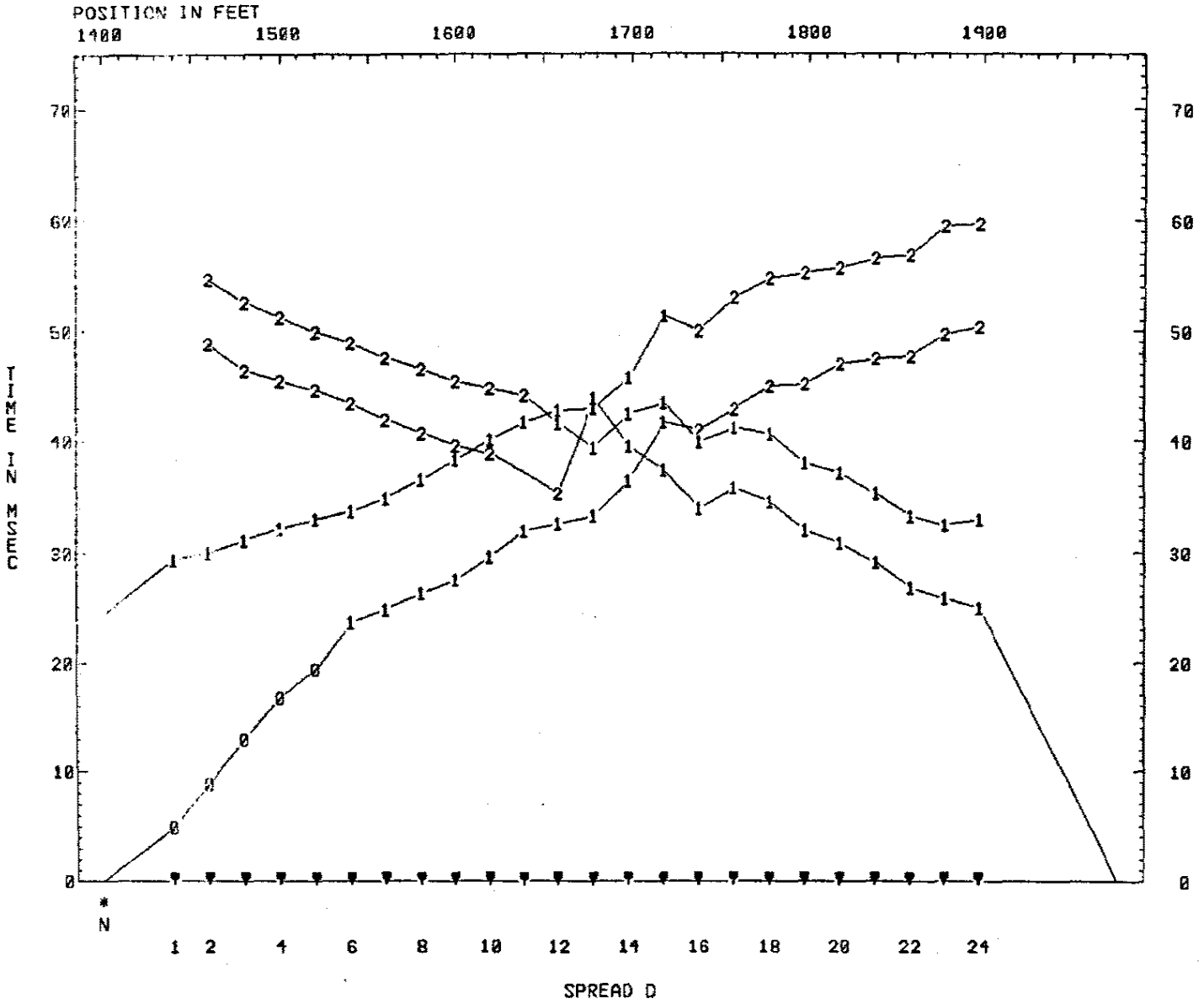
FILE 57911.SIP
NBH 5 7 9 11 - DATUM-CORRECTED TIMES



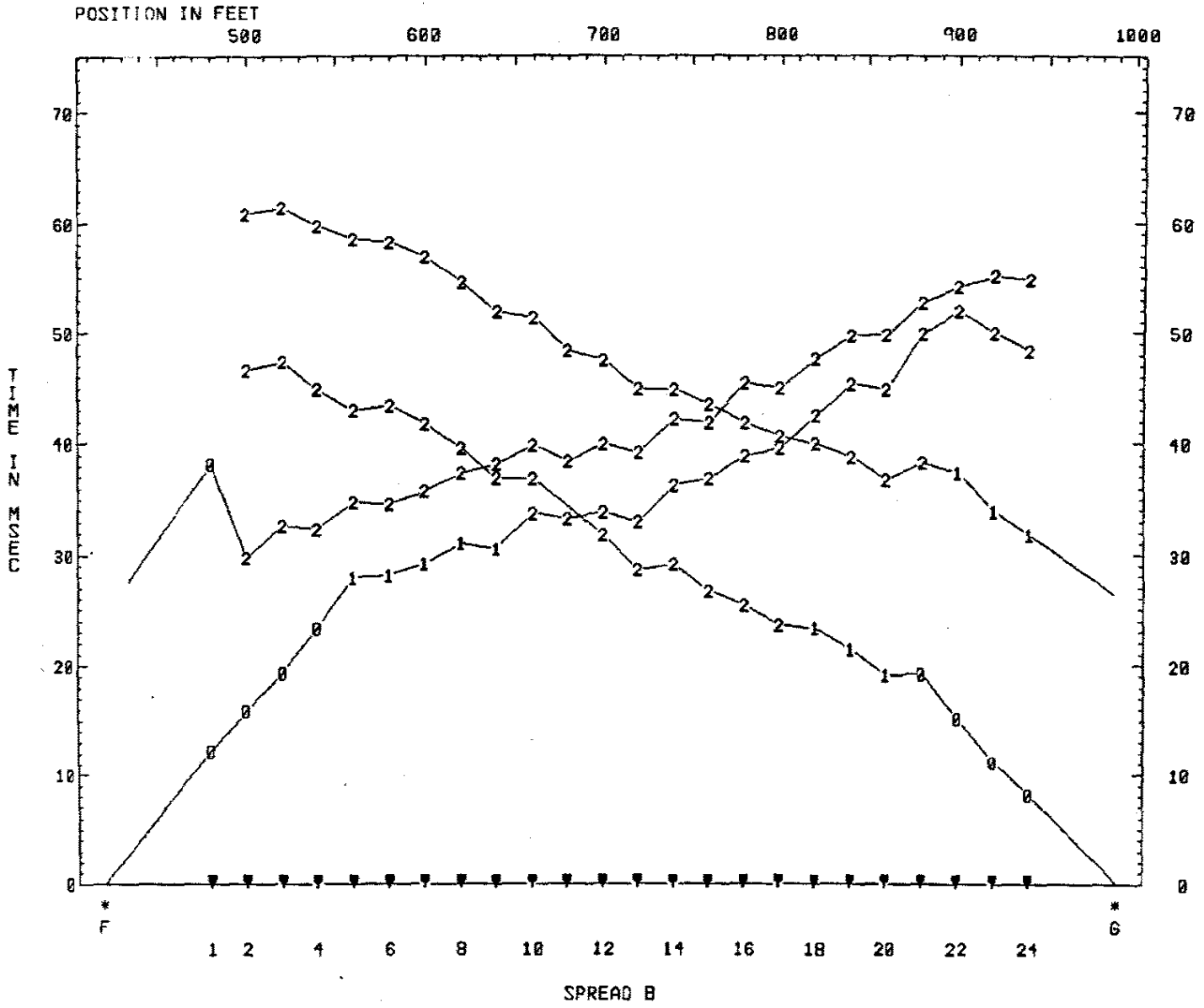
FILE 57911.SIP
NBH 5 7 9 11 - DATUM-CORRECTED TIMES



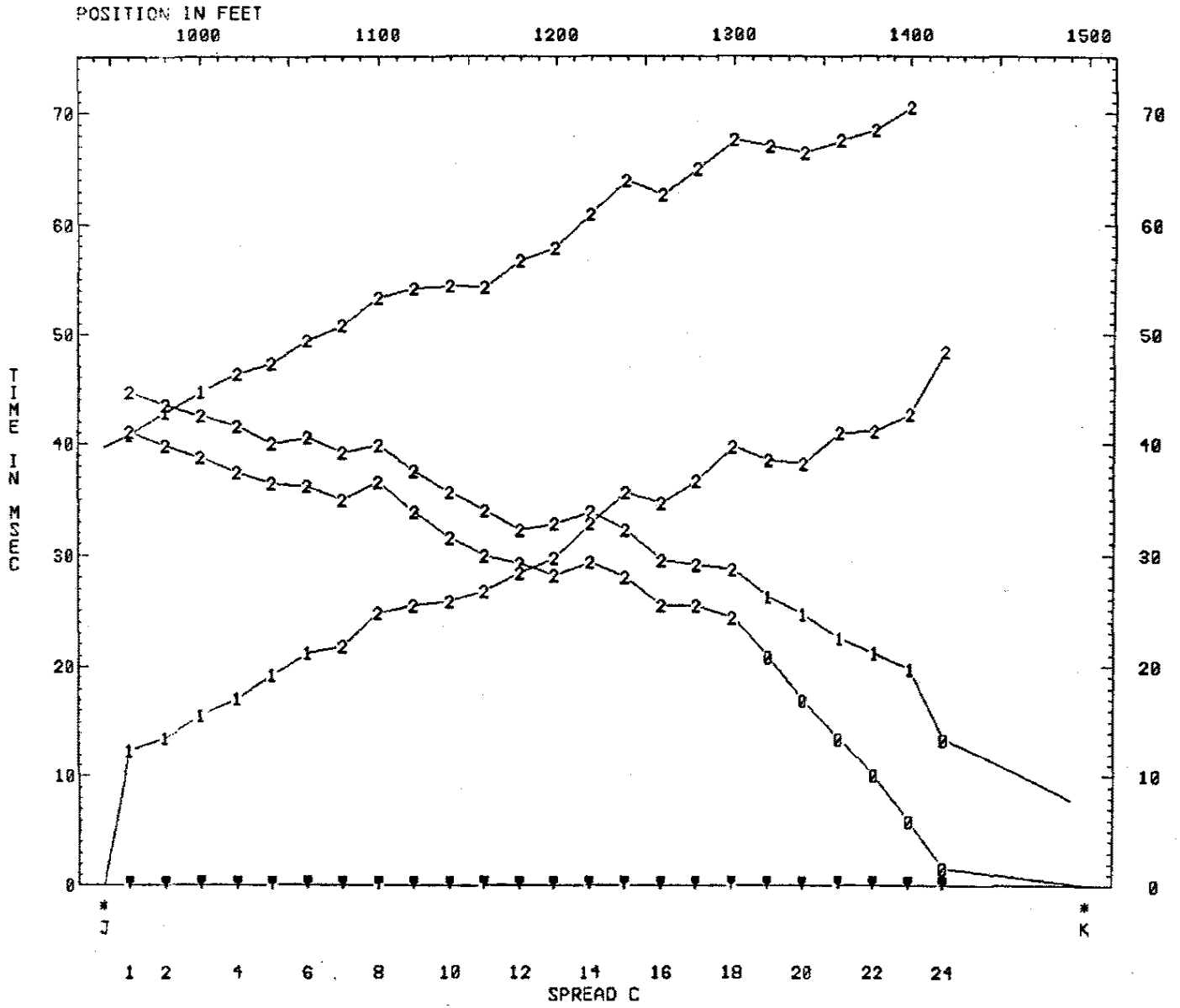
FILE 37911.SIP
NBH 5 / 0 11 - DATUM-CORRECTED TIMES



FILE 16810.SIP
NBH LINES 4 6 8 10 WEST EDGE OF COFFFER DAM - DATUM-CORRECTED TIMES



FILE 16810.SIP
NBH LINES 4 6 8 10 WEST EDGE OF COFFFER DAM - DATUM-CORRECTED TIMES



FILE 46810.SIP
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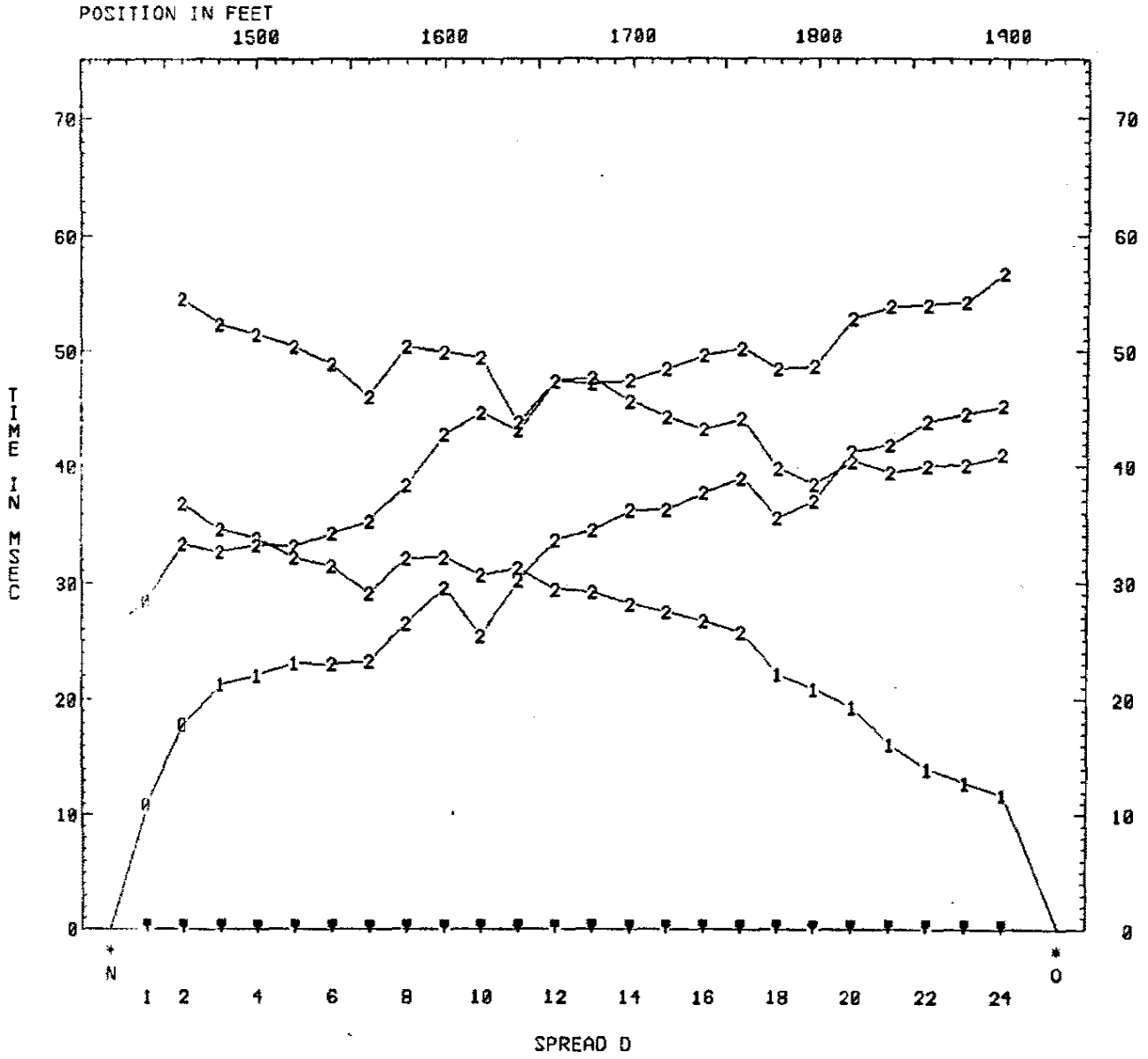


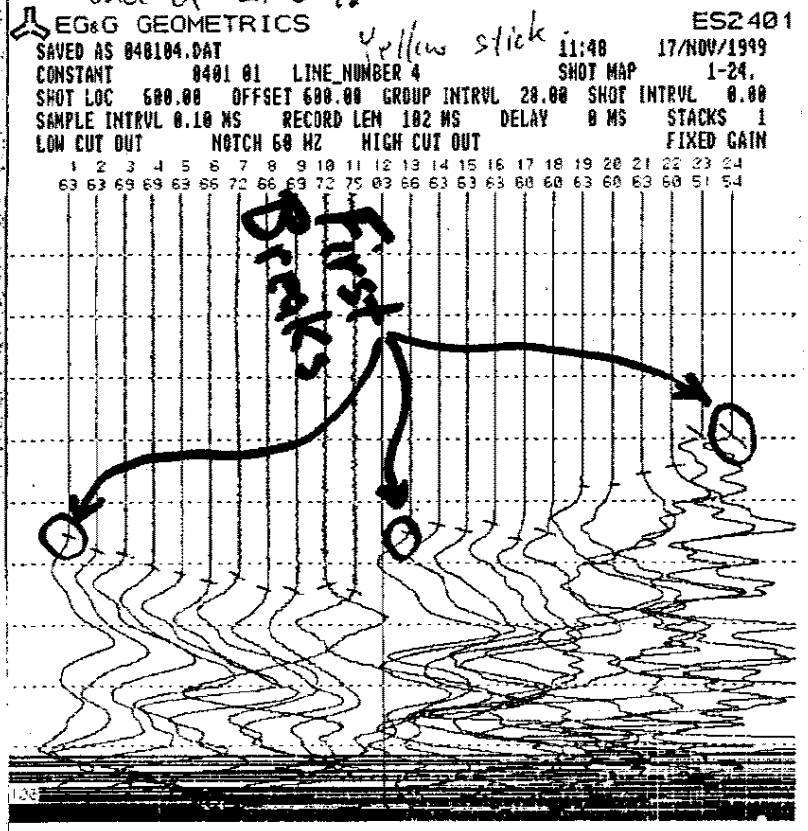
11/17/99
1148

Line 4

040104

Offend shot = shot pt

about 200 feet north of the north end of Line 4.

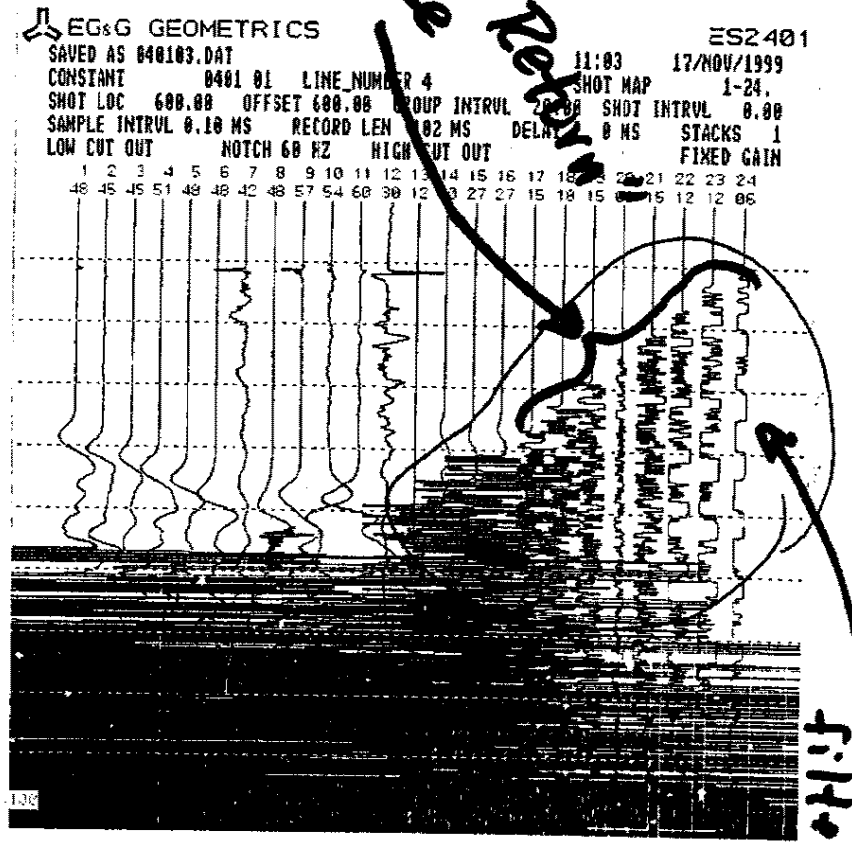


Line 4
(yellow stick)

end shot
EOL - N

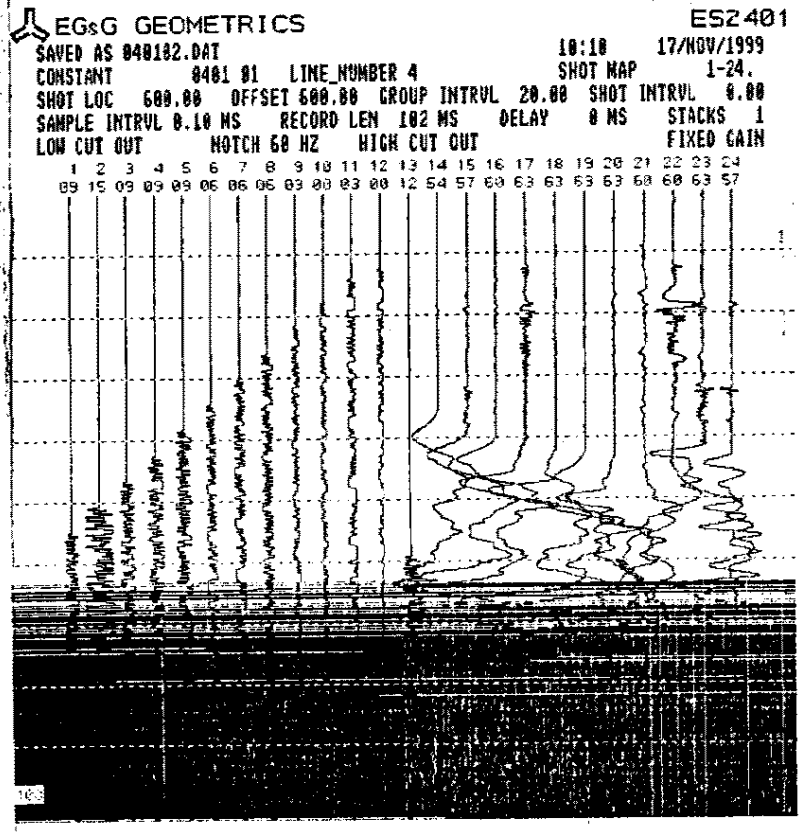
11/17/99

red end of cable



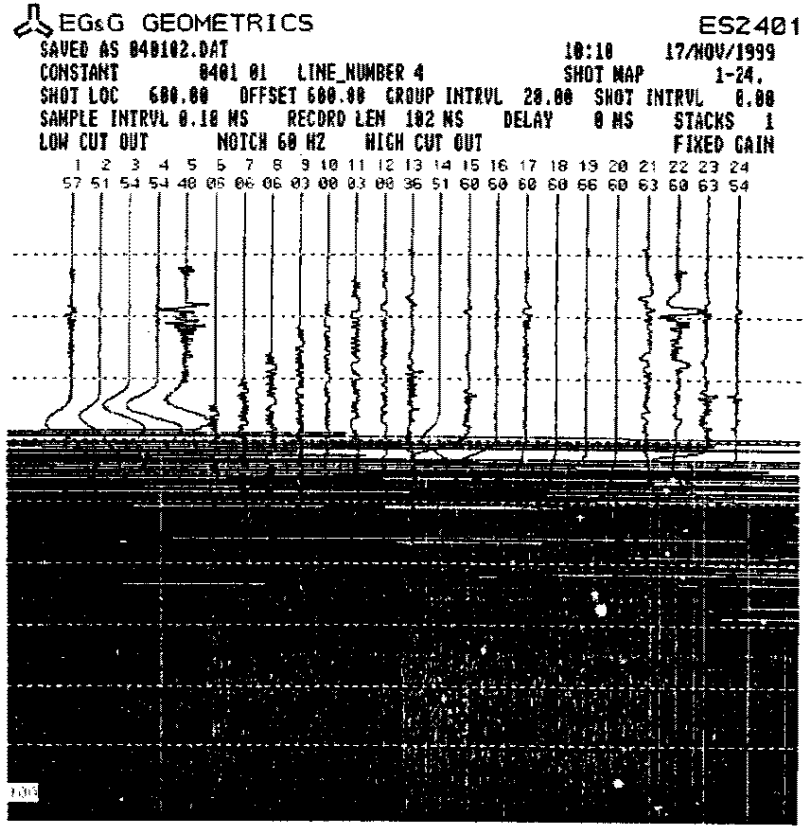
Line 4 End shot 11/17/99

yellow shot EOL-S red end of cable



Line 4 end shot 11/17/99

yellow stick EOL-S red end of cable

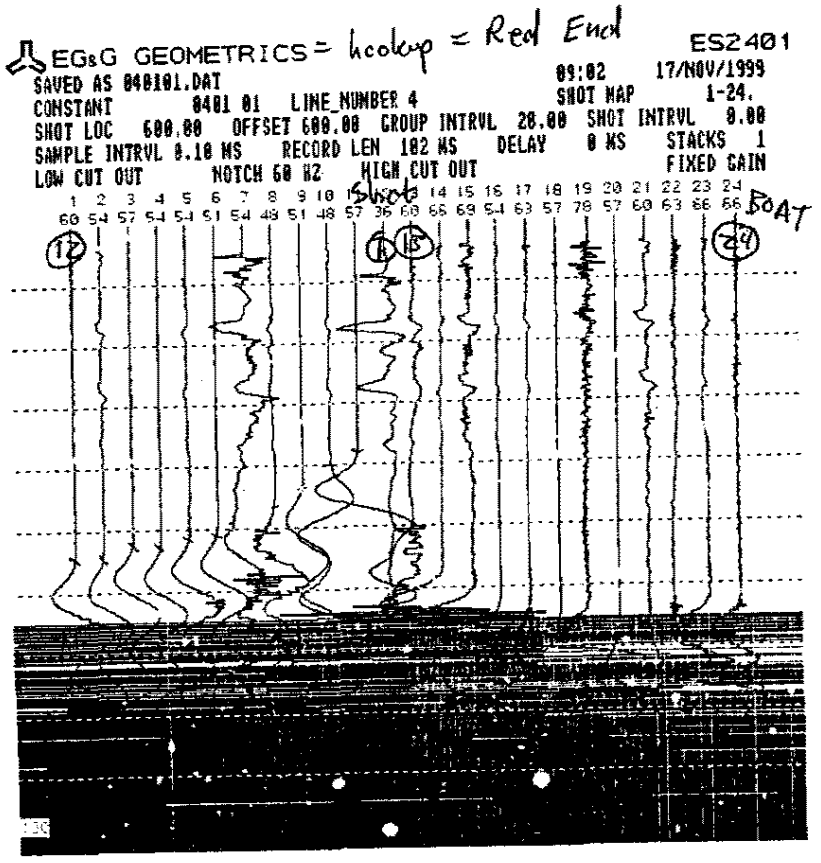


040101

Line 4

11/17/99
0902

Off-end shot ~ 100-200' south of south end of Line 4.

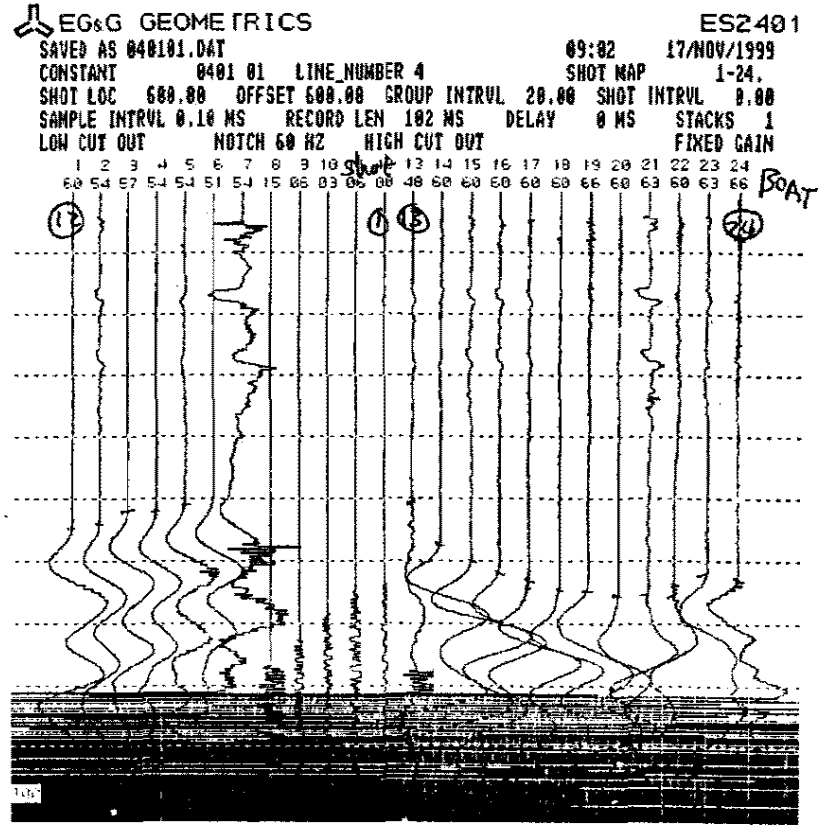


040101

Line 4

11/17/99
0902

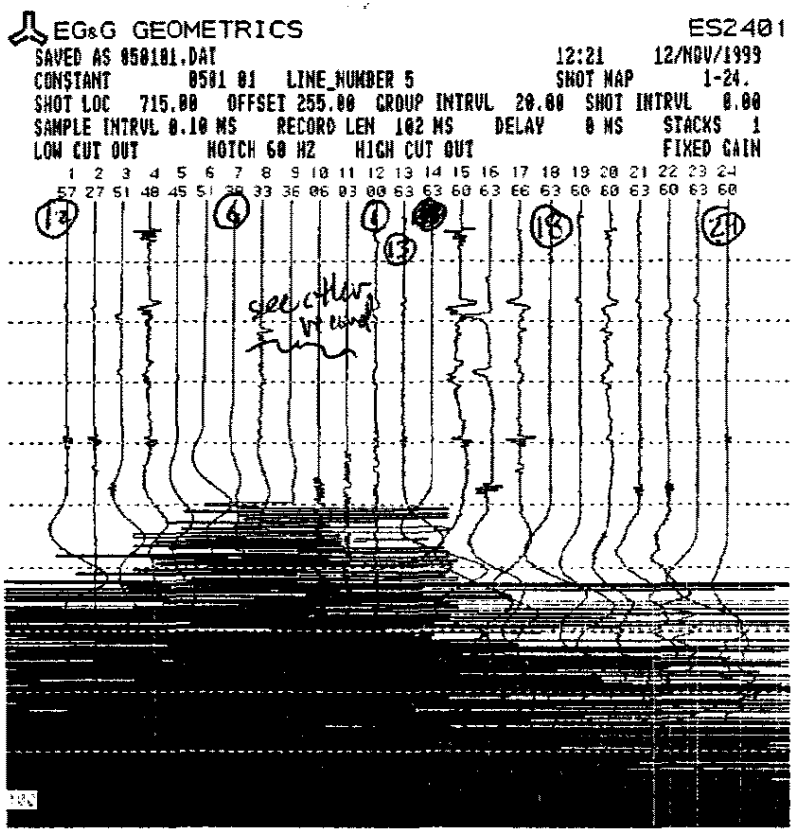
Off-end shot ~ 100-200' south of end of Line 4.



Yellow Cable / Line 5 — 11/12/99 ~1225 PM

Line 5 is the eastern edge of outer wall at north end of CDF "D"

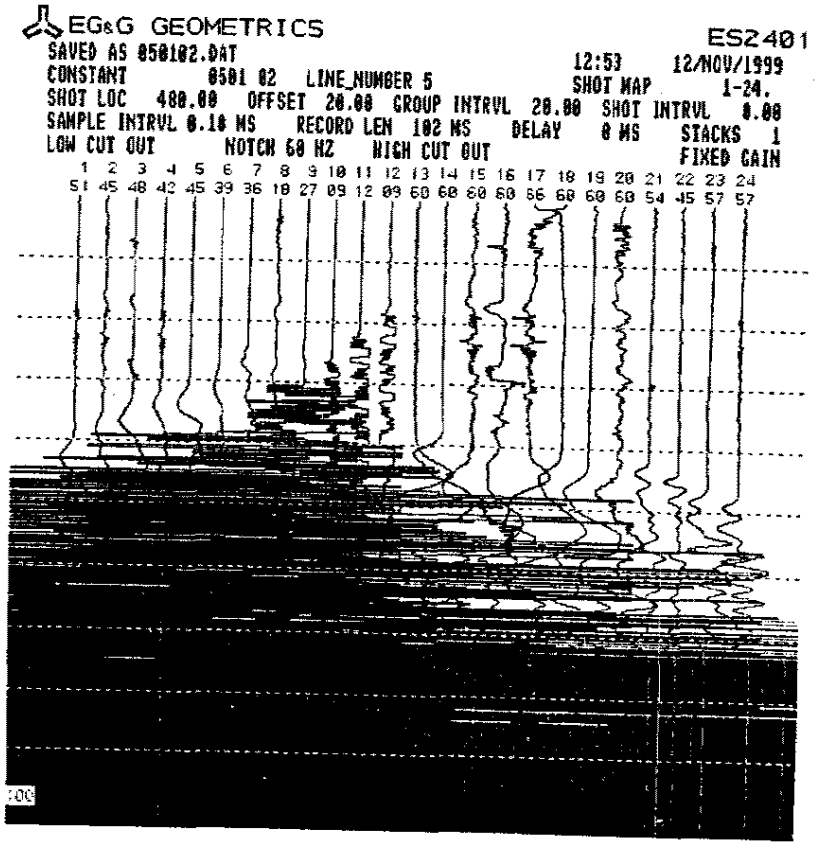
$\boxed{050101}$ offend shot ~ 250' south of the south end of Line 5



Line 5 — End Shot - South end — 11/12/99 ~1255 PM

050102

Yellow

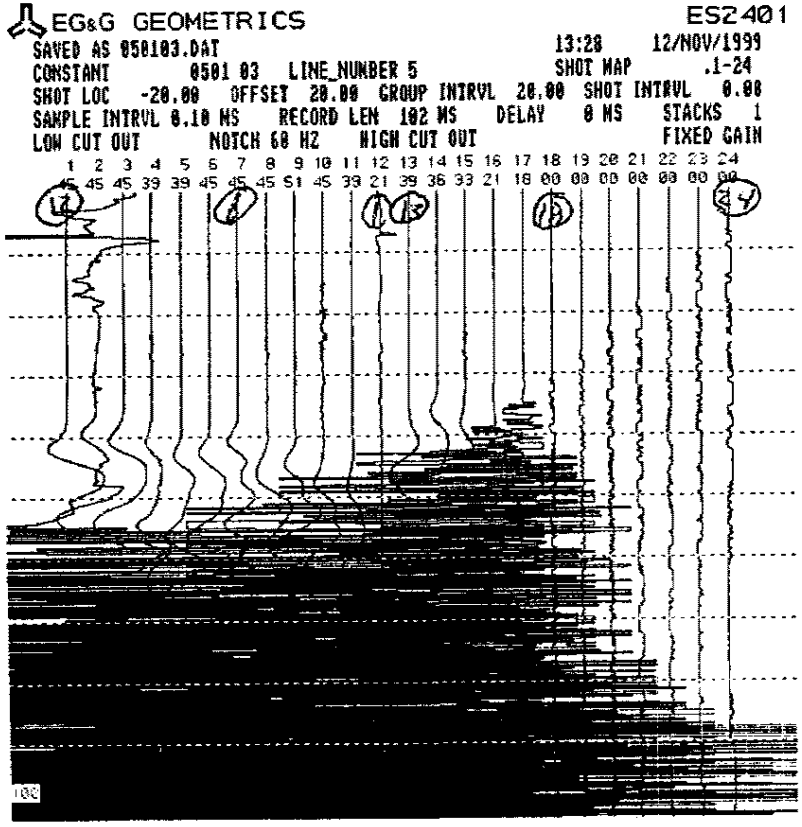


Line 5

11/12/99
~1328

$\boxed{050103}$ End shot at North end of Line 5

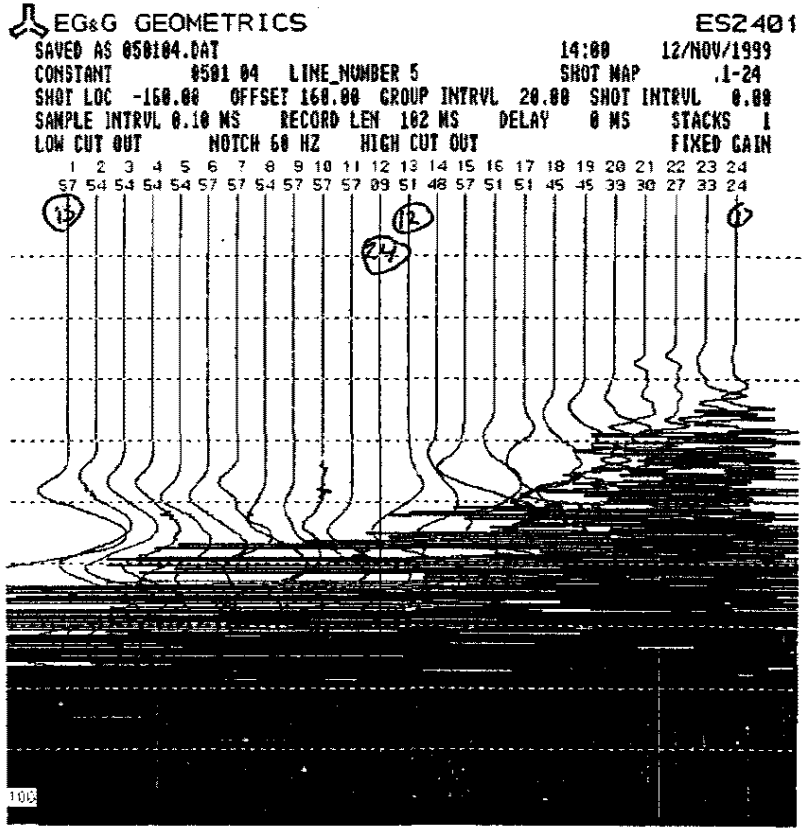
Yellow End



Line 5

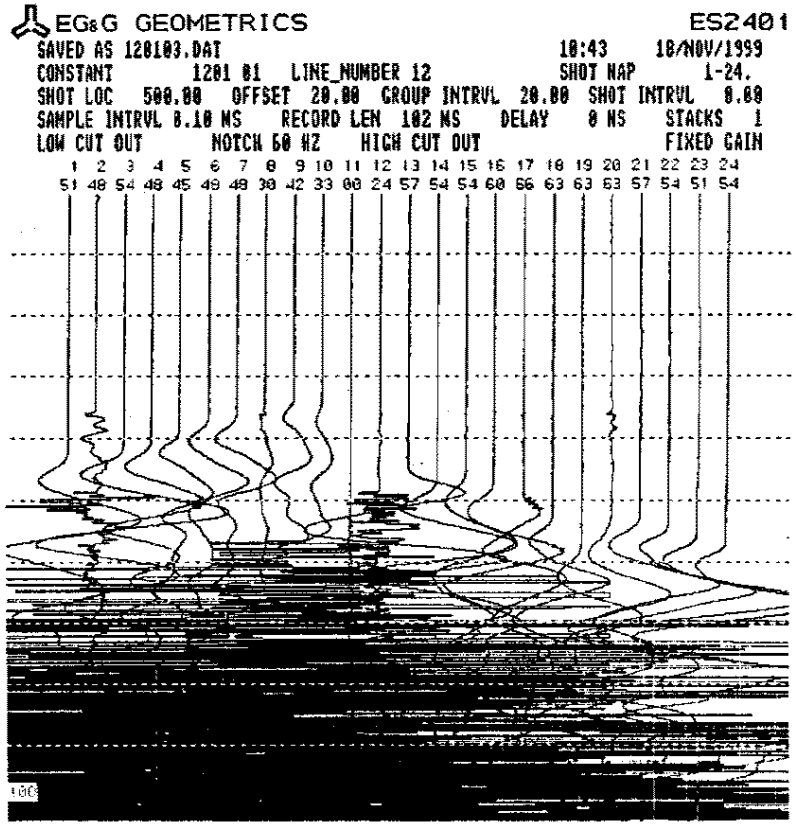
11/12/99
~1400

050104 off end shot about 120 feet north of north end of Line 5



120103 off end shot Line 12

off end shot ~ 100 feet E of line
yellow stake yellow cable

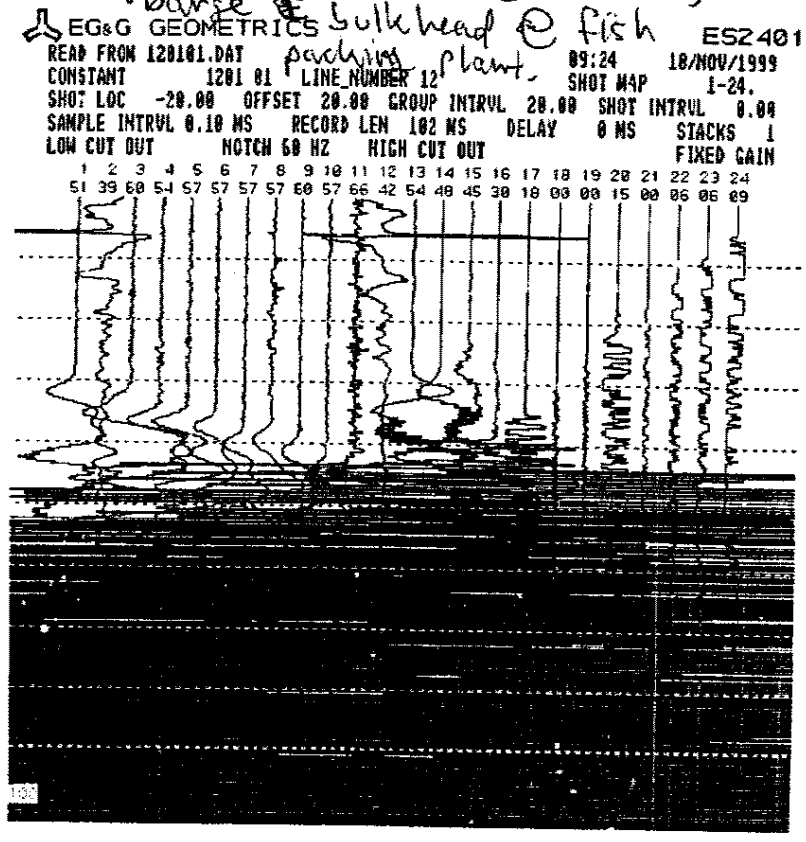


Line 12

11/18/99
9:24

120101

End shot ~ 30' West of the west end of Line 12. Up against bulkhead @ Packer; between barge & bulkhead @ fish packing plant.



Line 12

11/18/99

1005

120102

End shot ~30' east off east end of Line 12. Yellow stick.

EOL near fuchsia #3 buoy

EG&G GEOMETRICS ES2401

READ FROM 120102.DAT 10:05 18/NOV/1999

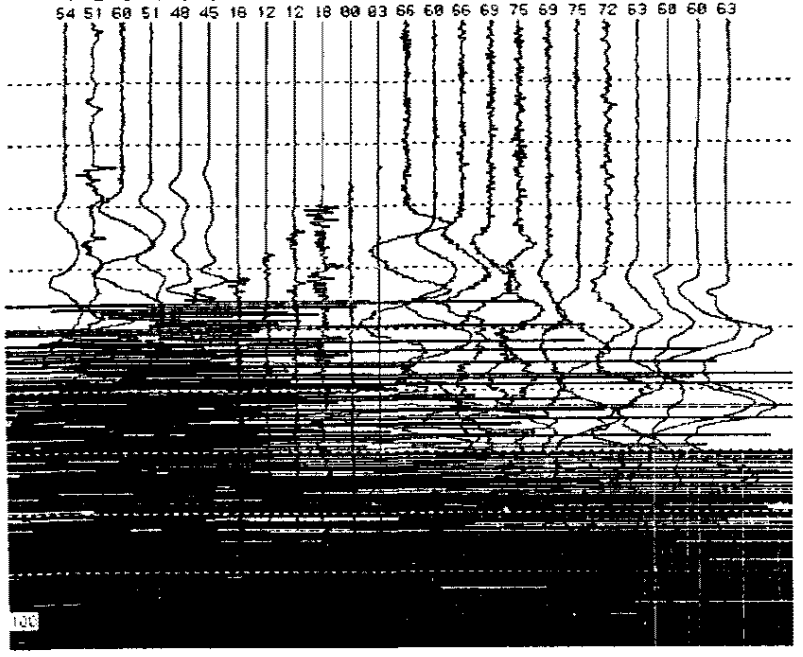
CONSTANT 1201 01 LINE_NUMBER 12 SHOT MAP 1-24.

SHOT LOC -20.00 OFFSET 20.00 GROUP INTRVL 20.00 SHOT INTRVL 0.00

SAMPLE INTRVL 0.10 MS RECORD LEN 102 MS DELAY 0 MS STACKS 1

LOW CUT OUT NOTCH 60 HZ HIGH CUT OUT FIXED GAIN

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
54	51	60	51	48	45	18	12	12	18	00	03	66	60	66	69	75	69	75	72	63	60	60	63



Line 12

11/18/99

1005

120102

End shot ~30' east of east end of Line 12. Yellow Stick.

Yellow End of Cable.

EG&G GEOMETRICS ES2401

READ FROM 120102.DAT 10:05 18/NOV/1999

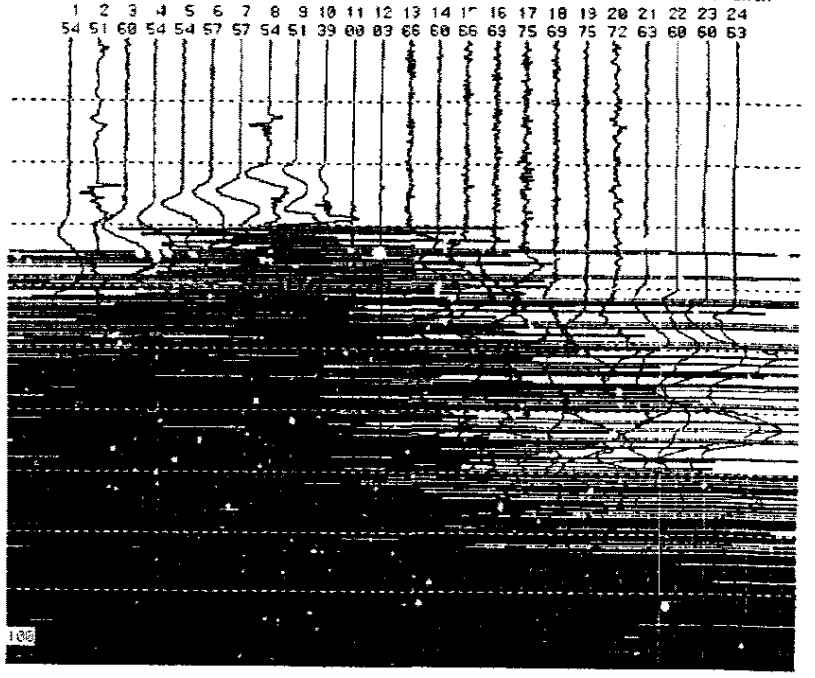
CONSTANT 1201 01 LINE_NUMBER 12 SHOT MAP 1-24.

SHOT LOC -20.00 OFFSET 20.00 GROUP INTRVL 20.00 SHOT INTRVL 0.00

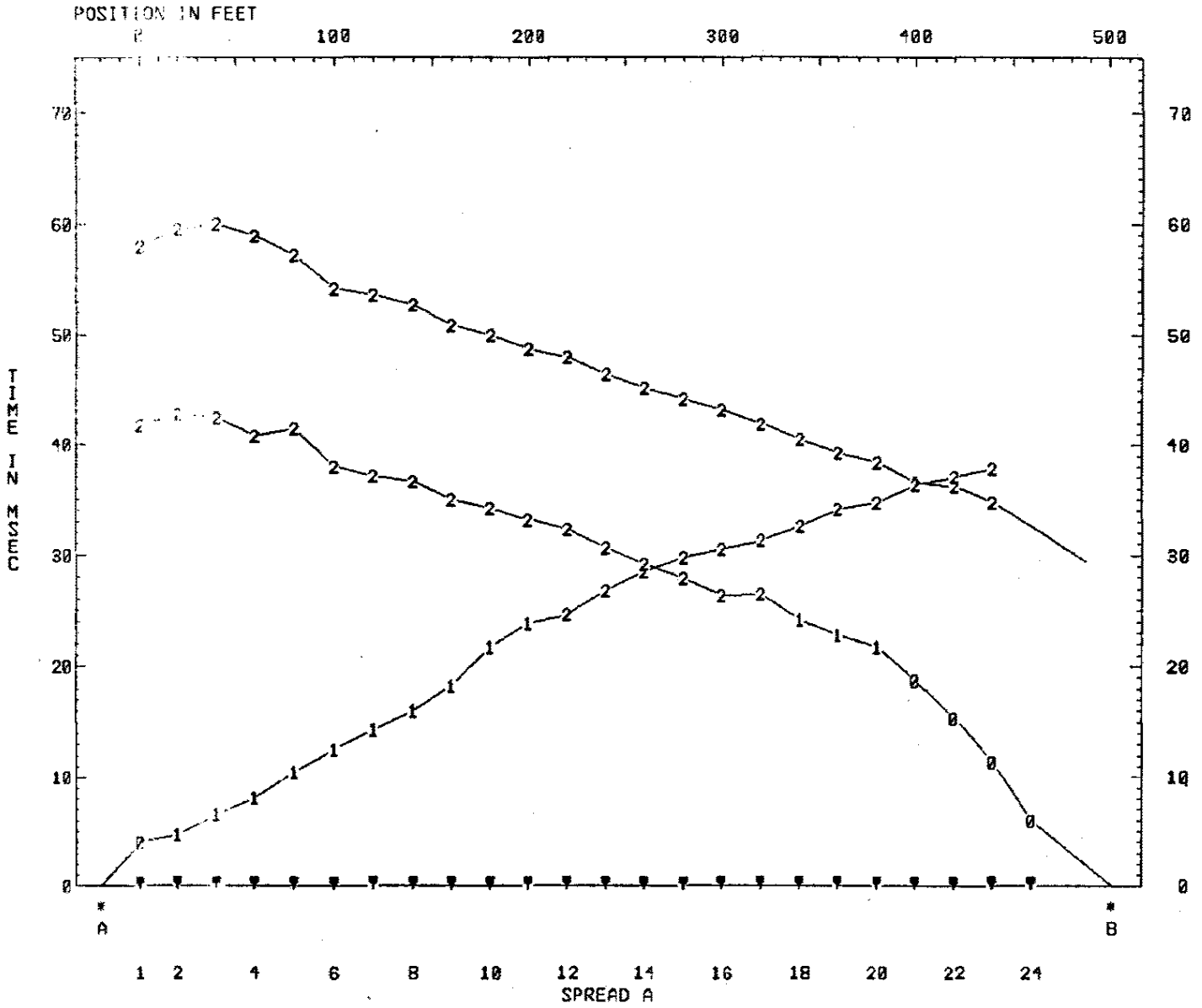
SAMPLE INTRVL 0.10 MS RECORD LEN 102 MS DELAY 0 MS STACKS 1

LOW CUT OUT NOTCH 60 HZ HIGH CUT OUT FIXED GAIN

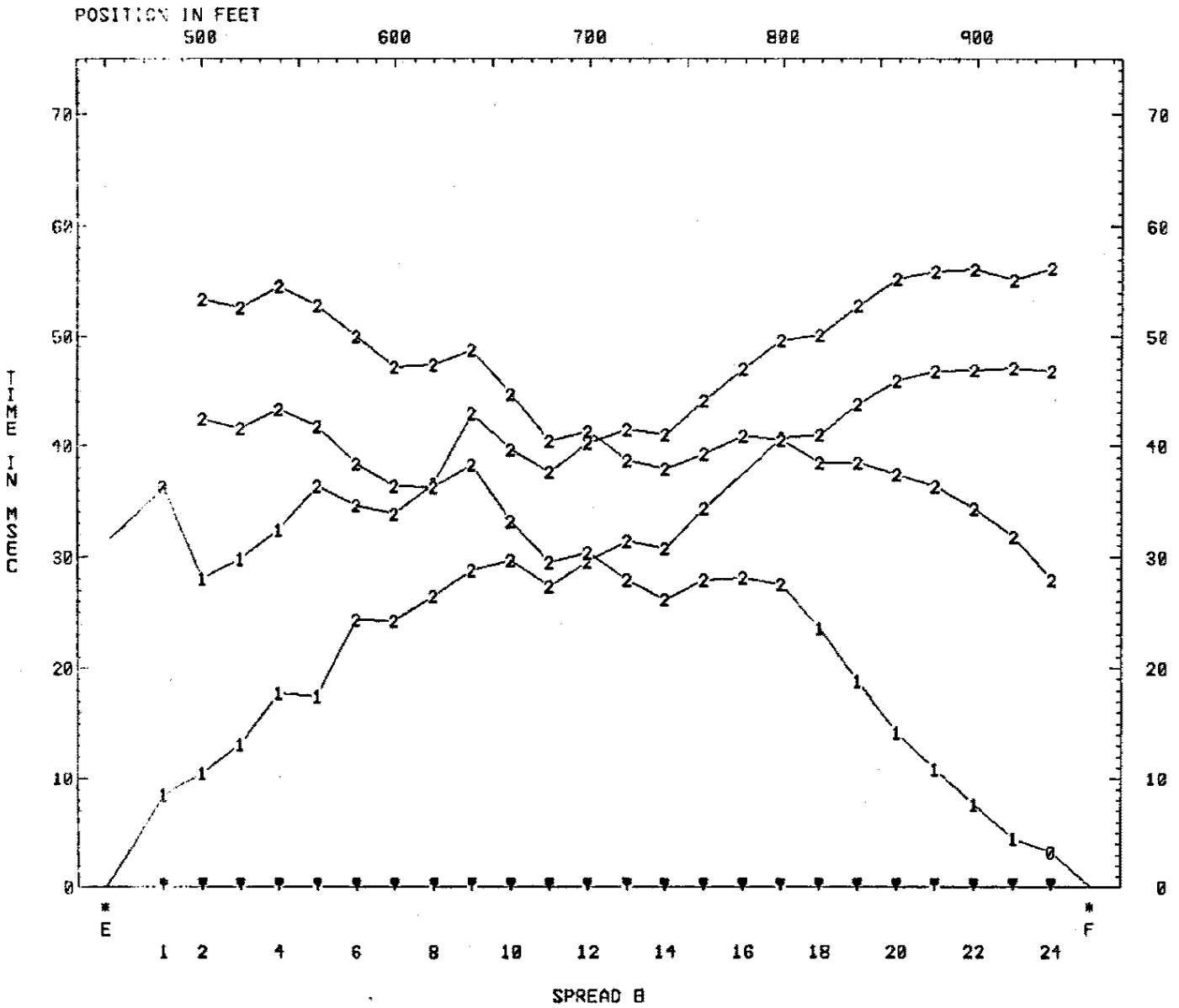
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
54	51	60	54	54	57	57	54	51	39	00	03	66	60	66	69	75	69	75	72	63	60	60	63



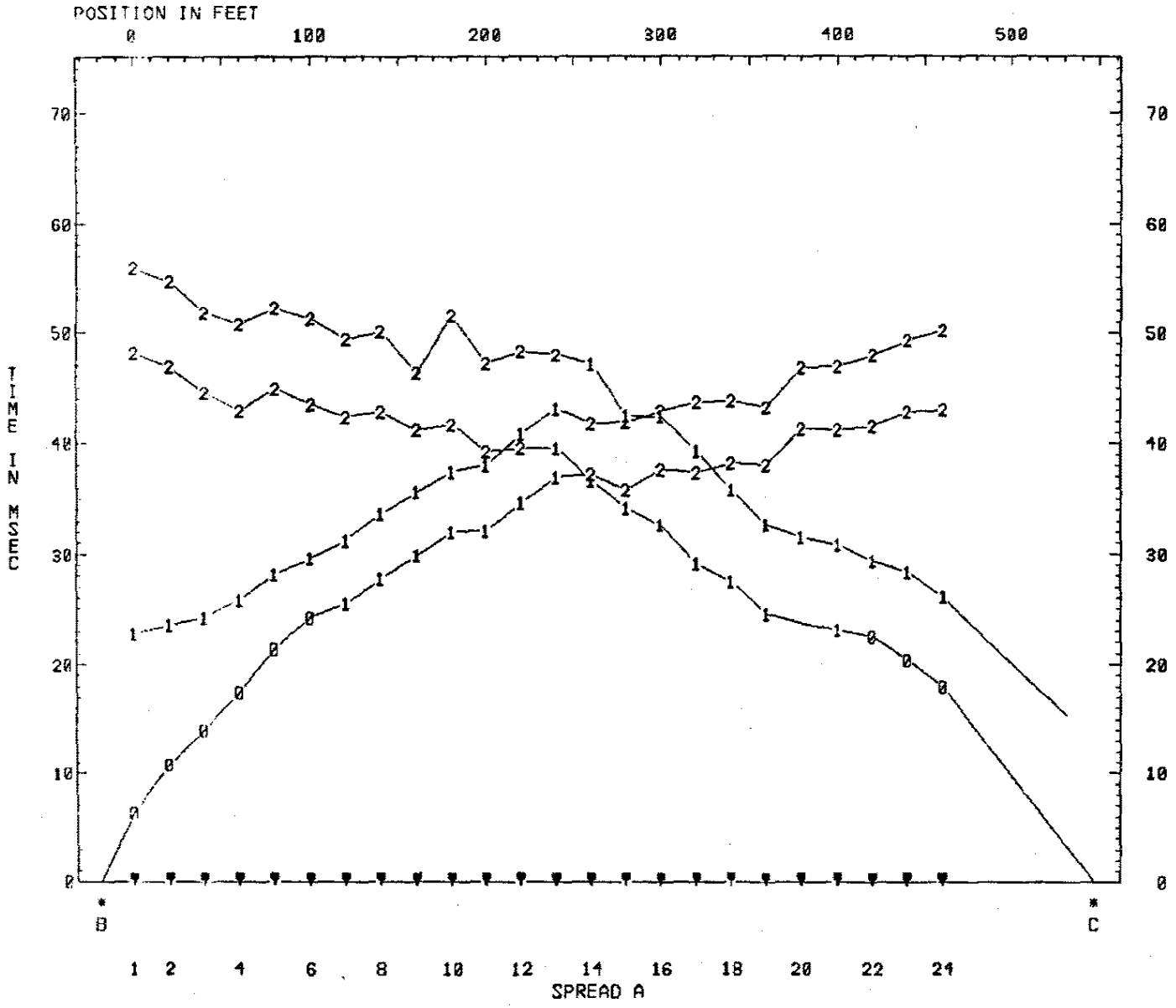
FILE ONETWO.SIP
NBH 1 2 - DATUM-CORRECTED TIMES



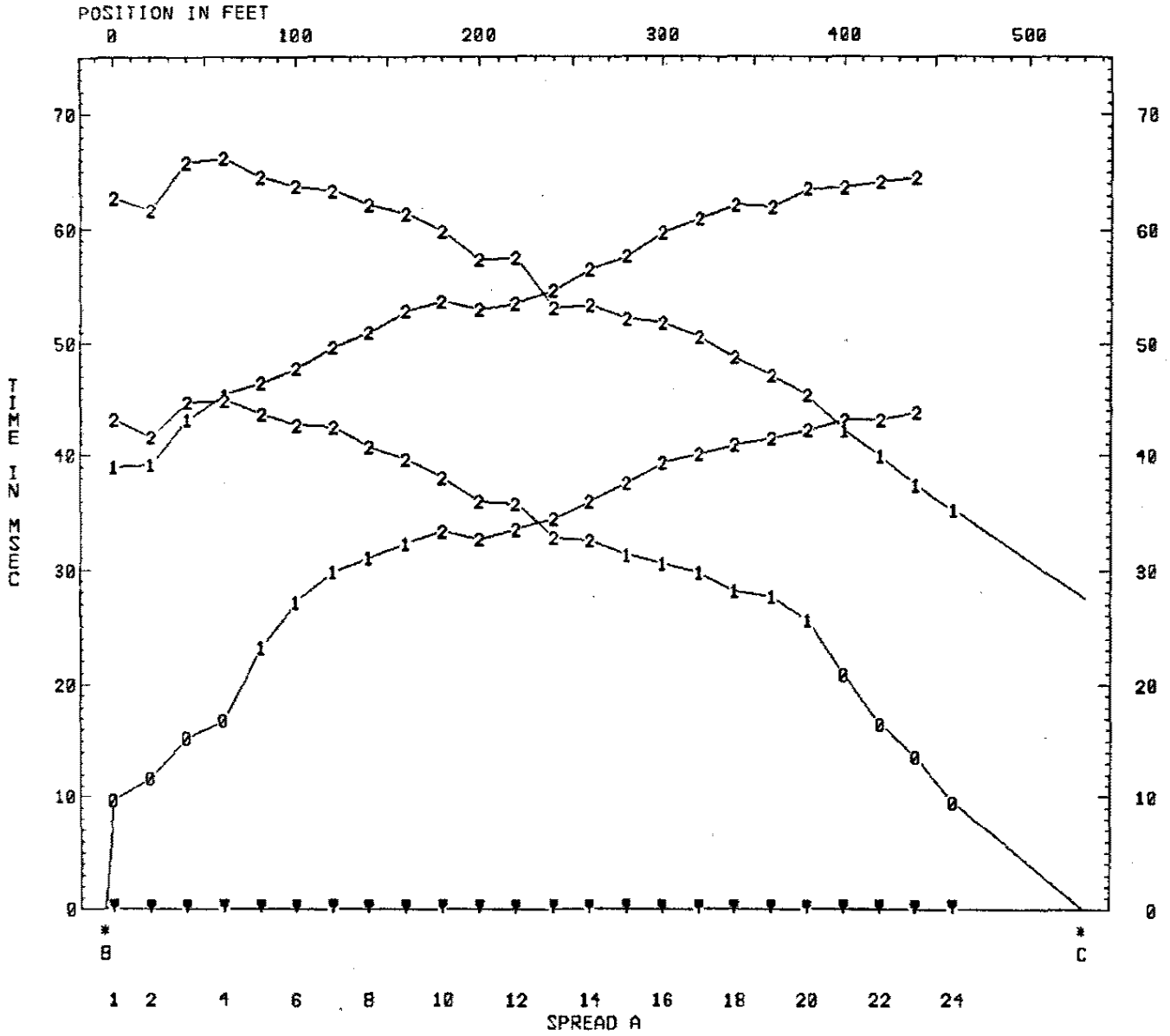
FILE ONETWO.SIP
NBH 1 2 - DATUM-CORRECTED TIMES



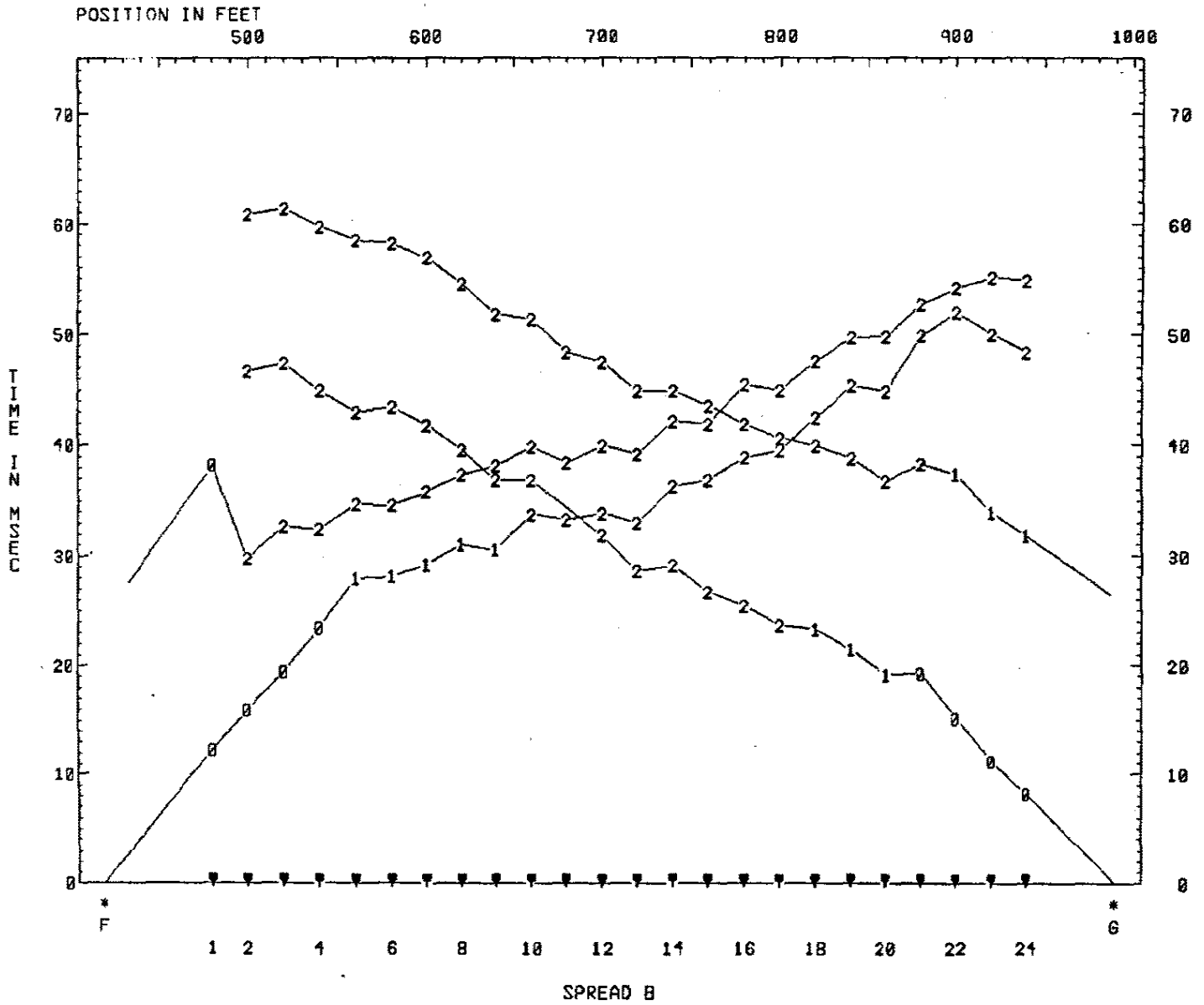
FILE S7911.SIP
NBH 5 7 9 11 - DATUM-CORRECTED TIMES



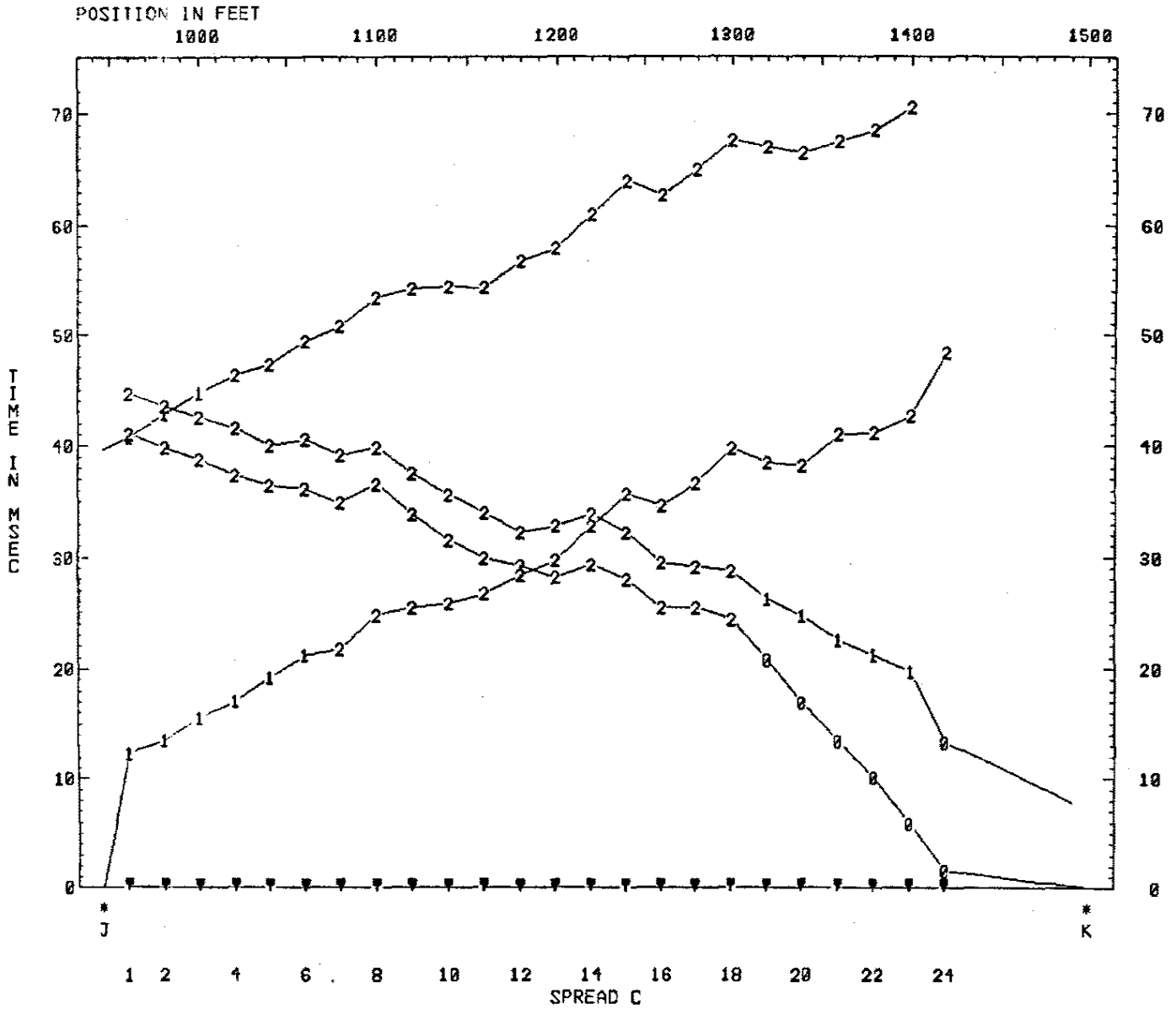
FILE 16810.SIP
NBH LINES 4 6 8 10 WEST EDGE OF COFFFER DAM - DATUM-CORRECTED TIMES



FILE 16810.SIP
NBH LINES 4 6 8 10 WEST EDGE OF COFFFER DAM - DATUM-CORRECTED TIMES



FILE 16810.SIP
NBH LINE 4 6 8 10 WEST EDGE OF COFFFER DAM - DATUM-CORRECTED TIMES



APPENDIX C

Original Phase I Refraction Results Section

The text below presents the original Results section from the Phase I (1999) Marine Seismic Refraction Report entitled: "Draft Report of Marine Geophysical Surveys: Uniboom and Seismic Refraction", which was submitted in February of 2000. All Figure and Appendix references pertain to the original report.

RESULTS

The Seismic Refraction survey was significantly more successful in profiling bedrock characteristics at the site, particularly in the area of critical interest along the CDF alignment. The advantage of having the sensor array and energy source directly on and in the sediment was apparent in the clear "first breaks" on the seismic records (see example instrument print-outs in Appendix B) that were obtained from the areas that had proven difficult with other geophysical methods.

Profiles generated from the data, using the subsurface modeling software packages SIP2 and SeisOpt, indicate that the bedrock character in the area of interest is irregular, marked by undulations of the bedrock surface. The "highs" on the bedrock surface elevation (NGVD 29) noted in the harbor portions of the CDF are approximately -40 feet. The "lows" in the bedrock topography noted from the data are in the -90 foot range (NGVD 29) places, this elevation difference occurs over a distance of only approximately 100 to 150 feet, indicating that there may be some fairly sharp bedrock topographic variation in the area.

The results of the seismic refraction portion of this program are best conveyed in the cross sections and surface map of Figures 3 through 5. The SIP2 inversion model bedrock surface is presented in Figure 3 at a scale of 1 inch equals 50 feet with no vertical exaggeration in true elevation NGVD 29. The existing boring results as interpreted from the boring logs are shown along each cross section. Crossing points with other seismic lines indicating the depth that bedrock was modeled at, are also shown. Boring FD-5 is the only boring that shows a large deviation from the SIP2 modeled bedrock surface. Based on these results, and the fact that FD-5 was drilled early on in the drilling program, it is believed that FD-5 may have been drilled into a boulder or an area of brecciated and weathered bedrock, and that the boring did not in fact terminate in "fresh" bedrock. The SeisOpt model (Figure 4A) shows a region of lower velocity associated with this potential boulder/fractured/heavily-weathered bedrock zone that supports this assertion.

SeisOpt velocity model results are presented in Figures 4A & 4B at a scale of 1 inch equals 50 feet with no vertical exaggeration in true elevation NGVD 29. Since SeisOpt generates a velocity field and not a "layer cake" model, the bedrock surface is not as immediately apparent to the untrained eye. Therefore, for presentation purposes, the SIP bedrock surface (from Figure 3) is overlain on the SeisOpt interpretation of the profiles (Figures 4A & 4B) for reference. The SIP2 and SeisOpt models are generally in good agreement with the overall morphology of the models being extremely similar. There are some areas where the two models do not appear to agree particularly well. This does not mean that the interpretations are incorrect, but rather that there is additional information (i.e., variation in lateral velocity field) that can be interpreted from the SeisOpt models which is not apparent in the SIP models. This additional velocity field information generated by the SeisOpt models is important because it provides additional information on the velocity field in the sediments above the bedrock, which can be a measure of sediment density or type. The relevance of this benefit becomes important when trying to assess the relative difficulty of penetrating sediments with construction objects such as piles or sheeting. Areas in the sediment column with anomalously high seismic velocities (such as those areas on Figures

4A and 4B which show velocities of approximately 10,000 feet/second or higher [green colored] in the "sediments" above the bedrock surface), may be indicative of areas of higher sediment density (such as a till) or areas containing an unusually large amount of boulders and cobbles. In either case, the anticipated result is denser or harder sediments, which would be more resistant to emplacement of engineered structures.

Additionally, the Seismic Refraction data contains several "Low Velocity Zones" (LVZs). The LVZs are anomalies in the data that occur at locations where the velocity of the energy wave traveling through the bedrock material is reduced, usually because the bedrock is fractured or severely weathered in that zone. LVZs are often indicators of faulted or severely fractured bedrock, and the locations of the LVZs noted in the data during this study are shown on the cross section interpretations in Figures 3 and 4A & 4B. While the presence of LVZs in the seismic data may indicate faulting or fracturing in the bedrock, they can also mark locations where the sediments above the bedrock may contain plucked boulders or other fault gauge material, the remnants of glacial processes pulling at the weakened bedrock surface in the LVZ area.

There is a large LVZ at the junction of lines 1&2 with lines 4&5 that appears that it may be fault related. Line 3 has a LVZ to the east of its crossing with lines 4&5 which could be a remnant erosional surface, a channel, or an extension of the LVZ at the junction of lines 1&2 with lines 4&5. There also appears to be a possible relic channel that trends NW-SE from the west end of line 13 through the LVZ on the east end of line 12.

Overall there is much variability in the bedrock surface present in both the SIP2 and SeisOpt models. In general the SIP2 models, which use an average velocity for each layer it models (velocities noted in Figure 3), tend to smooth the bedrock surface somewhat as compared to the SeisOpt models. The SeisOpt model bedrock surface (as shown on Figures 4A and 4B) is interpreted as being within the 10,000 to 12,000ft/sec "blue to green" or "green to yellow" color bar transition zones. The 10,000ft/sec transition is either a transition from the overburden to weathered bedrock, or a transition into well-consolidated materials such as a till. This transition however, at 10,000ft/sec, is generally considered to represent an area of overlap between the velocities of a weathered rock and well consolidated (e.g., till) materials. For this reason, and for this interpretation, it is expected that the 12,000ft/sec transition (marked by a color change from green to yellow on the SeisOpt profiles) is most likely the transition into competent rock.

A bedrock NGVD 29 elevation surface map is shown in Figure 5 at a scale of 1:1200. The SIP2 elevation of bedrock beneath each hydrophone was combined with all the existing boring data from CDF D to generate the bedrock elevation database. The blanking distance used for the gridding routine in Montaj was 50 feet, so only areas within 50 feet of a data point are gridded (colored in). This figure illustrates the magnitude and extent of the variation in the bedrock surface.

APPENDIX D

Original Phase I Refraction Conclusions Section

The text below presents the original Seismic Refraction Conclusions section from the Phase I (1999) Marine Seismic Refraction Report entitled: "Draft Report of Marine Geophysical Surveys: Uniboom and Seismic Refraction", which was submitted in February of 2000. All Figure and Appendix references pertain to the original report.

Seismic Refraction

The Seismic Refraction survey was significantly more successful in profiling bedrock characteristics at the site, particularly in the area of critical interest. The advantage of having the sensor array and energy source directly on and in the sediment was apparent in the clear "first breaks" on the seismic records that were obtained from the areas that had proven difficult with other geophysical methods.

Profiles generated from the data using subsurface modeling software indicate that the bedrock character in the area of interest is irregular, marked by undulations of the bedrock surface. The "highs" on the bedrock surface noted in this area *(in the harbor)* are approximately -40 feet (below mean sea level). The "lows" in the bedrock topography noted from the data are in the -90 foot (below mean sea level) range. In some places, this elevation difference occurs over a distance of only approximately 100 to 150 feet, indicating that there may be some fairly sharp bedrock topographic variation in the area.

Also noted in the Seismic Refraction data were the presence of several "Low Velocity Zones", or "LVZs". These anomalies in the data occur at locations where the velocity of the energy wave traveling through the bedrock material is reduced, usually because the bedrock is fractured or severely weathered in that zone. LVZs are often indicators of faulted or severely fractured bedrock, and the locations of the LVZs noted in the data during this study are shown on the cross section interpretations in Figures 3 and 4. While the presence of LVZs in the seismic data may indicate faulting or fracturing in the bedrock, they can also mark locations where the sediments *above* the bedrock may contain plucked boulders or other fault gauge material, the remnants of glacial processes pulling at the weakened bedrock surface in the LVZ area. It appears that such a phenomenon may be occurring in the northeastern corner of the CDF (along Seismic Line 5), where boring information and seismic information are not consistent, and it is likely that the boring encountered highly brecciated and weathered rock or boulders, whereas the Seismic data denotes the "fresher" bedrock surface. It should be noted that data in the LVZs may be somewhat subjectively interpreted, as the actual velocity within such a zone can only be determined relatively, and can vary dramatically depending upon the material, the amount of fracturing, and the amount of weathering.

In addition to processing the Seismic Refraction data with standard reduction programs, the data was run through an advanced program (SeisOpt), which analyzes the seismic wave velocity field in the subsurface using a "monte-carlo" approach. This was conducted in order to: 1) provide additional information on lateral velocity changes in the bedrock so that better "SIP" computer models of the bedrock surface could be generated; and 2) to provide information on the velocity field in the sediments above the bedrock, which can be a measure of sediment density or type. The relevance of the latter can become important when trying to assess the relative difficulty of penetrating sediments with construction objects such as piles or sheeting. Areas in the sediment column with anomalously high seismic velocities (such as those areas on Figure 4 which show velocities of approximately 10,000 feet/second or higher [green colored] in the "sediments" above the bedrock surface), may be indicative of areas of higher sediment density (such

as a till) or areas containing an unusually large amount of boulders and cobbles. In either case, the anticipated result is denser or harder sediments, which would be more resistant to emplacement of engineered structures.

Finally, it should be noted that the interpretations rendered in this report are not necessarily exclusive, but are rather the best-fit interpretations of all of the available information using current-day software and practices to render the results. The interpretations may be improved as additional information and data becomes available by incorporating the new information into the input parameters for the simulations and re-running the models.

APPENDIX E

Data CDs

APPENDIX C

"Dredged Material Management Plan (DMMP) Final Environmental Impact Report (FEIR)"

(October 15, 2003)

by Maguire Group

Dredged Material Management Plan (DMMP)
EOEA No. 11669

Final Environmental Impact Report (FEIR)

for New Bedford and Fairhaven Massachusetts

Office of Coastal Zone Management
City of New Bedford, MA
Town of Fairhaven, MA

October 15, 2003

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October 15, 2003

Prepared For:
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MA Department of Environmental Protection
MA Department of Environmental Management
MA Division of Marine Fisheries
MA Board of Underwater Archaeology
US Army Corps of Engineers
National Marine Fisheries Service
US Environmental Protection Agency
US Fish and Wildlife Service

Any errors in the use of data, policy guidance and/or recommendations provided for this document are the sole responsibility of CZM.

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LIST OF ACRONYMS

ACEC	Areas of Critical Environmental Concern
ALF	Active MSW Landfills and Active Demolition Landfills
APEG	Alkaline Polyethylene Glycol
ARCS	U.S. EPA's Alternative Contract Strategy Program
ATC	Adjacent to Channel
BCD	Base-Catalyzed Decomposition
BHNIP	Boston Harbor Navigation Improvement Project
BNL	Brookhaven National Laboratory
CA/THT	Central Artery/Third Harbor Tunnel Project
CAD	Confined Aquatic Disposal Site
CAD/OD	Confined Aquatic Disposal Sites for Overdredge
CAP	Capped Disposal Site
CCDS	Cape Cod Disposal Site
CDF	Confined Disposal Facility
CDF/TH	Confined Disposal Facility/Tidal Habitat Creation
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1976
CMR	Code of Massachusetts Regulations
CPUE	Catch Per Unit Effort
CWA	Federal Clean Water Act
CZM	Coastal Zone Management (Office of)
DAMOS	Disposal Area Monitoring System
DCAM	Massachusetts Division of Capital Asset Management (Formerly Division of Capital Planning Operations)
DEIR	Draft Environmental Impact Report
DEIS	Draft Environmental Impact Statement
DEM	Massachusetts Department of Environmental Management
DEP	Massachusetts Department of Environmental Protection
DMF	Massachusetts Division of Marine Fisheries
DMMP	Dredged Material Management Plan
DOD	U.S. Department of Defense
DPA	Designated Port Area
EDTA	Ethylenediaminetetraacetic Acid
EFH	Essential Fish Habitat
EMAP	Environmental Management and Assessment Program
EOEA	Executive Office of Environmental Affairs
EPB	Early Benthic Phase
FEIR	Final Environmental Impact Report
FEMA	Federal Emergency Management Agency
FIRMS	Flood Insurance Rate Maps
GIS	Geographic Information System
HDPE	High Density Polyethylene
HMW	High Molecular Weight
ILF	Inactive or Closed Solid Waste Landfills in Massachusetts
IWPA	Interim Wellhead Protection Area
KPEG	Potassium Ethylene Glycol
LEDPA	Least Environmentally Damaging Practicable Alternative

MassGIS MA Geographic Information System

MBDS Massachusetts Bay Disposal Site

MCP Massachusetts Contingency Plan

MCY Million Cubic Yards

MDPW MA Dept. of Public Works

MEPA Massachusetts Environmental Policy Act

MHD Massachusetts Highway Department

M.G.L. Massachusetts General Law

MLW Mean Low Water

MPA Massachusetts Port Authority

MPRSA Marine Protection Research and Sanctuaries Act

MSW Municipal Solid Waste

MWRA Massachusetts Water Resource Authority

NAD83 North American Datum 1983

NEPA National Environmental Policy Act

NFIP National Flood Insurance Program

NHA Massachusetts Natural Heritage Atlas

NMFS National Marine Fisheries Service

NOAA National Oceanic and Atmospheric Administration

NO_X Nitrogen Oxides

NWI National Wetlands Inventory

OD Overdredge

OSI Organism Sediment Index

PAH Polycyclic Aromatic Hydrocarbon

PCB Polychlorinated Biphenyl

PG&E Pacific Gas and Electric

POSW Dutch Development Program of Treatment Processes

RCRA Resource Conservation and Recovery Act

REMOTS Remote Ecological Monitoring of the Seafloor

RIDEM RI Dept. of Environmental Management

RMFP MWRA Residual Management Facilities Plan

SARA Superfund Amendments and Reauthorization Act of 1986

SAV Submerged Aquatic Vegetation

SEDTEC EPA Database

SFA Sustainable Fisheries Act

SSA Site Screening Analysis

TCLP EPA Toxic Characteristic Leachate Procedure

TSCA Toxic Substances Control Act

TPH Total Petroleum Hydrocarbons

TSS Total Suspended Solids

UDM Unsuitable Dredge Material

UR MHD Uneconomic Remainder Parcels

USACE U. S. Army Corps of Engineers

USEPA U. S. Environmental Protection Agency

USFWS U. S. Fish and Wildlife Service

USGS United States Geological Survey

VISITT EPA Database

VOC Volatile Organic Chemicals

ZSF Zone of Siting Feasibility

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The New Bedford/Fairhaven Dredged Material Management Plan (DMMP) Final Environmental Impact Report (FEIR) was prepared for the Office of Coastal Zone Management (CZM), City of New Bedford and Town of Fairhaven under the direction of:

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Applied Science Associates (ASA), Inc.
J. Craig Swanson, Ph.D. - Dredged Material Transport Modeling
Hyun-Sook Kim - Dredged Material Transport Modeling

ENSR International
Pamela Neubert, Senior Marine Ecologist

SAIC
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Sherry Poucher-Toxicologist

SECTION 1.0 - EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

This Final Environmental Impact Report (FEIR) evaluates the preferred alternative confined aquatic disposal (CAD) sites brought forward for final analysis to designate the preferred alternative from the New Bedford/Fairhaven Harbor Draft Environmental Impact Report (DEIR) by the Commonwealth of Massachusetts (Commonwealth) located in New Bedford and Fairhaven, Massachusetts (Figure 1-0). The DEIR provided a detailed and thorough analysis of a large variety of alternative disposal and dewatering sites and the preferred alternative CAD sites. In total, both reports in composite fulfill the Massachusetts Environmental Protection Act (MEPA) requirements for an EIR. The purpose of the EIR project is to provide state designation of a disposal site in New Bedford/Fairhaven Harbor (Harbor) for dredged material determined to be unsuitable for open-water disposal (hereinafter referred to as "unsuitable dredged material" or UDM). UDM in the Harbor is representative of environmental degradation caused by anthropogenic influences over the past century and a half.

This FEIR follows the Scope specified in the DEIR Certificate issued by the Secretary of the Executive Office of Environmental Affairs (EOEA) on June 14, 2002. It also includes water quality studies relative to dredging permit water quality criteria and model preliminary CAD cell engineering for both preferred alternative CAD cell site areas, Channel Inner (CI) at approximately 90 acres and Popes Island North (PIN) at approximately 80 acres. Additional marine natural resource information required by the DEIR Certificate and preliminary engineering required for these models was very helpful in the determination of the preferred alternative PIN. The preferred alternative model PIN configuration features five moderate capacity cells totaling approximately 250,000 cubic yards (cy) of UDM and one high capacity cell capable of safely holding approximately 1,800,000 cy of UDM, consistent with the Harbor Plan goals and for long-term use consideration (10 and 20 years, consistent with State-wide Dredged Material Management Plan objectives). This FEIR distributes capacity based on the geotechnical characteristics of the PIN area, in a conceptual scheme that serves as the basis for long-term use of the CADs. The specific size and location of individual CADs located within the PIN area will be determined by the specific dredging program developed by New Bedford and Fairhaven. Local state, and federal permitting requirements (or equivalent authorizations – see below) require detailed and site specific information regarding site engineering, chemistry, mitigation, and operations that will be developed by future project proponents.

The FEIR recommends a management structure under which New Bedford and Fairhaven manage CAD use under the terms of a Water Quality Certificate and Chapter 91 Waterways license of permit, or equivalent authorizations. (Under the Record of Decision for the New Bedford/Fairhaven Harbor PCB Superfund project, navigation dredging may be undertaken under the auspices of the state enhanced remedy. If so, the substantive requirements of the state regulatory programs must be met but the certificate, license or permits themselves would not be issued.)

Under this approach, the city and town would manage the CADs subject to applicable local, state, and federal authorizations; a Third party Inspector will provide field oversight for Massachusetts Department of Environmental Protection (DEP); and a Technical Advisory Committee to be determined will assist the DEP in monitoring the CAD operations. The FEIR

Figure 1-1. Proposed preferred alternatives CI and PIN CAD cell areas in New Bedford/ Fairhaven Harbor

anticipates that the management structure for use of the PIN CADs will be formally defined in the development of the Water Quality Certificate or Chapter 91 Waterways license or permit or equivalent.

The Scope specified in the DEIR Certificate includes detailed characterizations of proposed Harbor CAD site areas, an evaluation of alternatives, justification for designation of a site in close proximity to the BBDS, physical, biological, and human use characterizations of the two preferred alternatives, assessment of potential impacts from disposal at the preferred alternatives, and a recommendation of the preferred alternative CAD cell site for state designation. Also included are detailed CAD cell dredging disposal event modeling, and hydrodynamic analysis, management and monitoring of CAD disposal.

Additional geotechnical borings confirmed the depth to bedrock and revealed sediment stratigraphy necessary for to preliminary CAD cell engineering including side slope stability design of 1V: 3H. Underwater archaeological surveys showed no major impediments of historical importance to CAD cell development and identified minor fishing industry related debris for potential dredge contractor's consideration. Physical and chemical analysis of surficial sediments guided the definition of four-foot deep UDM horizons important to CAD cell volumes calculations. Surface water analysis supported water column chemistry and hydrodynamic modeling efforts. Macrobenthic sampling and identification of the preferred alternatives showed them to be currently inhabited by opportunistic species exemplary of disturbed habitat typical of degraded environmental conditions. Water column chemistry studies consisting of a series of three interdependent U. S. Environmental Protection Agency (EPA) approved procedures were applied to derive a final water effects ratio (WER), which can be used to adjust default water quality criteria for toxicity to real site-specific criteria and to define appropriate mixing zone under the water quality certification. Preliminary CAD cell configuration and CAD cell construction planning for the preferred alternatives was based on aspects of the additional natural resources information gathered for the FEIR.

Alternatives. Natural resource, geophysical, chemical, and human use information was developed in the DEIR and this FEIR. Preferred alternatives CI and PIN were screened using discretionary factors in this FEIR. The PIN site is selected as the preferred alternative based on its greater capacity, ability to accommodate multiple configurations of CAD cells, more cost – effective capacity (lower cost per cubic yard disposal), location away from main area of harbor operations (i.e., least conflict with heavy commercial and industrial vessel traffic), less impact to shellfish resources through avoidance of potential DMF shellfish relay area, higher ratio of capacity to footprint, and less potential for long-term water quality impacts by protected location behind Popes Island.

Modeling indicates that acute and chronic water quality impacts associated with CAD operation at the CI and PIN sites are generally similar and use of the sites can be managed to comply with applicable standards.

CAD Cell Dredging Disposal Event Modeling and Hydrodynamic Analyses. A field program was run for a full diurnal tidal cycle to provide site-specific tide and current with wind effects data for detailed CAD cell dredging disposal event modeling and hydrodynamic analyses.

Turbidity modeling and related instantaneous chemical release modeling was conducted for the preferred alternative. When the WER value was applied to predictive hydrodynamic modeling for the PIN, it was shown to allow less restrictive mixing zones yet remains protective to marine organisms. This concludes that water quality impacts from CAD development at the preferred alternative can be permittable.

Disposal Site Management and Monitoring. Disposal site management and monitoring guidelines for the preferred alternative are presented to assist Harbor dredging project proponents, contractors, CAD managers and regulators in developing specific management and monitoring plans on a project-by project basis. Monitoring guidelines are included to ensure adverse impacts are negligible and/or are identified as soon as possible following disposal activities in order to minimize potential impacts on the ecosystem of the Harbor.

Area of Impact. The CI site covers approximately 90 acres; the PIN site covers approximately 80 acres. Within these areas, the footprint of conceptual CAD cells within the CI area cover approximately 20 acres; within the PIN area approximately 35 acres.

Project Mitigation. Non-compensatory and compensatory mitigation measures expected with CAD cell construction and operations are described. Non-compensatory mitigation measures to ensure avoidance and minimization of negative environmental impacts are implicit throughout the document. Examples of these implicit avoidance and minimization steps are summarized. The Primary resources that will be impacted by CAD cells are shellfish (Northern quahogs and soft shell clams), winter-flounder spawning habitat and juvenile winter flounder. The PIN site appears to support higher numbers of juvenile winter flounder and better winter flounder habitat than the CI site. Impacts to juvenile winter flounder will be avoided through the time-of-year restrictions. Impacts to habitat will be minimized through maximizing depth to surface area of the CAD project. Natural sedimentation is expected to replicate existing spawning and juvenile winter flounder habitat over constructed CAD cell caps; artificial habitat mitigation is therefore not proposed.

Direct impacts to shellfish from removal will be mitigated based on consultation with the Division of Marine Fisheries (DMF). The construction proponent(s) may be required to replace a specific quantity of quahogs and clams as a project permit condition. DMF will mathematically formulate the loss of these shellfish per acre of impact due to PIN CAD cell construction as a service for potential proponent(s) on a project-by-project basis in cooperation with local municipal shellfish constables.

Section 61 Findings. Section 61 findings pertinent to the preferred alternative state designation are summarized for the regulatory agencies.

Responses to Comments. Responses to comments in letters received from DEP and DMF on the DEIR are included as part of the MEPA process.

State and Federal Review. This FEIR represents a key milestone in the MEPA review process. Upon approval of this FEIR by the Secretary of Environmental Affairs, the PIN CAD site will be an approved state-designated disposal site for dredged material unsuitable for unconfined open

water disposal. State designation does not constitute authorization for use of the site by specific projects. Any project proposing to use the site must comply with the applicable local, state and federal permitting requirements.

The FEIR identifies the Popes Island North site as the preferred alternative and the least environmentally damaging practicable alternative (LEDPA) site under the federal Clean Water Act. In a parallel process to MEPA review of the FEIR, CZM is working with the U. S. Army Corps of Engineers (USACE), U. S. Environmental Protection Agency (EPA), National Marine Fisheries Service (NMFS), and U. S. Fish and Wildlife Service to determine the LEDPA designation.

SECTION 2.0 - INTRODUCTION

2.0 INTRODUCTION

2.1 MEPA Certificate From New Bedford/Fairhaven Harbor DEIR

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GOVERNOR

BOB DURAND
SECRETARY

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JUN 17 2002
COASTAL ZONE MANAGEMENT
Exec. Office of Environmental Affairs

June 14, 2002

CERTIFICATE OF THE SECRETARY OF ENVIRONMENTAL AFFAIRS
ON THE
DRAFT ENVIRONMENTAL IMPACT REPORT

PROJECT NAME	: Dredged Material Management Plan
PROJECT MUNICIPALITY	: New Bedford and Fairhaven
PROJECT WATERSHED	: Buzzards Bay
EOEA NUMBER	: 11669
PROJECT PROPONENT	: Massachusetts Coastal Zone Management
DATE NOTICED IN MONITOR	: May 8, 2002

As Secretary of Environmental Affairs, I hereby determine that the Draft Environmental Impact Report submitted on the above project **adequately and properly complies** with the Massachusetts Environmental Policy Act (G. L. c. 30, ss. 61-62H) and with its implementing regulations (301 CMR 11.00).

This project is part of a state-wide Dredged Material Management Plan (DMMP) to address the issue of finding environmentally sound disposal sites for dredged material from the Commonwealth's eight Designated Port Areas (DPA) that is unsuitable for unconfined ocean disposal. This Draft EIR is being filed specifically for the DPA of New Bedford/Fairhaven Harbor. The DEIR deals with the disposal of dredged material and not with dredging itself. Individual dredging projects within the harbor must undergo their own environmental review.

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Studies reported in the baseline demand analysis have estimated that up to 960,000 cubic yards (cy) of contaminated and otherwise unsuitable material from both public and private dredging projects will require management and disposal over the next 10 years to maintain the DPA as a viable working port.

The DEIR has provided a detailed and thorough analysis of a large variety of alternative disposal and de-watering sites and has presented a preferred alternative. The preferred alternative involves construction of two Confined Aquatic Disposal (CAD) sites within New Bedford/Fairhaven Harbor, one just north of Popes Island and the other in the Inner Channel. These CADs have the capacity to accommodate the estimated volume of dredged material and are in close proximity to the dredging areas. Based on the level of detail of information provided in the DEIR, the selection of this method of disposal and these CAD sites is reasonable on both environmental and economic grounds.

As the DEIR indicates, before a final decision is made on a management plan, there will need to be some additional site specific information provided in the Final EIR. That site specific information is identified in the DEIR and includes:

- Additional geotechnical borings
- Macrobenthic sampling and identification
- Current measurements and water column chemistry
- Dredging and disposal event modeling and hydrodynamic analyses
- Underwater archaeological surveys
- Physical and chemical analyses of surgical sediments

I expect that this information will be provided in the FEIR. Should this site-specific information indicate that the preferred alternative, in whole or part, is not suitable, the FEIR should provide the same level of information on any alternative site or methodology that might be chosen.

The DEIR has provided sufficient information to allow the dismissal of upland disposal and upland reuse of the dredged materials, and those options need not be carried forward in the FEIR. Nevertheless, while the DEIR has also shown that Alternative Technologies are not practicable or cost-effective at

this time, these technologies are being continuously advanced. Therefore, I expect that their use will be re-evaluated periodically by the proponent and the permitting agencies to determine whether all or some of the dredged material can be managed in the future using an improved Alternative Technology.

The DEIR has presented a Monitoring and Management Plan that uses a tiered monitoring strategy. Under this strategy, if lower level monitoring uncovers adverse effects, a higher level of monitoring would be implemented and, if necessary, management actions such as restricting or curtailing disposal operations might be implemented. The DEIR also identifies a number of Best Management Practices for the CADs that have been used in other disposal operations with considerable success.

The DEIR also indicates that the proponent intends to establish a Technical Advisory Committee that will include representatives of local, state and federal agencies. This group will establish what specific actions will be taken in response to monitored problems, and will determine who is responsible for taking any necessary actions. This group should also consult with the Division of Marine Fisheries (DMF) to develop a schedule for CAD use, and to develop appropriate plans for shellfish propogation and other mitigation measures, as indicated in the DMF comment.

I am pleased with the progress made to date on this important project and I look forward to reviewing the more detailed information in the FEIR.

June 14, 2002
Date

Bob Durand

Comments received :

Department of Environmental Protection
Division of Marine Fisheries

BD/rf

2.2 FEIR Organization

The organization of the New Bedford/Fairhaven Harbor DMMP FEIR follows the framework established in MEPA to fully explore alternatives, and is organized into the following sections.

Section 1.0 - Executive Summary, summarizes the report contents, lists the principal environmental impacts of the alternatives and identifies mitigation measures to be implemented to mitigate unavoidable environmental impacts. This section also indicates the steps that will be taken prior state designation.

Section 2.0 - Introduction, presents the reader with the background of the DMMP planning process, MEPA procedural history and a summary of "scoping" and coordination involved in developing this FEIR.

Section 3.0 – Additional Site-specific Aquatic Resource Information, presents additional and supportive preferred alternatives CAD site-specific resources information primarily suggested by the DEIR and concurred by the DEIR Certificate.

Section 4.0 - Selection Of The Preferred Alternative CAD Cell Site, outlines the application of the DMMP disposal site screening process and criteria. This section presents the evaluation of potential impacts and benefits associated with the preferred alternative CAD sites. This section details the potential impacts on specific resources in the vicinity of the CAD sites.

Section 5.0 - Detailed CAD Cell Dredging Disposal Event Modeling And Hydrodynamic Analyses, is a detailed description of affected environments in the vicinity of the preferred alternative PIN CAD cell site area. This section presents a series of computer simulations performed to estimate the water quality from dredging and disposal operations at the proposed PIN CAD site in the Harbor. The computer models BFHYDRO (Boundary Fitted Hydrodynamic model), SSFATE (Suspended Sediment FATE model), STFATE (Short-Term FATE dredged material disposal model) and BFMASS (Boundary Fitted Mass Transport model), were employed for hydrodynamic, dredging and disposal modeling, respectively.

Section 6.0 - Compliance with Regulatory Standards, is an overview of the current regulatory framework under which disposal of UDM occurs. This section describes the applicable regulations associated with implementing the preferred alternative.

Section 7.0 - Mitigation Measures, this section describes the associated measures to be taken to avoid, minimize or mitigate the negative impacts associated with implementation of the preferred alternatives. This section presents biological time-of-year dredging windows recommendations.

Section 8.0 –Dredging Management Plan, presents guidelines of monitoring the preferred alternatives for long-term environmental impacts and the management of operations for the preferred alternative disposal site.

Section 9.0 - Section 61 Findings, are included as required by MEPA, to outline whether the implementation of the preferred alternative will be likely to cause either direct or indirect damage to the environment. This section makes findings describing potential environmental impacts confirming that all practicable measures have been taken to avoid, minimize or mitigate potential damage to the environment.

Section 10.0 - Response to Comments, is a comment-by-comment response to correspondence received by the MEPA office and resource agencies regarding the New Bedford/Fairhaven Harbor DMMP DEIR. This section contains a copy of the DEIR Certificate and resource agency comment letters with highlighted comments. A set of answers to each highlighted comment is provided immediately after each letter.

The structure and content of the New Bedford/Fairhaven Harbor DMMP FEIR is directly controlled by three primary sets of regulations. At the state level, the MEPA Scope that identifies the information that must be evaluated as part of the site identification process. This outline will ensure that the requirements of the state's environmental policies are met. At the federal level, the FEIR is subject to the provisions of Section 404 of the Clean Water Act (Section 404), and to the National Environmental Policy Act (NEPA). The Section 404 and NEPA outlines will ensure meeting the requirements of federal environmental policies.

The first task, then, was to integrate the requirements of these three authorities. To do this, previous projects that have faced the same task were investigated. First, site selection processes used by the state to site the Cape Cod Disposal Site (MADEM Generic EIR, 1992), and by the USACE and Massport to site the disposal cells for the Boston Harbor Navigation Improvement Project (USACE & Massport Final EIR, 1996) were evaluated. Then, at the direction of the federal agencies, the process used more recently by the Corps of Engineers for the federal Providence River Navigation Project (USACE DEIR, 1998) was also examined. After extensive discussion with the state and federal agencies, the screening process chosen was modeled after the Providence River project, in large part because the federal agencies who reviewed the DEIR developed the Providence screening, and were therefore familiar with the logic of the document.

The DEIR was reviewed in 2002 and the DEIR Certificate was issued June 14, 2002. The DEIR suggested and the Certificate concurred that certain site-specific resource information on the preferred alternative CAD sites was necessary to assist in the final alternatives screening for the preferred alternative in the FEIR. DEP and DMF submitted letters explaining each of the two agencies concerns expected to be addressed regarding the selection of the preferred alternative in the FEIR.

In the FEIR, CZM presents the additional resources information that proved helpful in the analysis and final selection of the preferred alternative CAD site for the Harbor.

2.3 New Bedford/Fairhaven Harbor

New Bedford/Fairhaven Harbor (Harbor) is located on the west side of Buzzards Bay, at the mouth of the Acushnet River. The Harbor is located about 166 miles from New York via Long Island Sound and 83 miles from Boston via the Cape Cod Canal. A gated hurricane barrier across the lower harbor, completed in 1966, protects the New Bedford, Fairhaven and Acushnet area from tidal storms. The Harbor includes all the tidewater lying northerly of a line from Clarks Point at the southern extremity of New Bedford to Wilbur Point at the southern end of Fairhaven, and extends to the head of navigation on the Acushnet River at Acushnet. The outer harbor consists of the area south of the hurricane barrier at Palmer Island, and the inner harbor consists of the area north of the barrier to a short distance above the New Bedford/Fairhaven Bridge (USACE 1996).

The federal navigation channel in the Harbor consists of a main channel authorized extending from deep water in Buzzards Bay through the New Bedford-Fairhaven Bridge (U.S. Route 6); a channel extending from the lower maneuvering area along the upper waterfront to the vicinity of Fish Island and the swing bridge; a channel west of Pierce and Kilburn Wharf to the old causeway pier; and an anchorage area north of Palmer Island, off the Fairhaven main waterfront. (USACE 1996)

The Harbor has a history of seafaring traditions that continue today with an active fishing fleet. New Bedford/Fairhaven Harbor hosts a wide variety of vessel traffic. The fishing fleet is the most important with more than two hundred (200) vessels operating out of the Harbor. The bulk of the vessels are steel hulled vessels fishing for ground fish and scallops supplying the nation with fish products. Maritime support industries in the Harbor include vessel maintenance and repair facilities, both dockside and/or at various facilities along the waterfront. Equipment and provisions purchased relative to the catching of these products such as food, ice, fuel, oils and many other products have a great impact upon the areas economy. (New Bedford HDC, 1999)

Harbor-related businesses in New Bedford and Fairhaven account for $671 million in worldwide sales and 3,700 local jobs. The seafood industry as a whole, core and support services, accounts for 97% of harbor sales worldwide, or $653 million. Additionally, other waterfront area businesses contribute and estimated $18 million in sales and nearly 600 jobs. Growth of the seafood industry over the next five years could result in an additional $59-155 million in sales and 140-410 new jobs. (New Bedford Harbor Plan, 2000).

Since the publication of the DEIR, the City of New Bedford under the auspices of the New Bedford Harbor Development Commission (NBHDC) have completed maintenance dredging of the slip to the south of State Pier, the fairways leading thereto and a portion of the federal navigational and maintenance channel immediately northwest of the proposed CI CAD cell area (Apex, 2002).

The largest cruise ship ever to dock in the Harbor, 611 feet long by 79 feet wide, the Regal Empress, docked at the State Pier in summer 2002 (Kalisz, 2002). A total of thirty cruise ships were due to dock at the State Pier over 2002. In August 2004 a high-speed ferry is set to begin service between the State Pier and Martha's Vineyard (Providence Journal, 2003). The new high-

speed ferry operators expect to run as many as ten trips per day which equates to as many as 20 harbor passages per day, possibly some in darkness. These harbor developments are expected to be positive stimulants to the slow economy in New Bedford pegged at 12% unemployment in 2003 (Providence Journal, 2003). The State Pier is located on the New Bedford waterfront just northwest of the proposed alternative CI CAD cell site area, and well south of the other proposed alternative PIN CAD cell site area.

Deep-draft commercial fishing vessels as long as 150 feet have been servicing the new herring and mackerel processing plant located on Fish Island north of the CI area and south of the PIN CAD cell area (Commercial Fisheries News, 2002). This new small pelagic fish processing plant is expected to hire 75 employees at current capacity. The Fish Island processing plant is located on the New Bedford waterfront north of the proposed alternative CI CAD site area and south west of the proposed alternative PIN CAD cell area.

2.4 Background of the CZM DMMP

The Executive Office of Environmental Affairs (EOEA), through its office of Coastal Zone Management (CZM), is providing technical assistance to the City of New Bedford and Town of Fairhaven in support of the harbor planning objectives through the development of a DMMP for New Bedford/Fairhaven Harbor dredged sediments. The DMMP has a ten-year planning horizon. The development of this New Bedford/Fairhaven Harbor DMMP DEIR involved two project phases to address the critical issue of finding environmentally sound and cost effective disposal sites or methodologies for dredged material unsuitable for unconfined ocean disposal.

The DMMP Phase I information was used to identify baseline conditions and data gaps, and served as the basis for the preparation of the MEPA ENF for the New Bedford/Fairhaven Harbor DMMP. Phase II of the DMMP has focused on conducting the field work, research, and analysis necessary to undertake a detailed assessment of the potential environmental impacts associated with the dredged material disposal alternative(s) identified through the DMMP process.

The purpose of the DMMP for New Bedford/Fairhaven Harbor is to identify, evaluate and permit, within the Zone of Siting Feasibility (ZSF) for New Bedford/Fairhaven Harbor, a dredged material disposal site(s) or methodology with sufficient capacity over the next twenty years to accept dredged material unsuitable for unconfined ocean disposal from public and private dredging projects.

The lack of a practicable cost-effective method for the disposal of UDM in an environmentally sound manner has been a long-standing obstacle to the successful completion of dredging projects in the Harbor. The disposal alternative siting process has been closely coordinated with the City of New Bedford and Town of /Fairhaven, through the Dredged Material Management Committee (DMMC).

Members of the DMMC were appointed by the City of New Bedford and Town of Fairhaven to serve in an advisory capacity to represent the interests of each community throughout the development of the DMMP. The DMMC was responsible for reviewing project related materials, holding informational sessions and communicating with the DMMP consulting team

and Harbor Master Planning Committee. Members of the DMMC included staff from the City of New Bedford's Department of Public Works, Harbor Development Commission, business and economic development interests, Town of Fairhaven's Executive Secretary, a member of the fishing industry and the New Bedford/Fairhaven Harbor Master Planning Committee.

Coordination with local port planning interests was an important component of the development of the New Bedford/Fairhaven Harbor DMMP DEIR. The simultaneous development of both the DMMP and the New Bedford/Fairhaven Harbor Master Plan has aided the identification of the future dredging needs for the maintenance and improvement in navigation within the Harbor and with the identification of potential sites for the disposal of UDM.

The New Bedford/Fairhaven Harbor DMMP DEIR identifies disposal alternatives with sufficient cumulative capacity to accept dredged material unsuitable for unconfined ocean disposal from public and private dredging projects for the twenty-year planning horizon. In the FEIR, the configuration of the final preferred alternative is presented for planning purposes. Final UDM capacities, continued refinement of dredging needs, regulatory analysis of the preferred alternatives, and integration of New Bedford/Fairhaven Harbor development priorities will ultimately determine specific dredging projects including CAD cell designs. For the FEIR-level planning assessment, overall need is assumed to be the total projected twenty-year volume of dredged material. Accordingly, the FEIR provides sufficient conceptual CAD cell configurations that can be created to accommodate, at a minimum, all of New Bedford and Fairhaven's dredging needs over a ten-year period and very likely the twenty-year period depending on actual project development.

2.5 Massachusetts Environmental Policy Act (MEPA) Procedural History

The submission of the ENF for the New Bedford/Fairhaven DMMP on June 10, 1998, started the official MEPA review process for the DMMP. On July 10, 1998, pursuant to the Massachusetts Environmental Policy Act (M.G.L. c. 30, ss. 61-62H) and the MEPA Regulations (301 CMR 11.00), the Secretary of the Executive Office of Environmental Affairs (EOEA) made the determination that the New Bedford/Fairhaven Harbor DMMP requires the preparation of an Environmental Impact Report (EIR). Because the project involves the potential alteration of more than ten acres of Land Under the Ocean (a resource area regulated under the Massachusetts Wetlands Protection Act, M.G.L. c. 131, s. 40) and involves the use of state agency funding through the Seaport Bond Bill (Chapter 28 of the Acts of 1996), the New Bedford/Fairhaven Harbor DMMPs exceeded the "categorical inclusion" threshold at Section 11.25(2) of the MEPA regulations in effect in June 1998, requiring by regulation the preparation of an EIR. (Under the current MEPA Regulations, promulgated in July 1998, the New Bedford/Fairhaven Harbor DMMP exceeds the 10-acre wetland resource area alteration "Mandatory EIR" threshold at 301 CMR 11.03(a)b. The Mandatory EIR thresholds contained in the July 1998 MEPA Regulations have replaced the Categorical Inclusion thresholds from previous versions of the MEPA regulations.) The EIR for New Bedford/Fairhaven Harbor DMMP includes the DEIR submitted in 2002 and this FEIR in composite. The DEIR Certificate was issued June 14, 2002.

2.6 Scoping Summary

The Secretary's DEIR Certificate of June 14, 2002 (included in this Section of this FEIR), establishes the backbone of scope for this FEIR. The additional resource information for the FEIR includes:

- Additional geotechnical borings
- Macrobenthic sampling and identification
- Current measurements and water column chemistry
- Dredging and disposal event modeling and hydrodynamic analysis
- Underwater archaeological surveys
- Physical and chemical analyses of surficial sediments

2.6.1 Coordination with Federal Agencies

The USACE has developed a method of coordinating the review and approval time-lines of the various federal resource agencies charged with reviewing major projects involving discharges of dredged or fill material in waters of the United States, regulated under Section 404 of the Clean Water Act or activities in tidal waters regulated under Section 10 of the Rivers and Harbors Act of 1899. Based upon the mapping overlay planning methodology developed by noted landscape architect Ian McHarg in the 1960s, the USACE's "Highway Methodology" provides a valuable tool for decision-making in a coordinated fashion. This methodology integrates the planning and design of a project with the requirements of the USACE permit regulations. The USACE serves as the coordinator of comments from the federal agencies, including the USEPA, the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS).

Participation by the USACE in the earliest stages of project planning is a key provision of the Highway Methodology. The evaluation of alternatives to the project is key to the successful completion of the methodology. Alternatives analysis are based upon the determination of the project "purpose and need" (developed under the National Environmental Policy Act (NEPA)) and the "overall/basic project purpose" required under the EPA 404(b)(1) guidelines and used by the Corps in project permitting.

The 404(b)(1) guidelines establish pass/fail environmental tests, to be completed before a determination is made on the balancing of overall project benefits versus detriments. An USEPA/USACE's Memorandum of Agreement, signed in February 1990, mandates a three-step iterative process of avoidance, minimization and mitigation of adverse impacts to wetlands functions and values (USACE, New England Division, 1993).

Application of the Highway Methodology to the New Bedford/Fairhaven Harbor DMMP DEIR involved several key milestones including the USACE's concurrence with the DEIR Outline, Basic Project Purpose (BPP), and Aquatic and Upland Zones of Siting Feasibility (ZSFs). Documentation of the USACE's implementation of the Highway Methodology was presented in the DEIR Appendix B which contains letters presenting the coordinated federal comments. For the FEIR, the USACE was helpful to confer and develop the sampling plan methodology to determine the UDM vertical horizon (Section 8.0, Appendix A).

2.6.2 Coordination with State Agencies

Because of the array of permits required from the state to implement various disposal types and technologies proposed, DMMP planning has also required the close coordination with state regulatory agencies, particularly the Department of Environmental Protection (DEP), Division of Marine Fisheries (DMF) and Massachusetts Historical Commission (MHC). The broad-reaching policy issues involved in the disposal of UDM have also been explored with these agencies, and will require continued coordination through the development of the FEIR. Close coordination with state agencies was essential to developing this FEIR. However, all statements and conclusions contain herein are the sole responsibility of CZM. State agencies will be reviewing and formally commenting to MEPA on the content and conclusion of this FEIR pursuant to their regulatory oversight responsibilities.

2.6.2.1 Department of Environmental Protection

Since Massachusetts does not have comprehensive regulations for the disposal of dredged material, DEP Divisions with jurisdiction over UDM disposal including: Wetlands and Waterways, Water Pollution Control, Waste Site Cleanup and Solid Waste Management were approached at key DMMP milestones. DEP agencies reviewed and concurred with the site selection criteria developed to insure consistency with existing state regulations. Issues regarding aquatic disposal were discussed at numerous meetings, phone calls and e-mail correspondence.

2.6.2.2 Division of Marine Fisheries

DMF participation in, and oversight of, investigations of marine resources conducted in support of the DMMP was invaluable to developing the detailed assessments provided in the DEIR. Communications regarding Harbor preferred alternatives shellfish mitigation were conducted with the DMF Regional shellfish biologist for shellfish mitigation planning of this FEIR. The on-going coordination with DMF has played an integral role in data collection and identification of areas needing further study for the New Bedford/Fairhaven Harbor DMMP.

2.6.2.3 Massachusetts Board of Underwater Archaeological Resources

As the sole trustee of the Commonwealth's underwater heritage, the Massachusetts Board of Underwater Archaeological Resources (MBUAR) is committed to promoting and protecting the public's interests in these resources for recreational, economic, environmental, and historical purposes. Under Massachusetts General Law Chapter 6, sections 179-180, and Chapter 91, Section 63, the Board is charged with the responsibility of encouraging the discovery and reporting, as well as the preservation and protection, of underwater archaeological resources. Because the Board's jurisdiction extends over the inland and coastal waters of the state, the siting of aquatic disposal alternatives has been sensitive to the MBUAR’s charge. Ongoing communication and with the MBUAR will continue throughout the remainder of the New Bedford/Fairhaven Harbor DMMP planning process.

SECTION 3.0 – ADDITIONAL SITE-SPECIFIC RESOURCE INFORMATION

3.0 ADDITIONAL SITE-SPECIFIC AQUATIC RESOURCE INFORMATION

3.1 Borings to Confirm Depth to Bedrock and Determine Side Slope Stability

The New Bedford/Fairhaven Harbor DEIR provided a detailed analysis of alternative disposal sites for the disposal of unsuitable dredged materials (UDM)(MAGUIRE, 2002). The preferred alternative disposal sites presented in the DEIR consist of two confined aquatic disposal (CAD) sites within New Bedford/Fairhaven Harbor (Harbor). The two CAD sites are referred to as Channel Inner (CI) and Popes Island North (PIN) (Figure 3-1). Phase I exploratory geotechnical investigations were conducted for the DEIR (Maguire, 2002). Geotechnical borings and other geophysical studies were undertaken at each of the potential CAD locations (Maguire, 2002). Comments on the DEIR concurred with recommended additional site-specific Phase II geotechnical borings to obtain a greater level of confidence in the depths to bedrock for this FEIR. The new Phase II borings also provided sediment characteristics for preliminary engineering including side-slope stability of (CAD) cells of the CI and PIN resource areas (Maguire, 2003, and see Appendix A).

Note: The FEIR distribution capacity is based on the geotechnical characteristics of the CAD areas as a conceptual basis for long-term use of the CADs. Specific CAD sites and location within the area of the preferred alternative will be determined by the specific dredging program developed by New Bedford and Fairhaven.

3.1.1 Goal

The goal of the additional borings was to confirm depths to bedrock and to determine CAD cell side slope stability. Specific depths to bedrock were established to provide a more accurate estimate of the potential CAD cell capacities. Geotechnical analysis of sub-aqueous soil samples from the four additional borings provided sediment engineering properties to support the preliminary design of stable and constructible CAD cell side-slopes (Maguire, 2003, and see Appendix A).

3.1.2 Description of Study

The two proposed CAD cell sites are located approximately ½-mile apart (Figure 3-1). The CI site has an area of approximately 90-acres (Figure 3-2) and is the more southerly area. The PIN site, with an area of approximately 80-acres, is the more northerly area (Figure 3-3). Fieldwork consisted of integrated geotechnical and geophysical investigation efforts. Phase I geophysical seismic refraction surveys in the DEIR were the primary investigatory tool used to develop the study area bedrock surface database and establish preliminary CAD cell design parameters. These geophysical surveys were used to assist in the appropriate location of Phase II marine boring explorations contained in this FEIR. Four Phase II borings were drilled between October 15 – 23, 2002 at predetermined locations within the two sites studied (Figures 3-2, 3-3). The boring locations were selected to verify maximum/minimum bedrock elevations or were located in areas of “low confidence” bedrock interpretation.

The Phase II geotechnical drilling program was conducted with a barge mounted drill rig in the Harbor. Samples of soil were collected during the drilling program using a split-spoon sampler. Rock-core samples were collected from the borings using a diamond-bit rock core barrel. The borings were performed in areas that supplement previously collected geotechnical information. Phase II borings also provided representative sediment samples and sampling standard penetration test (SPT) data, from mudline to bedrock depth, necessary for sediment engineering property estimates. The geotechnical laboratory program was undertaken to assist in sediment strata differentiation and sediment engineering property development. The laboratory program was also designed to provide a sediment physical property database for this and subsequent State-wide CAD cell design and construction feasibility assessments.

Site Area	**Marine Borings**	
	Phase II October 2002	**Total Borings**
CI	NBH – 9, 10 and 11	3
PIN	NBH - 8	1

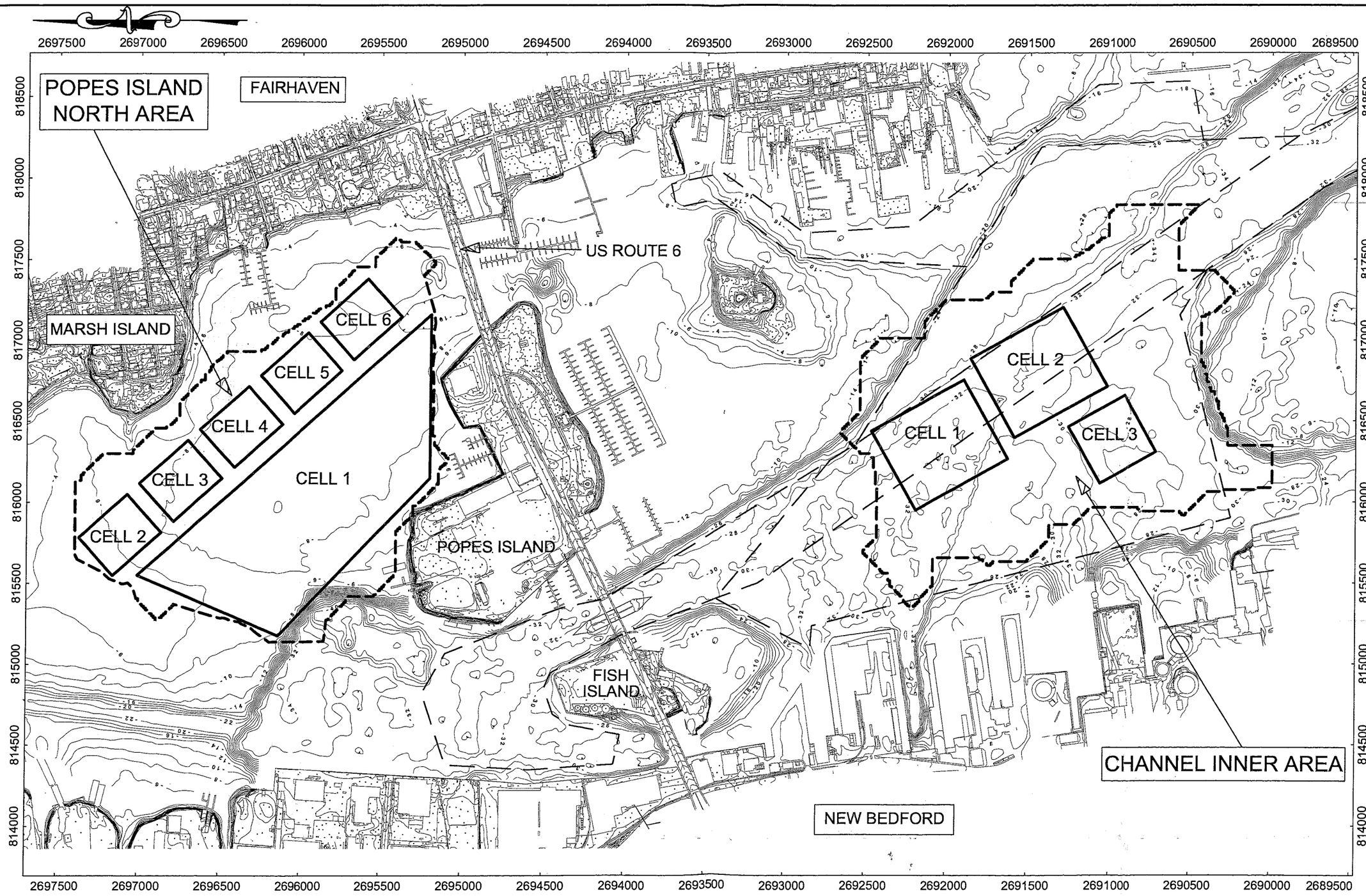
The geophysical program used data from the four additional Phase II borings to recalibrate the existing bedrock profile model for greater confidence (Apex, 2003). Initial depth-to-bedrock information was re-run using the final models from 2001 as a starting point. Based on the comparisons between the existing models and the new depth to bedrock elevation information gained through the 2002 drilling program, various lines were re-analyzed. More refined geophysical bedrock profile modeling recalibrated with supplemental data was the most cost efficient approach to produce high resolution bedrock profiles of these 90- and 80-acre sub-aqueous sites. It should be noted that project borings are widely spaced and only general trends in subsurface conditions are revealed. Due to the wide spread boring location spacing they were integrated with area wide geophysical exploratory techniques.

3.1.3 Results

The Phase II geotechnical program borings of the two proposed CAD cell sites revealed similar geologic stratigraphy, from mudline down:

- Surficial organic sediments, Organic Silt and Peat, are geologically recent, Holocene Era, deposits.
- The Interbedded silts, sands, and sands and gravels with occasional boulders, are complex bedded Glacial-Drift Pleistocene Age deposits composing the bulk of the stratigraphic column.
- The deepest Glacial Till stratum is generally dense, thin and boulder laden. The Glacial Till stratum was formed by direct glacial ice-contact during the Pleistocene Age.

The bedrock, Gneissic Granite (Alaskite), is surficially fractured and observed to be in a fresh to slightly weathered condition. Of note are the extensive Organic Silt and Peat deposits observed in boring NBH-1, located at the north end of the Popes Island North site. During initial cell



NOTES:

1. Base Plan of the New Bedford Harbor area was obtained from the US Army Corps of Engineers and has not been field verified.
2. Coordinates are shown in the State Plane Coordinate System, Massachusetts Mainland Zone 2001, Referenced to the 1983 North American Datum (NAD83).

POPES ISLAND NORTH AND CHANNEL INNER CAD CELL SITE LOCATIONS

0 600 1200 1800

SCALE: 1"=600' FEET

LEGEND

- FEDERAL NAVIGATION CHANNEL, ANCHORAGE AND MANEUVERING AREA LIMITS (CHANNEL INNER AREA)
- 2 FOOT BATHYMETRIC CONTOUR
- PROPOSED CAD CELL CONFIGURATION
- LIMITS OF GEOPHYSICAL/GEOTECHNICAL EXPLORATION AND INTERPRETATION

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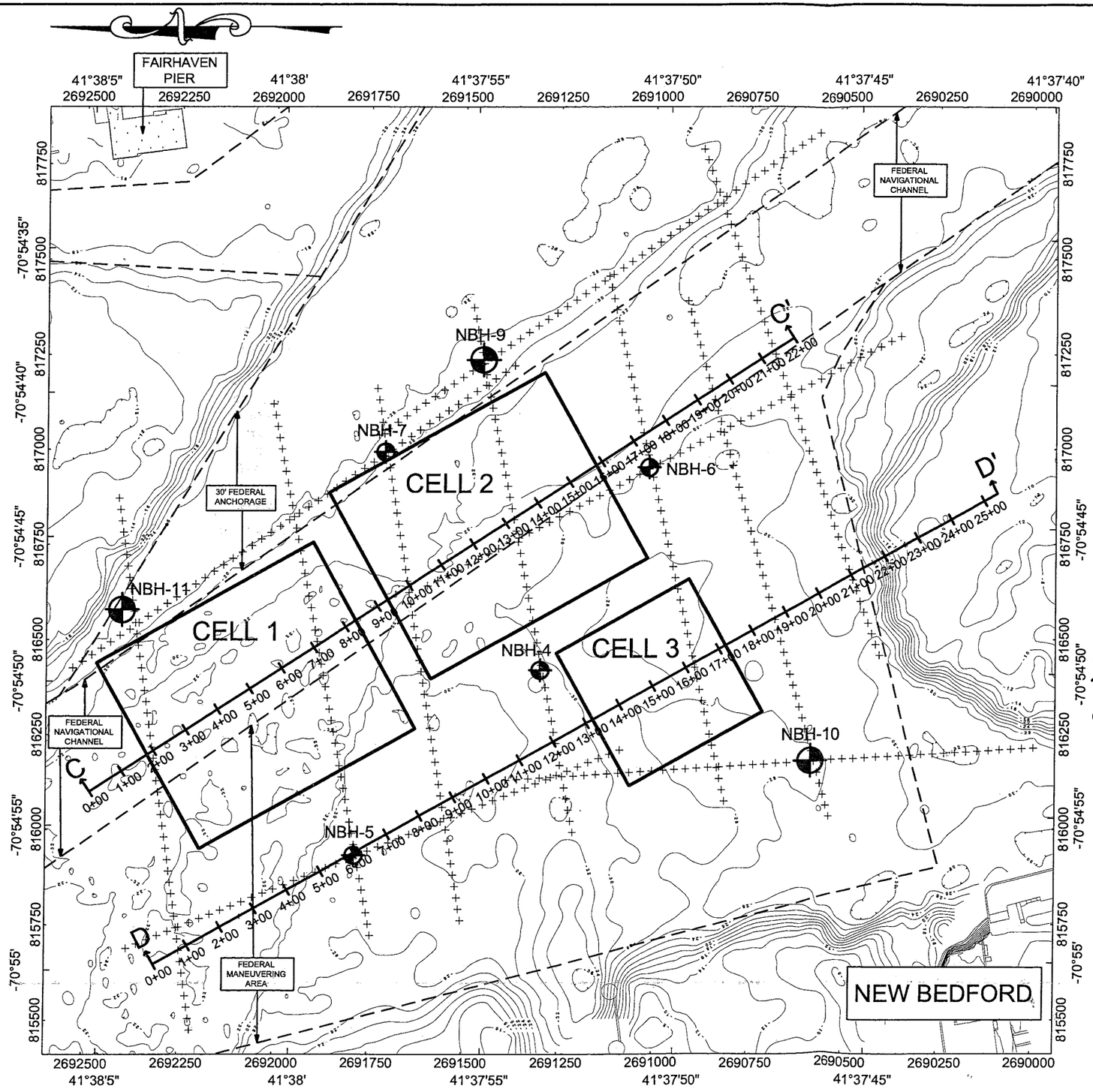
MAGUIRE GROUP

NEW BEDFORD/FAIRHAVEN HARBOR DMMP FEIR

FIGURE 3-1. POPES ISLAND NORTH AND CHANNEL INNER CAD CELL SITE LOCATIONS

PROJECT NO.:	16454
DESIGNED BY:	---
DRAWN BY:	---
CHK'D BY:	
DATE:	06/02/03
SCALE:	AS NOTED

Drawing file: N:\PROJECTS\DML\GEOTECH\APEX ENGINEERING 5-8-03\Presentation Drawings\HALF-SIZES 8-27-03\16451GFC100.dwg Plotted: Sep 15,2003-8:12am By: Wisney



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LEGEND

NBH-7 — PHASE I PROJECT BORING LOCATIONS

NBH-10 — PHASE II PROJECT BORING LOCATIONS

FEDERAL NAVIGATION CHANNEL, ANCHORAGE AND MANEUVERING AREA LIMITS

GEOPHYSICAL SURVEY LINES

2 FOOT BATHYMETRIC CONTOUR

PROPOSED CAD CELL CONFIGURATION

C C' 0+00 1+00 2+00 3+00 4+00 — PROFILE LOCATION WITH STATIONING

3. SCALE:

0 300 600 900

SCALE: 1"=300' FEET

CHANNEL INNER CAD CELL CONFIGURATION SUBSURFACE PROFILE AND EXPLORATION LOCATION PLAN

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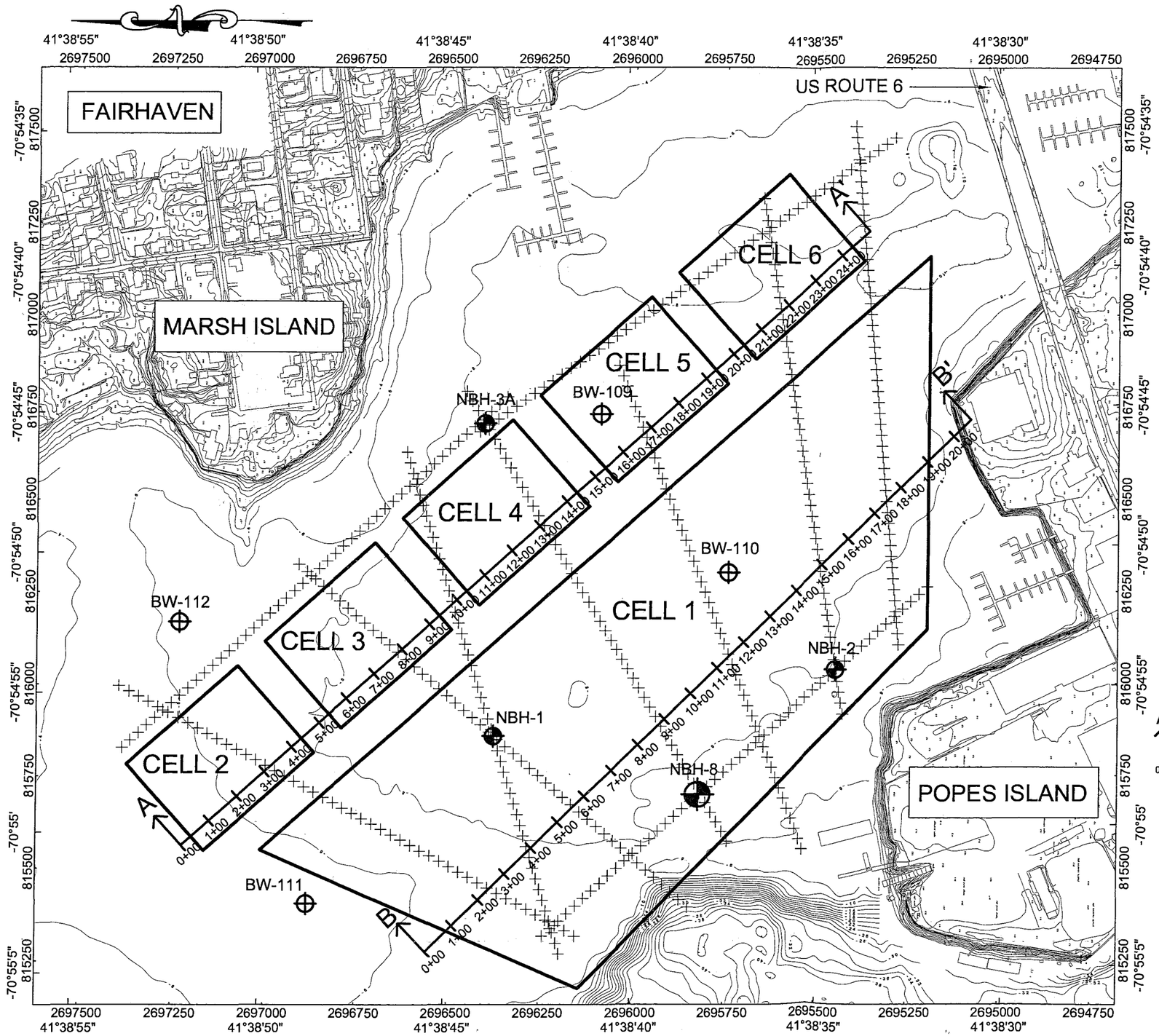
FIGURE 3-2. CHANNEL INNER CAD CELL CONFIGURATION SUBSURFACE PROFILE AND EXPLORATION LOCATION PLAN

PROJECT NO.:	16454
DESIGNED BY:	---
DRAWN BY:	---
CHK'D BY:	
DATE:	06/02/03
SCALE:	AS NOTED

Drawing file: N:\PROJECTS\GML\GEOTECH\APEX ENGINEERING 5-8-03\Presentation Drawings\HALF-SIZES 8-27-03\16451GFG101.dwg Plotted: Sep 15,2003-8:23am By: Whitney



NOTES:

1. Base Plan of the New Bedford Harbor area was obtained from the US Army Corps of Engineers and has not been field verified.
2. Coordinates are shown in the State Plane Coordinate System, Massachusetts Mainland Zone 2001, Referenced to the 1983 North American Datum (NAD83).

LEGEND

NBH-1 — PHASE I PROJECT BORING LOCATIONS

NBH-8 — PHASE II PROJECT BORING LOCATIONS

BW-110 — EBASCO SERVICES 1988 STUDY BORING LOCATIONS

GEOPHYSICAL SURVEY LINES

1 FOOT BATHYMETRIC CONTOUR

PROPOSED CAD CELL CONFIGURATION

A A' — PROFILE LOCATION WITH STATIONING (0+00 1+00 2+00 3+00 4+00)

3. SCALE:

0 300 600 900

SCALE: 1"=300' FEET

POPES ISLAND NORTH
CAD CELL CONFIGURATION
SUBSURFACE PROFILE AND EXPLORATION LOCATION PLAN

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FIGURE 3-3. POPES ISLAND NORTH CAD CELL CONFIGURATION SUBSURFACE PROFILE AND EXPLORATION LOCATION PLAN

PROJECT NO.:	16454
DESIGNED BY:	---
DRAWN BY:	---
CHK'D BY:	
DATE:	06/02/03
SCALE:	AS NOTED

PAGE 3-2c

dredging, the organic sediments are the least stable and exhibit the shallowest stable slope angles. The most prominent stratigraphic feature, the Interbedded Glacial Drift and the deepest sediment stratum, the Glacial Till, are observed to contain boulders, which will have to be addressed by the dredging management plan. The Glacial Drift is thought to contain only occasional boulders; while the more limited thickness Glacial Till significantly more. It is probable that cell dredging will not extend significantly into the Glacial Till stratum, dependent upon the defined Till limits.

For the Phase II geophysical program profiles generated from the data indicated that the bedrock character in both areas of interest is irregular, and marked by undulations of the bedrock surface (Figure 3-4). The results of the re-interpretation of the refraction data are best conveyed as contoured surface maps of the bedrock as determined from the interpreted seismic data. Figures 3-5 and 3-6 depict the results of the seismic data interpretation for CI and PIN area, respectively. The figures display the inferred top of bedrock surface as determined from the seismic refraction data as a color-coded contour elevation (referenced to NGVD29), in order to aid in the identification of trends in the surface (i.e., blue areas are deeper and red/pink/orange areas are shallower).

The “highest” bedrock surface elevation noted in the CI area is in the range of minus 35 feet (NGVD29). The “lows” in the bedrock topography, noted from the data within the possible CAD footprint are in the minus 66-foot range (NGVD29). The mean elevation of the bedrock surface in the CI area is minus 52-foot (NGVD29) (See Figure 3-5). The “highest” bedrock surface elevation noted in the PIN area is in the range of minus 28 feet (NGVD29). The “lows” in the bedrock topography, noted from the data within the possible CAD footprint are in the minus 95-foot range (NGVD29). The mean elevation of the bedrock surface in the Popes Island North area is minus 66 feet (NGVD29) (See Figure 3- 6).

Data collected in the CI revealed potential faulting or fracturing that trends north to south through the center of the area also affected seismic velocities and the models calculated using these velocities. Data collected in the PIN proved a high confidence indicating sound bedrock surface. Adding to the confidence in this area, is supporting seismic data northwest of the survey area (Foster Wheeler, 2001).

3.1.4 Summary

The Phase II geotechnical program determined that both the CI and PIN areas have sediment engineering properties to support the preliminary design of stable and constructible CAD cell 1V: 3H side slopes. Also, the absence of apparent bedrock precipice formations that might restrict CAD cell capacity restrictions was clarified. More refined depth of sediment from mudline to bedrock information helped define CAD cell capacities for CI and PIN. The estimated capacity for UDM is approximately 150,000 cubic yards (cy) at CI and approximately 2,050,000 cy at PIN.

The CI site is an area of uniformly shallow sediment depth. As a result, even a small project CAD cell would take up a large surface area making a small project CAD cell quite large in plan-

area. This configuration results in a relatively large required total volume of sediment handled in relation to the volume of space created for contaminated sediment. The presence of the federal navigation channel, maneuvering and anchorage areas further complicate this area.

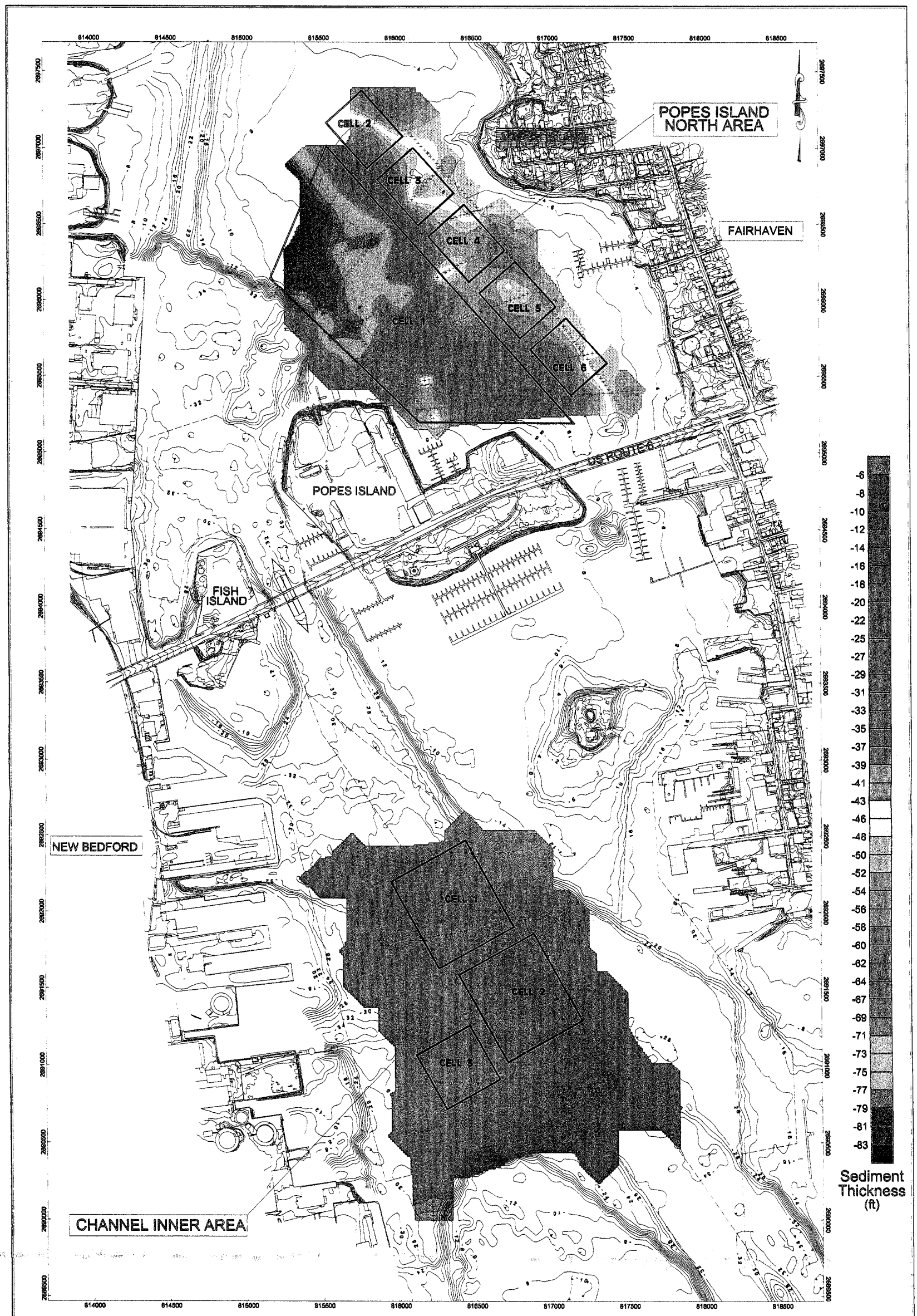
The PIN site typically exhibited shallower water and deeper sediment depths. In the PIN site, accommodation for five moderate volume dredge projects, ±50,000 cy each, as well as a large volume dredge project, ±1,800,000 cy, fits well with revealed subsurface conditions. The relatively shallow sediment depths along the area's eastern, Fairhaven, edge favors a moderate project cell approach, while the deeper sediment depths along the western bedrock valley, adjacent to Popes Island favors a large project cell approach. If moderate projects are initially considered for the PIN site, the potential for a dredge material quantity to fit within the eastern, shallow cell and shallow water depth area should be considered for specific project estimates. In addition, initial moderate project time estimates should reflect the use of smaller less efficient but more mobile equipment. Greater detail on CAD cell development is contained in Section 3.3 *Preliminary CAD Cell Configuration and Construction Planning.*

3.2 Comparative Dredged Materials Options

The DEIR presented discussions on a great number of UDM disposal options for dredged materials generated from Harbor maintenance before arriving at the preferred alternative CAD cells CI and PIN that are evaluated for the preferred alternative in this FEIR. Upland and aquatic disposal categories were thoroughly explored and evaluated. The off-site upland disposal was researched for the DEIR (Maguire, 2002). The process to prepare dredged material for final upland disposal or reuse involves the following primary site functions: off-loading; material screening; lime treatment; soil amendment; and transfer to disposal/reuse site (DEIR section 4.0). The cost for upland disposal ranges from $62 - $333/cy for silty UDM that is not suitable as final cover for landfills.

Aquatic disposal options for Harbor UDM other than the preferred alternative CAD cells, included disposal in traditional offshore dumping sites and subsequently capping the UDM with SDM. The hydrodynamic conditions for this remedy must be depositional, so that capping materials are not eroded over perpetuity thus chancing recontamination of the environment. Aquatic disposal options considered in the DEIR included the Buzzards Bay Disposal Site (BBDS) and West Island disposal area. These locations among others did not pass screening of the alternatives in the DEIR (Maguire, 2002, and see Section 4.0).

EPA has made a commitment to dispose of Harbor sediment containing very highly elevated "actionable levels" of contamination. In 1983 the EPA declared an area that has been defined as approximately 18,000 acres surrounding and including the Harbor as The New Bedford Harbor Superfund Site (EPA, 1998). In 1998 the EPA planned to construct four shoreline Confined Disposal Facilities (CDF) along the Upper Harbor shoreline. These CDFs were to be reconstructed coastal land features. The design of these CDFs included installation of permanent steel bulkheads set off the existing shoreline and back filling shore-side voids with contaminated materials then capping with clean materials to prevent recontamination with the environment. In 2002, the EPA issued formal additional information and a refined cleanup approach for the upper and lower Harbor. The new information eliminates a 17-acre CDF and replaces this shoreline



NOTES:

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2. Coordinates are shown in the State Plane Coordinate System, Massachusetts Mainland Zone 2001, Referenced to the 1983 North American Datum (NAD83).
3. Sediment Thickness Calculated as the Difference Between Bedrock and Mudline Elevations.

LEGEND

- FEDERAL CHANNEL, ANCHORAGE AND MANEUVERING AREA
- 2 FOOT BATHYMETRIC CONTOUR
- HYDROPHONE LOCATION
- PROPOSED CAD CELL CONFIGURATION

REV.	DESCRIPTION	BY	DATE
1.	POSSIBLE CAD CONFIGURATION	TDM	06/05/03

FIGURE 6 - SEDIMENT THICKNESS MAP

CHANNEL INNER & POPES ISLAND NORTH AREAS
SEISMIC REFRACTION - REVISED MODEL

NEW BEDFORD HARBOR
BRISTOL COUNTY, NEW BEDFORD, MASSACHUSETTS

374 Congress St
Suite 500
Boston MA 02210
617 728-0070

SCALE:	DRAWN:	DESIGN:	CHECKED:	PROJECT# 0410.001.01
	TDM	TDM	JAB	

1" = 350' 0 350 700 1050 SCALE FEET

NEW BEDFORD/FAIRHAVEN HARBOR DMMP FEIR

FIGURE 3-4. HARBOR CAD SITES
SEDIMENT THICKNESS
TO BEDROCK SURFACE PLAN

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225 Foxborough Boulevard
Foxborough, Massachussetts 02035

CZM

PROJECT NO: 16454
DESIGNED BY: ---
DRAWN BY: ---
CHK'D BY:
DATE: 06/02/03
SCALE: AS NOTED

MARK	DATE	DESCRIPTION

NOTES:

1. Base Plan of the New Bedford harbor area was obtained from the US Army Corps of Engineers and has not been field verified.
2. Coordinates are shown in the State Plane Coordinate System, Massachusetts Mainland Zone 2001, Referenced to the 1983 North American Datum (NAD83). Vertical Datum referenced to NGVD29.
3. Boring information and position supplied by The Maguire Group.

LEGEND:

- SEISMIC CALIBRATION BORING (MAGUIRE)
- FEDERAL CHANNEL, ANCHORAGE AND MANEUVERING AREA LINE
- HYDROPHONE LOCATION (PHONE NUMBER & BEDROCK ELEVATION INDICATED)
- 2' BATHYMETRIC CONTOUR
- PROPOSED CAD CELL EXTENT
- PROFILE LOCATION

0 150 300 450
1" = 150'
SCALE FEET

PAGE 346

SCALE: AS NOTED
DATE: 06/02/03
CHK'D BY:
DRAWN BY:
DESIGNED BY:
PROJECT NO.: 16454

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FIGURE 3-5. CHANNEL INNER BEDROCK SURFACE PLAN

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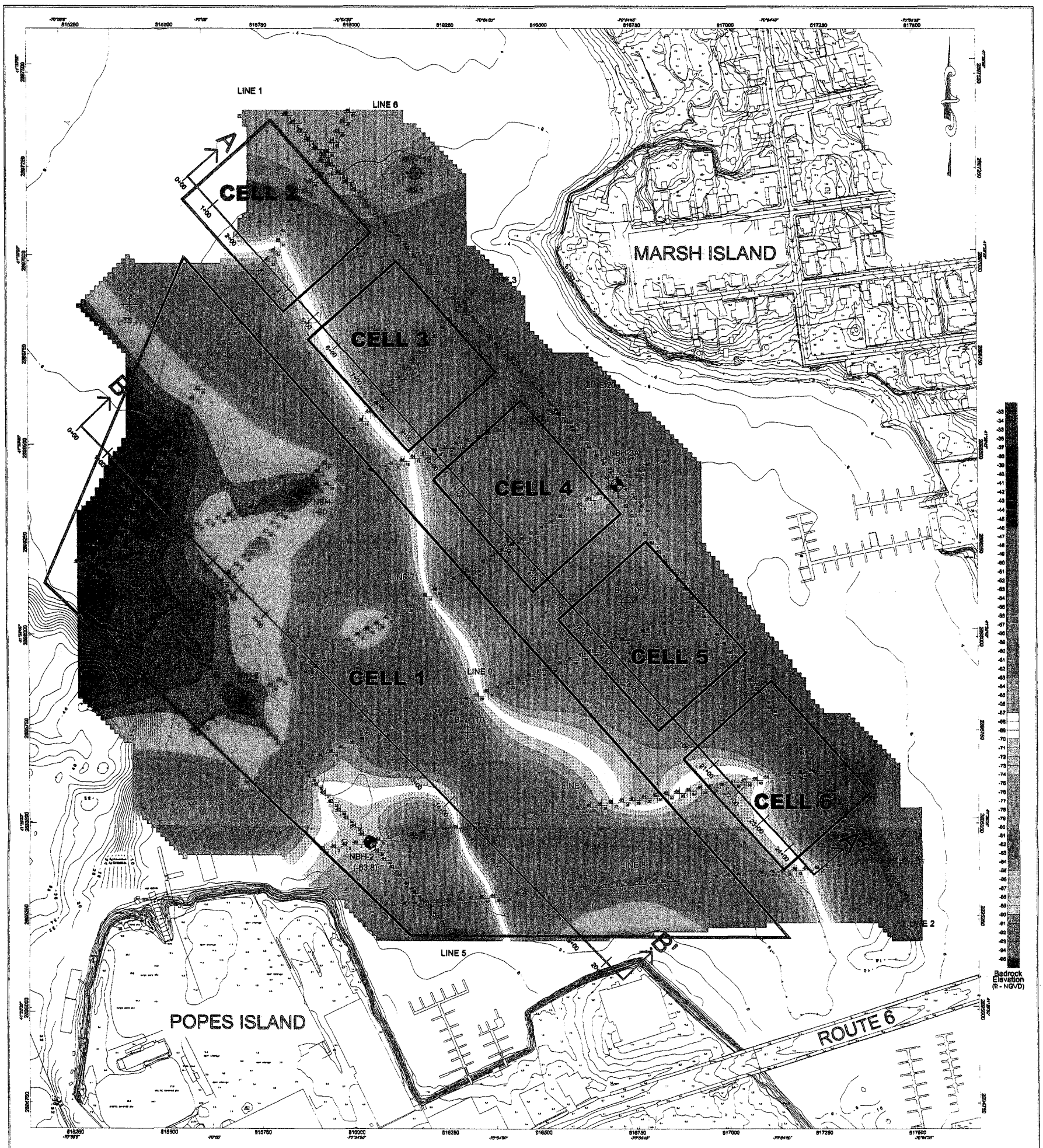
225 Foxborough Boulevard
Foxborough, Massachussetts 02035

CZM

MARK	DATE	DESCRIPTION



NOTES:

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2. Coordinates are shown in the State Plane Coordinate System, Massachusetts Mainland Zone 2001,Referenced to the 1983 North American Datum (NAD83). Vertical datum NGVD29.
3. Boring information and position supplied by The Maguire Group.

LEGEND

- SEISMIC CALIBRATION BORING
- EBASCO BORING (APPROXIMATE LOCATION)
- HYDROPHONE LOCATION (PHONE NUMBER & BEDROCK ELEVATION)
- 1' BATHYMETRIC CONTOUR
- PROPOSED CAD CELL EXTENTS
- PROFILE LOCATION

0 150 300 450
1" = 150'
SCALE FEET

PAGE 3-26

PROJECT NO.: 16454
DESIGNED BY:
DRAWN BY:
CHK'D BY:
DATE: 08/02/03
SCALE: AS NOTED

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FIGURE 3-6. POPES ISLAND NORTH BEDROCK SURFACE PLAN

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CZM

MARK	DATE	DESCRIPTION

disposal with off-site upland disposal (EPA, 2002). This change reflects considerable savings to the Agency clean-up cost. Still the estimate for the latest change equates to approximately $400/cy to dispose of the actionable contaminated Harbor sediment for perpetuity (EPA, 2002).

3.3 Preliminary Cad Cell Configuration And Construction Planning

The DEIR provided the basis for conceptual engineering for CAD cells at the preferred alternatives CI and PIN sites. The FEIR distribution capacity is based on the geotechnical characteristics of the CAD areas as a conceptual basis for long-term use of the CADs. Specific CAD sites and locations within the area of the preferred alternative will be determined by the specific dredging program, developed by New Bedford and Fairhaven. In response to the Draft EIR Certificate, the Secretary called for site-specific information supportive of a Preferred Alternative Cad cell management plan. This Certificate states that if the site-specific information indicates that the preferred alternative, in whole or part, is not suitable, the FEIR will provide the same level of information on any alternative site or methodology that might be chosen. Information derived from the latest geotechnical and geophysical studies that the FEIR was applied to this preliminary CAD cell configuration and construction planning to attain a higher level of management confidence. Application of the latest geotechnical and geophysical findings provided a lower level of management confidence for CI and conversely a higher level of management confidence in PIN (section 3.1 of this FEIR). Also, after the publication of the DEIR, the NBHDC expressed particular interest to include small moderate capacity CAD cells of approximately 50,000 cy UDM capacity in the overall CAD cell planning horizon.

3.3.1 Preferred Alternatives CAD Cell Configurations and Construction Planning

Distances between CAD cells at each site were maintained at 100-feet for construction efficiency and cell stability considerations. In calculating the volume of each cell, a slope of 1Vertical: 3Horrizontal (1V: 3H) was determined to be suitable to produce stable and constructible cell side slopes. This geotechnical evaluation was based upon a review of: boring and sediment laboratory test data, examination of sediment samples, geophysical interpretations, and qualified geotechnical research and experience in the New England area with similar sediment profiles. The stability of cell side slopes is in part a function of exposure time to environmental and operational forces.

Table 3-1, Estimated Sediment Engineering Properties, summarizes estimated sediment engineering properties and cell side slopes for preliminary CAD cell design. In the short-term, repetitive forces imposed by dredging operations, tidal current and wave loadings as well as storm forces will slightly degrade initially stable submarine slopes. In the long-term, cell side slopes need to be stable enough to maintain the full depth integrity of sequestered contaminated organic sediments that have relatively weak structural properties. The recommended 1V: 3H CAD cell side slopes assumed the variety of sediment types involved as well as a reasonably short-term, single season, exposure period, i.e., CAD cells would likely be dredged and backfilled in one season.

Final cell capping may occur during the subsequent season to allow the confined sediments time to consolidate and gain structural stability. (See discussion in Section 8.0, Dredging Management Plan.) A 10-foot buffer was maintained between proposed bottom of CAD cell and the average bedrock surface within the CAD cell footprint. This buffer accounts for inaccuracies in the defined bedrock surface, variations in the actual bedrock surface and further maintains several feet of dense sediment buffer between cell contained contaminants and possible fractured bedrock surfaces. Cell capping thickness determination for CAD cells requires consideration of bioturbation, consolidation, erosion, operational, and chemical isolation as design parameters (USACE, 1998).

The objective of capping the contaminated dredged materials in NBH CAD cells is to adequately isolate the UDM from the environment (Palermo, et al., 1998). A three-foot CAD cell cap was introduced as conceptual in the DEIR. Equivalent caps have been engineered for the CAD cells of Boston Harbor Navigation Improvement Project (BHNIP), Providence River and Harbor Maintenance Dredging Project (PRHMDP) and Newark Bay Confined Disposal Facility (NBCDF and USACE, 1995 and USACE, 2001 and PANYNJ, 1998). Post-dredge monitoring of CAD cells of BHNIP shows effective recolonization of opportunistic macrobenthic species within one year (ENSR, 2001). An extremely conservative four-foot CAD capping thickness was assumed for the CAD cells in this particular Harbor due to the highly elevated level of known contaminants (ENSR, 2002). Even though much of the contaminated dredged material expected to be sequestered in the PIN CAD cell is below EPA actionable levels, the four-foot conservative capping layer has been planned for environmental safety (EPA, 1998).

3.3.1.1 Channel Inner Area CAD Cells

After investigating the potential storage volume within the CI area, it is apparent that the shallow bedrock and general location of the proposed cells may severely limit the potential capacity in this area. Volumes were calculated assuming three cells in the CI area. All three CAD cells were designed to accommodate approximately 50,000 cubic yards of material. Figure 3-2 shows the cell configuration.

In addition, the proposed CI CAD cells are located within the federal channel and associated maneuvering /anchorage area. In order to account for future dredging activities, which may disturb the suitable material cap, an additional contingency of three (3) feet was planned. This additional contingency is expected to be either an additional cap thickness of three (3) feet, or a depressed surface (i.e., leaving the final grade 3-feet below required depths). This extra operational compensation was added to protect the cap from being dredged as part of ongoing maintenance dredging during normal harbor/port operations. For each CAD cell, total storage capacity equals the volume of suitable material expected to be placed.

Figure 3-7 below shows an estimate of the division of the available volume for the CI area. Table 3-2 below summarizes the calculations for the CI area.

New Bedford/Fairhaven Confined Aquatic Disposal Cell
Feasibility Study
Estimated Sediment Engineering Properties

Stratum	SPT Value[1]		Avg. Stratum	Atterberg Limits[2]				Organic	Grain Size Components (%)[4]			Unit Weight (lb/ft^3)[5]			Unified	Effective Stress Parameters[7]		Recommended
	N_{avg}	N_{corr}	Thickness (Ft.)	W_n	LL	PL	PI	Content (%)[3]	Silt/Clay	Sand	Gravel	γ_{total}	$\gamma_{bouyant}$	γ_{dry}	Classification[6]	c	ϕ	Cell Side Slope (Vert:Hor)[8]
Popes Island North																		
Organic Silt (O)	WOR	WOR	17	64	73	29	44	5.6	62	37	1	110	46	66	OH,OL	0	26°	1 : 3
Peat (P)	WOR	WOR	4	206	253	160	93	45.7	94	6	0	95	31	25	P_t, OL	0	26°	1 : 3
Interbedded Glacial Drift (I)	20	18	49	Granular - Non Plastic				NA[9]	17	68	15	126	62	100	SW, SM, SP, ML	0	30°	1 : 3
Glacial Till (T)	40	30	5	Granular - Non to Low Plasticity				NA	17	43	40	135	71	120	SM, GC, GM	0	38°	1 : 3
Channel Inner																		
Organic Silt (O)	WOR	WOR	5	69	54	28	26	4	59	33	8	110	46	66	OH, OL	0	26°	1 : 3
Interbedded Glacial Drift (I)	10	16	16	Granular - Non Plastic				NA	14	66	20	124	60	97	SW, SM, SP	0	30°	1 : 3
Glacial Till (T)	60	60	6	Granular - Non to Low Plasticity				NA	14	51	35	135	71	120	SM, SP	0	38°	1 : 3

[1] N_{avg} = average stratum Standard Penetration Test (SPT) value per ASTM D 1586, N_{corr} = average stratum SPT value corrected for overburden pressure.
[2] Wn = average natural sample water content per ASTM D 2216 - 98; average Atterberg Limits: LL, PL and PI = Liquid Limit, Plastic Limit and Plasticity Index per ASTM D 4318 - 98 (Method A).
[3] Average Organic Content % per ASTM D 2974-87 (Method B & C).
[4] Stratum differentiation into average grain size components: Fines, Sand and Gravel are as per the Unified Classification System. The Interbedded Glacial Drift and Glacial Till strata contain occasional boulder sized materials. Refer to item 6 below.
[5] Estimated stratum average unit weight: total, bouyant and dry.
[6] Unified Soil Classification System per ASTM D 2487-90.
[7] Estimated average effective stress sediment parameters: c = cohesion, ϕ = friction angle, based upon SPT and grain size correlation and regional experience.
[8] Recommended CAD Cell side slope for preliminary design, assumed short term single season dredge/backfill exposure.
[9] NA = Not available, no organics present.

Table 3-1. Estimated Sediment Engineering Properties

Table 3-2. Volume Calculation summary for the Channel Inner Area CAD configuration shown in Figure 3-7**.**

Cell	Average Bedrock Elevation	Average Bathymetric Elevation	Sediment Thickness	Available Dredge Depth	Total Dredged Volume	Total Storage Capacity
1	-57 ft	-31 ft	**26 ft**	16	**213,000 CY**	**48,500 CY**
2	-57 ft	-31 ft	**26 ft**	16	**213,000 CY**	**48,500 CY**
3	-58 ft	-28 ft	**30 ft**	20	**111,900 CY**	**55,750 CY**

- **Average Bedrock Elevation –Average Bathymetric Elevation = Sediment Thickness**
- **Sediment Thickness – Bedrock Buffer (10-feet) = Available Dredge Depth**
- **Total Dredged Volume = Available Dredge Depth x (length and width of cell) *using 1:3 slope***
- **Total Storage Capacity = Total Volume Dredge – (top 4-foot contaminated material + 4-foot suitable material cap + 3-foot maintenance dredge contingency)**

Table Assumptions:

- All volumes are calculated as Volume of the Void (VOV) and do not take into account sediment properties (i.e., bulking, etc.). The volumes are approximate, and are based on average elevations within each proposed cell.
- **Average Bedrock Elevations** were calculated using Oasis Montaj V5.16 minimum curvature model of the bedrock surfaces within each of the proposed CAD cells. A mathematical modeling cell size of 12 was maintained to construct the minimum curvature model of the bedrock surface.
- **Average Bathymetric Elevations** were calculated similarly to the Average Bedrock Elevations using the USACE bathymetric data 1997 and a mathematical cell size of 8.
- **Sediment Thickness** was calculated by subtracting Bathymetric/Mud line Elevation from the Bedrock Elevation.
- **Available Dredge Depth** is the depth of material excavated allowing the proposed CAD cell to terminate allowing a 10-foot sediment buffer between the bottom of the CAD cell and the bedrock surface. The available dredge depth can also be thought of as the depth of material to the bottom of the proposed CAD cell.
- **Total Volume Dredged** is the amount of material needed to be removed to form the proposed CAD cell given the average dredge depth and assuming a 1:3 (V: H) side slope for each cell.
- **Total Storage Capacity** is the final volume after disposing of the top 4-feet of "contaminated" material back into the cell and allowing for the 4-feet of clean cap material. A maintenance dredge contingency of 3-feet is also allowed for.

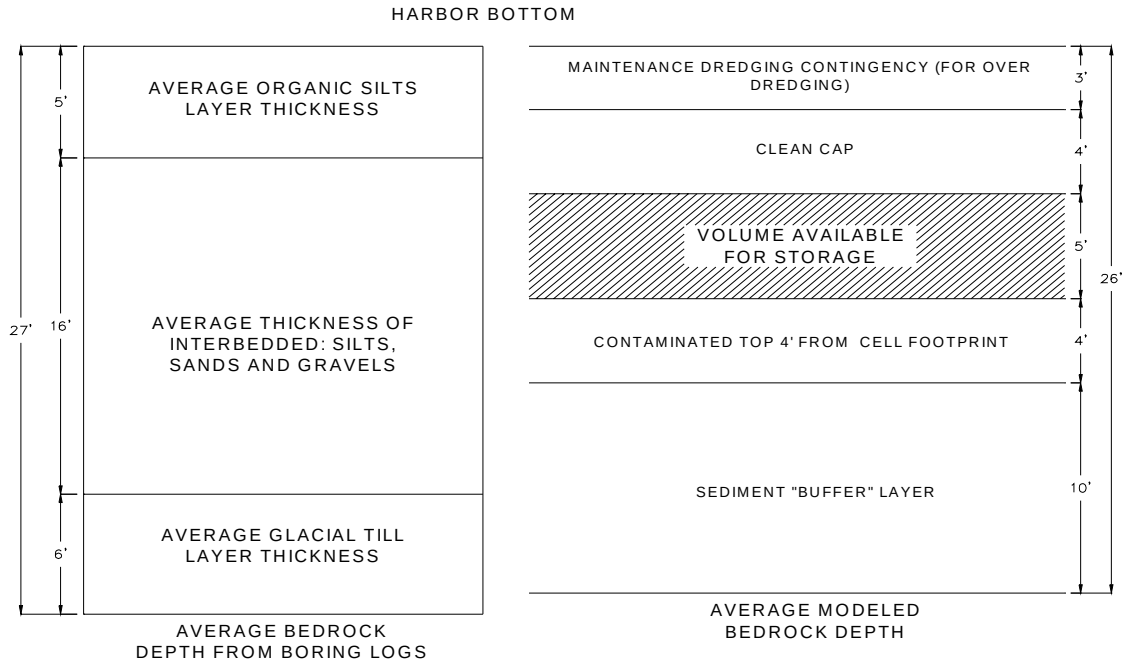


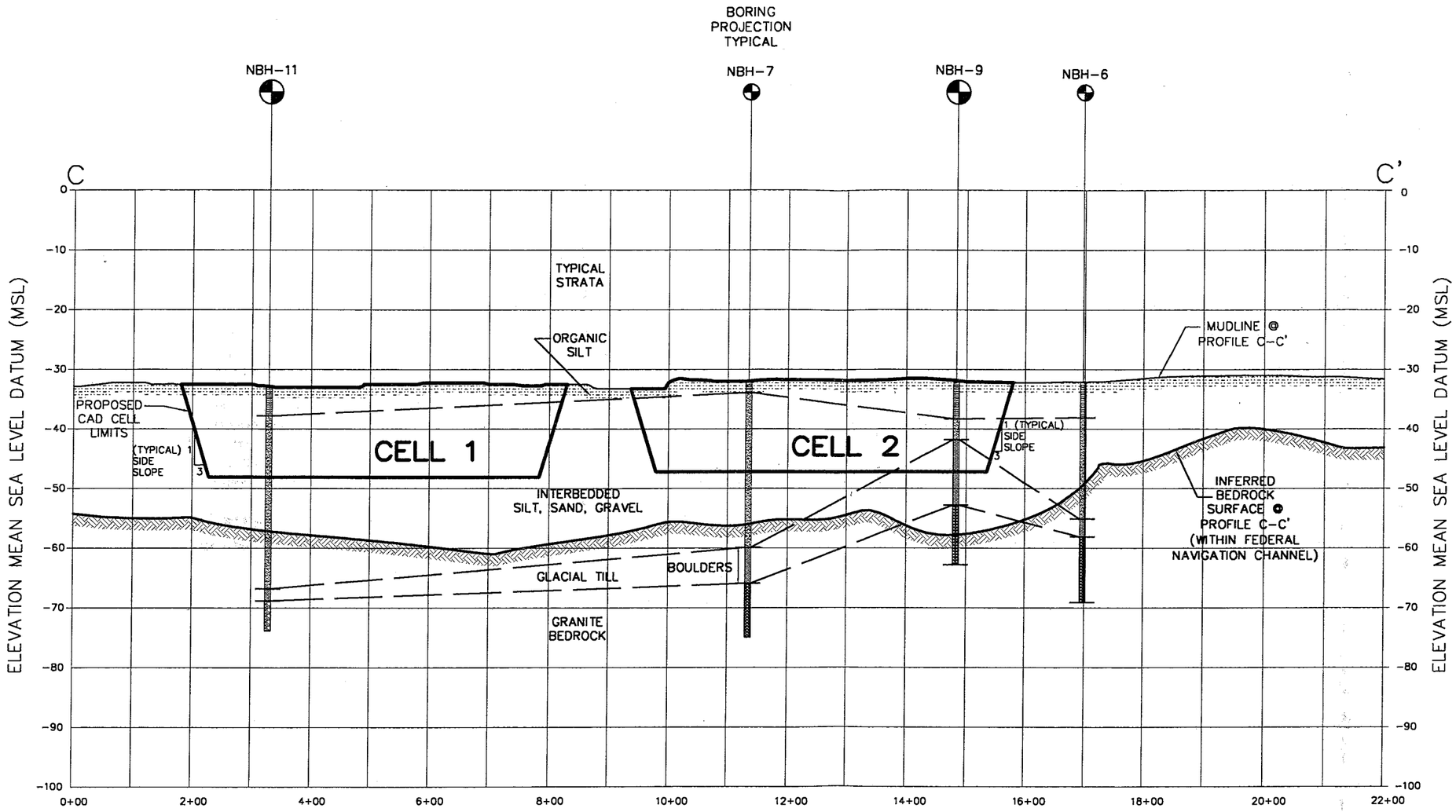
Figure 3-7. Breakdown of the division of available storage capacity and average geological cross section as seen in the borings conducted in the CI area.

3.3.1.2 Cross Section Profiles – Channel Inner Area CAD Cells

Two Stratigraphic Cross Sections were extracted from a profile cut through the CI area proposed CAD cells 1 and 2 (C-C¹) (Figure 3-8) and proposed CAD cell 3 (D-D¹) (Figure 3-9). The cross-sections were constructed by digitizing the modeled bedrock surface and the bathymetric surface over the length of the profile. Boring information collected as part of the project was also extrapolated to the profile centerline to depict the types and thickness of geology encountered.

3.3.1.3 Popes Island Area CAD Cells Volumes Calculations

Volumes were calculated using a conceptual configuration of six cells in the PIN area (See Figure 3-3). Cell 1 was designed for a capacity of 1.8 million cubic yards. Cells 2 through 6 were designed to accommodate approximately 50,000 cubic yards of material each. There is an additional loss of cell volume since the upper four (4) feet of footprint sediment in the PIN area is unsuitable and will be placed back into the cell, taking up volume associated with the top four (4) feet of material. Additionally, a cap of four (4) feet of suitable material will be placed on top, for a cell total of eight (8) feet of depth subtracted from the calculations for each cell. Table 3-3 below summarizes the calculations for the PIN area. For each CAD cell, total storage capacity equals the volume of suitable material expected to be placed, at the proposed BBDS. Figure 3-10 shows a graphical breakdown of the division of available volume and geological types.



LEGEND:

NBH-6 PHASE I PROJECT BORING LOCATIONS

NBH-11 PHASE II PROJECT BORING LOCATIONS

PROFILE STATIONING IN FEET

CHANNEL INNER SUBSURFACE PROFILE C-C'

NOTES:

1. FOR PROFILE ORIENTATION REFER TO FIGURE 5.
2. INFERRED STRATA LIMITS FROM BORING INFORMATION.
3. SCALE:

HORIZONTAL

0 200 400 600

SCALE: 1"=200' FEET

VERTICAL

0 20 40 60

SCALE: 1"=20' FEET

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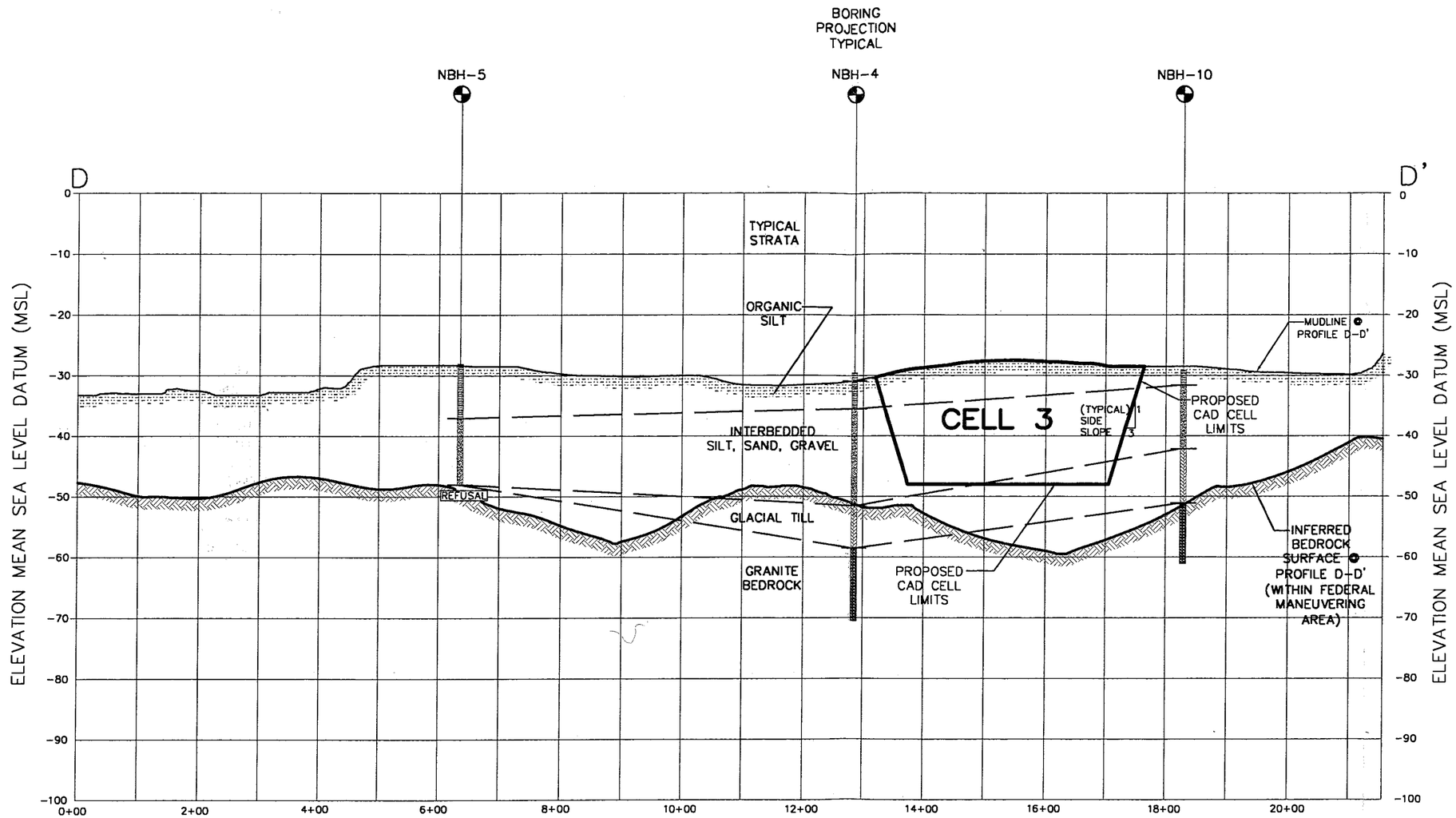
FIGURE 3-8. CHANNEL INNER SUBSURFACE PROFILE C-C'

PROJECT NO.:	16454
DESIGNED BY:	---
DRAWN BY:	---
CHK'D BY:	
DATE:	06/02/03
SCALE:	AS NOTED

Drawing file: N:\PROJECTS\DML\GEOTECH\APEX ENGINEERING 5-8-03\Presentation Drawings\HALF-SIZES 8-27-03\16451CFC202.dwg Plotted: Sep 15,2003-9:01am By: WHoney



PROFILE STATIONING IN FEET

CHANNEL INNER SUBSURFACE PROFILE D-D'

NOTES:

1. FOR PROFILE ORIENTATION REFER TO FIGURE 5.
2. INFERRED STRATA LIMITS FROM BORING INFORMATION
3. SCALE:

HORIZONTAL

0 200 400 600

SCALE: 1"= 200' FEET

VERTICAL

0 20 40 60

SCALE: 1"=20' FEET

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FIGURE 3-9. CHANNEL INNER SUBSURFACE PROFILE D-D'

PROJECT NO.:	16454
DESIGNED BY:	---
DRAWN BY:	---
CHK'D BY:	
DATE:	06/02/03
SCALE:	AS NOTED

Drawing file: N:\PROJECTS\CIVIL\GEOTECH\APEX ENGINEERING 5-8-03\Presentation Drawings\HALF-SIZES 8-27-03\16451CFC203.dwg Plotted: Sep 15,2003-9:03am By: Wilcoxy

Table 3-3. Volume Calculation Summary for the PIN area CAD configuration shown in Figure 3-10.

Cell	Average Bedrock Elevation	Average Bathymetric Elevation	Sediment Thickness	Available Dredge Depth	Total Dredged Volume	Total Storage Capacity
1	-75 ft	-8 ft	**67 ft**	57 ft	**2,275,000 CY**	**1,841,000 CY**
2	-50 ft	-6 ft	**44 ft**	34 ft	**82,375 CY**	**48,100 CY**
3	-54 ft	-8 ft	**46 ft**	36 ft	**83,800 CY**	**49,500 CY**
4	-57 ft	-9 ft	**48 ft**	38 ft	**84,950 CY**	**50,700 CY**
5	-58 ft	-9 ft	**47 ft**	39 ft	**65,450 CY**	**51,200 CY**
6	-57 ft	-8 ft	**49 ft**	39 ft	**85,450 CY**	**51,200 CY**

- **Average Bedrock Elevation –Average Bathymetric Elevation = Sediment Thickness**
- **Sediment Thickness – Bedrock Buffer (10-feet) = Available Dredge Depth**
- **Total Dredged Volume = Available Dredge Depth x (length and width of cell), *using 1:3 slope***
- **Total Storage Capacity = Total Volume Dredge – (top 4-foot contaminated material + 4-foot suitable material cap)**

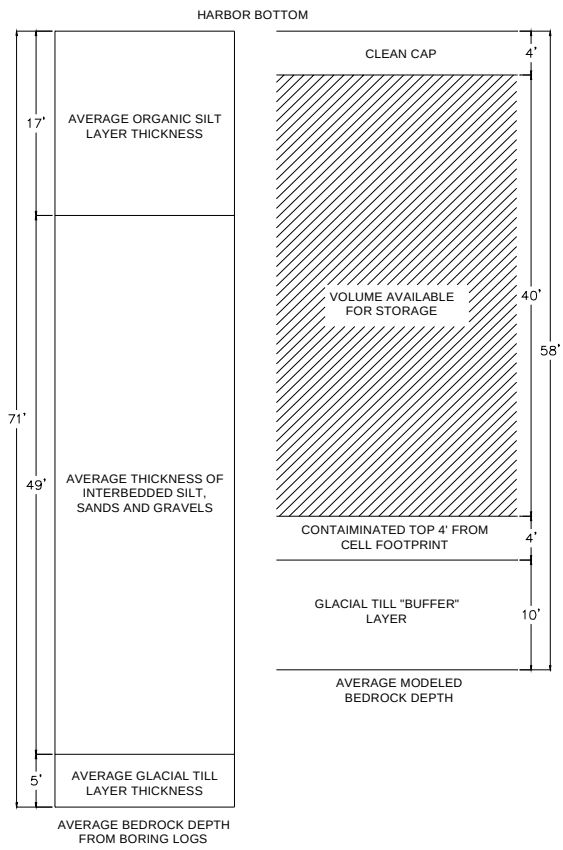


Figure 3-10. Breakdown of the division of available storage capacity and an average geological cross section from the borings conducted in the PIN area.

3.3.1.4 Cross Section Profiles –Popes Island North CAD Cell Area

Stratigraphic cross sections were extracted from profile cuts through proposed CAD Cells 2 – 6 (A-A¹)(Figure 3-11) and CAD Cell 1 (B-B¹) (Figure 3-12) in the PIN area. The locations of the cross sections are shown on Figure 3-3. The cross sections were constructed by digitizing the modeled bedrock surface and the bathymetric surface over the length of the profile. Boring information collected as part of the project was extrapolated to the profile centerline to depict the types and thickness of geology encountered.

3.3.2 Summary

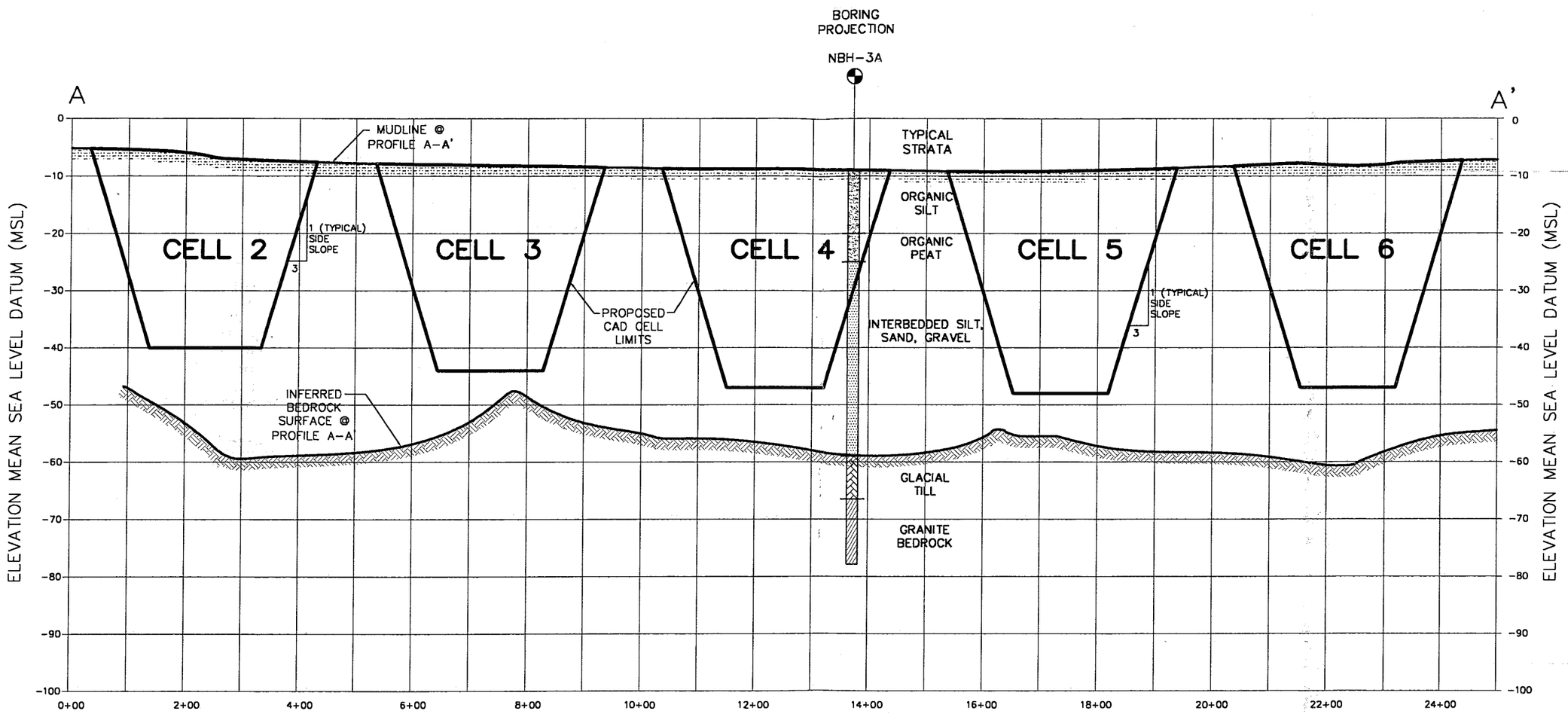
3.3.2.1 Channel Inner

The CI site is an area of uniformly shallow sediment depth, making even a moderate volume project CAD cell expansive in plan-area and relatively inefficient to complete. The inefficiency is due to the limited five-foot depth for contaminated dredge project material after taking into consideration all of the following design parameters; ten-foot bedrock buffer, four-foot suitable cap, additional three-foot operational and maintenance contingency (for protection against over-dredging) and four-foot contaminated CAD cell footprint layer. Therefore, to accommodate considerable dredged material volumes the CI CAD cell footprints must cover a large area. The ongoing and likely increased presence of navigation, maneuvering and anchorage activities overlying the CI site further complicate this area's development.

3.3.2.2 Pope's Island North

The PIN CAD cell area is a submerged marine geological resource measuring approximately 80 acres by 60 feet deep of sub-aqueous sediment appropriate to sequester approximately 2,050,000 cy of Harbor UDM. The NBHDC has identified an annualized seasonal need to dredge and sequester approximately 50,000 cy of UDM in keeping with Intermediate Goals of their Harbor plan. The DEIR showed long-term Harbor UDM disposal needs at 960,000 cy for ten-years and 2,555, 280 (including 20% contingency) for twenty years. The final CAD cell configuration may vary in layout from the six cell preliminary configuration provided in the FEIR. However, preliminary engineering necessary to characterize the CAD areas required for the State designation required conceptual engineering design of CAD cells. The PIN CAD cell configuration consists of five moderate volume cells approximately 50,000 cy each and one high capacity cell of approximately 1,800,000 cy capacity. This configuration was selected to accommodate several smaller projects and either one major project (such as a USACE maintenance project) or several additional smaller projects. The PIN CAD resource will be designated as a CAD area to be developed to respond to the Harbor's current and future dredging needs in an the most environmentally responsible and cost-efficient manner.

However the CADs are ultimately configured, it is important to note that the conceptual layout of the CAD area has been designed in response to the revealed subsurface conditions. The relatively shallow sediment depths along the area's eastern extent, near Marsh Island, favor the moderate



PROFILE STATIONING IN FEET

POPES ISLAND NORTH SUBSURFACE PROFILE A-A'

NOTES:

1. FOR PROFILE ORIENTATION REFER TO FIGURE 2.
2. SCALE:

HORIZONTAL

0 200 400 600

SCALE: 1"=200' FEET

VERTICAL

0 20 40 60

SCALE: 1"=20' FEET

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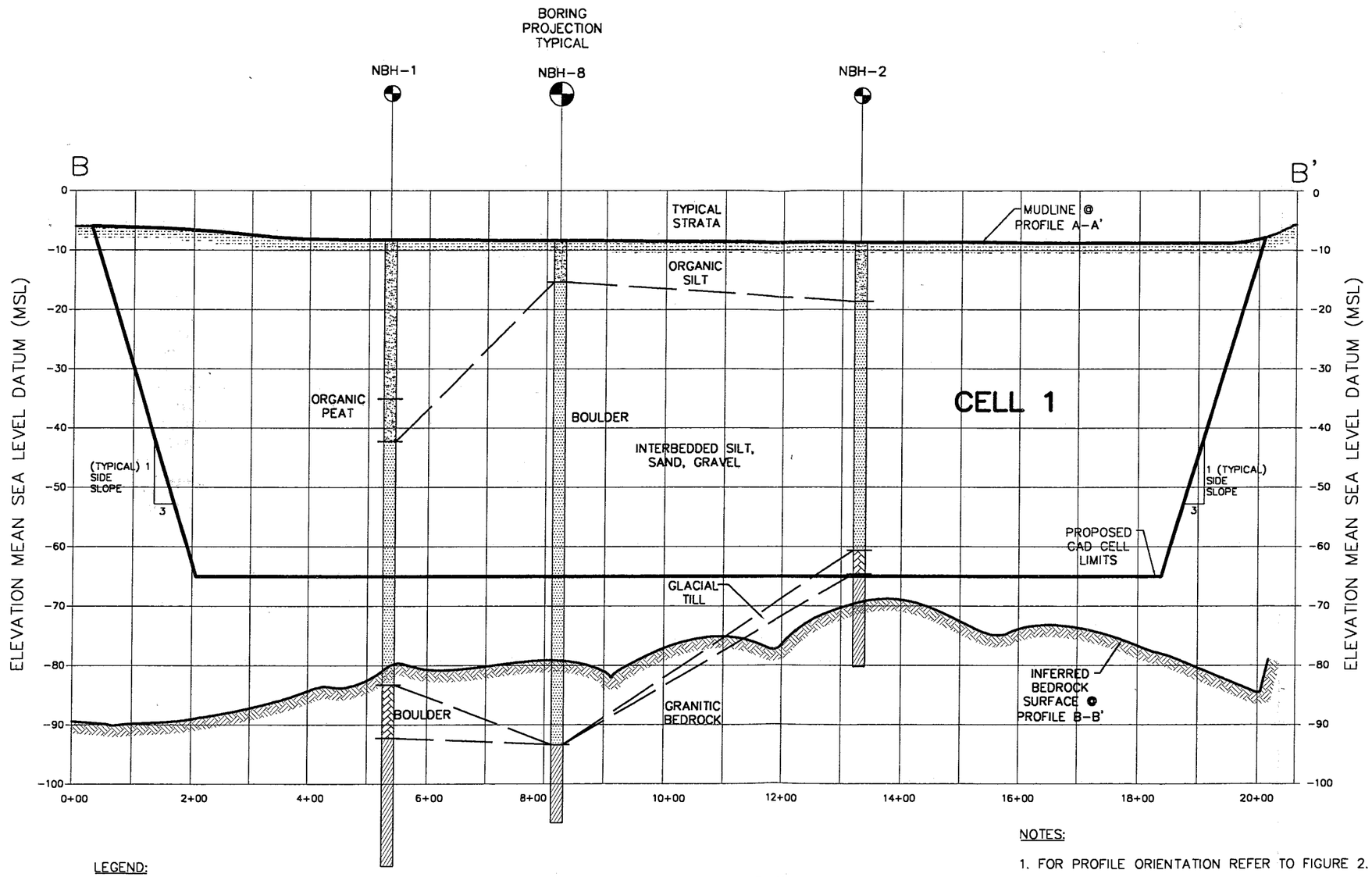
FIGURE 3-11. POPES ISLAND NORTH SUBSURFACE PROFILE A-A'

PROJECT NO.:	16454
DESIGNED BY:	---
DRAWN BY:	---
CHK'D BY:	
DATE:	06/02/03
SCALE:	AS NOTED

Drawing File: N:\PROJECTS\CIVIL\GEOTECH\VPEX ENGINEERING 5-8-03\Presentation Drawings\11x17-SIZES 8-27-03\16451GF2200.dwg Plotted: Sep 15,2003-9:04am By: Wtaney



LEGEND:

NBH-1 PHASE I PROJECT BORING LOCATIONS

NBH-8 PHASE II PROJECT BORING LOCATIONS

PROFILE STATIONING IN FEET

POPES ISLAND NORTH SUBSURFACE PROFILE B-B'

NOTES:

1. FOR PROFILE ORIENTATION REFER TO FIGURE 2.
2. INFERRED STRATA LIMITS — — — FROM BORING INFORMATION
3. SCALE:

HORIZONTAL

0 200 400 600

SCALE: 1"=200' FEET

VERTICAL

0 20 40 60

SCALE: 1"=20' FEET

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FIGURE 3-12. POPES ISLAND NORTH SUBSURFACE PROFILE B-B'

PROJECT NO.:	16454
DESIGNED BY:	---
DRAWN BY:	---
CHK'D BY:	
DATE:	06/02/03
SCALE:	AS NOTED

Drawing file: N:\PROJECTS\CIVIL\GEOTECH\APEX ENGINEERING 5-8-03\Presentation Drawings\HALF-SIZES 8-27-03\16451CFC201.dwg Plotted: Sep 15,2003-9:05am By: Whovey

approach. The deeper sediment depths along the western bedrock valley adjacent to Popes Island favor a high capacity CAD cell project approach.

The preliminary CAD cell engineering design configured the five moderate capacity cells in the eastern extent to retain the deeper sediment depths above the western bedrock valley for high capacity project(s). This configuration maximizes of the available area. If necessary, moderate capacity cells may be constructible in the deep sediment over the western bedrock valley. The deep organic layer will be more easily dredged and access from the navigable channel north of Popes Island is convenient. However, if moderate capacity CAD cells are located in the deeper sediment, capacity potential beneath moderate capacity cells will be sacrificed and overall cell capacity will be compromised.

Two approaches may be followed to access the shallower sediment depth eastern extent of PIN CAD cell area. One solution is a course over existing depths of approximately 10 to 12 feet at high tide with low capacity scows of approximately 500 cy. With this approach any additional UDM required to be dredged, for improved scow passage will be added to cell capacity. Another solution is a course over an in-channel CAD cell(s) constructed to 20 feet of draft at high tide with up to a 2000 cy scow load from navigable depths to the eastern area. In the event a high capacity CAD cell was constructed prior to moderate capacity cells in the eastern area, a 20-foot deep channel from navigable waters could be incorporated into the final design. In the latter approaches additional draft to 20 feet above the final cell cap equates to an additional volume of suitable material from the CAD cell(s) disposed of at BBDS, (Note that there may be additional ways to maximize access and efficiency; see the next paragraph.) Generally, rate of UDM disposal is measurable relative to the scow capacity. Cell construction guidelines are included in the PIN CAD cell management plan, Section 8.0.

In conversations with the dredging industry, dredgers have stated that their strong preference is to be allowed to propose construction alternative regarding access routes, capacity, cell design, and location in response to a given volume to be dredged and in configuration of potential future CAD locations (GLDD, personal communication, 2003). The potential impediments described above are presented to generally inform the reader that 1) CAD design and layout will need to be addressed thoughtfully; 2) each design scenario will contain efficiencies and inefficiencies; and 3) dredging management and construction expertise must be employed in final CAD design and management.

3.4 Underwater Archaeological Surveys

An initial literature based assessment of cultural resources, including the location of possible shipwrecks was conducted for the DEIR. The MEPA Certificate included the requirement for site-specific underwater archaeological surveys. For this FEIR, more detailed cultural screening and site-specific marine geophysical surveys were conducted at the Harbor to identify possible cultural anomalies and hazards to the development of CAD cell at either the CI or PIN sites (Apex, 2003, and Appendix B).

3.4.l Goal

The purposes of the survey are to: 1) determine the presence or absence of submerged cultural resources potentially eligible for the National Register of Historic Places; and 2) identify possible hazards to future dredging or disposal activities.

3.4.2 Description of Study

This additional cultural resource assessment presents an analysis of the collected cultural and geophysical data of potentially significant cultural and natural features lying on the harbor bottom that could pose an obstacle or a hazard to dredging. The cultural screening provides an historical context, while the hazards/obstruction screening reflects the results of the underwater surveys completed for this FEIR.

3.4.2.1 Cultural Screening

The first permanent European settlement in the study area began in 1652 when settlers from Plymouth bought the land presently encompassing Dartmouth, New Bedford, Fairhaven and Westport. New Bedford's spacious and naturally deep harbor became an ideal location for the development of the fisheries industry. Whaling soon became the primary industry in New Bedford and Fairhaven. The first whalers in the colonies left from Nantucket and New Bedford as early as 1690. Related maritime industries sprung up in New Bedford, and particularly Fairhaven, in support of the whaling industry, including shipbuilding, ropewalks, and candle factories. Water depth in the harbor was reported between 18 and 24 feet (Ricketson, 1858). However, by 1888, whaling had declined dramatically. Only 74 whalers worked out of New Bedford in that year, with a tonnage of 18,911 (Sayer, 1889). Ultimately, the future of whaling as a source of oil was ended once Colonel Drake discovered oil in the ground in northwestern Pennsylvania in 1859. By the end of the nineteenth century, whaling had given way to textile mills as the leading industry in the New Bedford economy. It was not until after the First World War, when the introduction of diesel powered fishing boats allowed vessels to economically reach the rich offshore fishing banks, that New Bedford once again became a prominent fishing port.

Massachusetts Bureau of Underwater Archaeology (MBUA) files contained information on three previous archeological surveys in the project vicinity including the DEIR (Maguire, 2002) (Cox, 2001) (Cembrola, 1989). For two of these projects conducted previously in the Harbor a number of targets identified by magnetic and acoustic surveys as possible archaeological importance turned out to be modern debris and derelict vessels that did not satisfy Two of the projects were completed using. The report concluded that none of the vessels satisfied National Register of Historic Places (NRHP) criteria (Cox, 2001a).

3.4.2.2 Hazards/Obstructions Screening

Marine geophysical data for this survey was collected from the two areas of the Harbor that are of interest to the project: CI and PIN. The geophysical was comprised of site-specific geophysical surveys that covered CI and PIN CAD study areas using two survey techniques:

side scan sonar and magnetometer. The data were processed and interpreted by geophysicists, and potential targets, which may represent cultural resources and/or hazards to the future operations, were identified and registered on summary maps of the areas. These target summary maps display the locations of the potential targets identified on a base map of New Bedford Harbor (Appendix F).

Field operations for the Harbor marine geophysical survey were conducted from October 21 through October 24, 2002. The marine surveys were conducted from a 32-foot aluminum survey vessel, *R/V Cyprinodon*, outfitted with side scan sonar and a magnetometer. Shipboard systems were integrated with a Differential Global Positioning System (DGPS) so that the geophysical data collected from the instruments could be tagged with precise position information at regular intervals.

3.4.3 Results

Preliminary analysis and interpretation of the geophysical survey information was performed each day in order to plan the remaining work or modify the survey program in specific areas. The objective of the data analysis and interpretation phase was to characterize the responses from the geophysical data in terms of their most probable sources (i.e., rock, buried object, pipe, cable, etc.). An integrated approach to the analysis and interpretation phase was implemented for this project, in which targets and features detected by magnetic and side scan sonar imagery were collectively interpreted. This strategy allowed targets and features detected by both instruments to be more accurately characterized in terms of depth and probable source. The magnetic and side scan data were also analyzed and interpreted in concert with the historic structure pattern and lithologic and geotechnical sampling data existent for the harbor. Experienced geophysicists identified target and feature responses within the data and generated color-coded maps and target anomaly lists for the geophysical anomalies.

3.4.4 Summary

Numerous targets of interest were identified on the summary maps. These targets included both potentially manmade and natural objects and features. The “cultural” objects identified include: linear features which are thought to be indicative of the presence of pipes and cables; individual targets thought to generally represent stand-alone features such as mooring blocks, anchors, and miscellaneous dropped objects; and groups of targets clustered together and thought to generally represent modern vessel debris. Analysis of remote sensing data identified 43 magnetic and/or acoustic targets in the two survey areas. Most of the targets appear to be isolated single source objects, modern debris, or geologically related objects. While three of the remote sensing targets found in the CI survey area generated magnetic signatures suggestive of submerged cultural resources, they are located within the dredged portion of the federal channel. This indicates that the target sources are very likely modern debris since such areas were subjected to periodic maintenance dredging.

None of the remote sensing targets appears to contain submerged cultural resources. No additional underwater archeological investigation is recommended. Several of the targets

identified (such as large sections of old dock), may represent difficult issues for future dredging or other project operations, and may require further investigation.

3.5 Physical And Chemical Analysis Of Surficial Sediments

Physical and chemical analyses of surficial sediments in the CAD cell areas were determined for this FEIR (Maguire, 2003, and see Appendix E, F; ENSR, 2003). Additionally, marine water samples were collected to support elutriate testing for use in site-specific water quality assessment study.

3.5.1 Goal

Goals of the site-specific surficial sediments sampling and analyses to determine the vertical and horizontal horizons of surficial unsuitable dredged materials (UDM) and analyze sediment of the benthos in the preferred alternative CAD cell sites. Site-specific surficial sediment sampling was conducted for physical analysis through two sampling techniques 1) vibracore probes for surficial chemistry analysis; and 2) surface grab sampling as part of the sediment grain size for the macrobenthic analysis study (Maguire, 2003; ENSR, 2003).

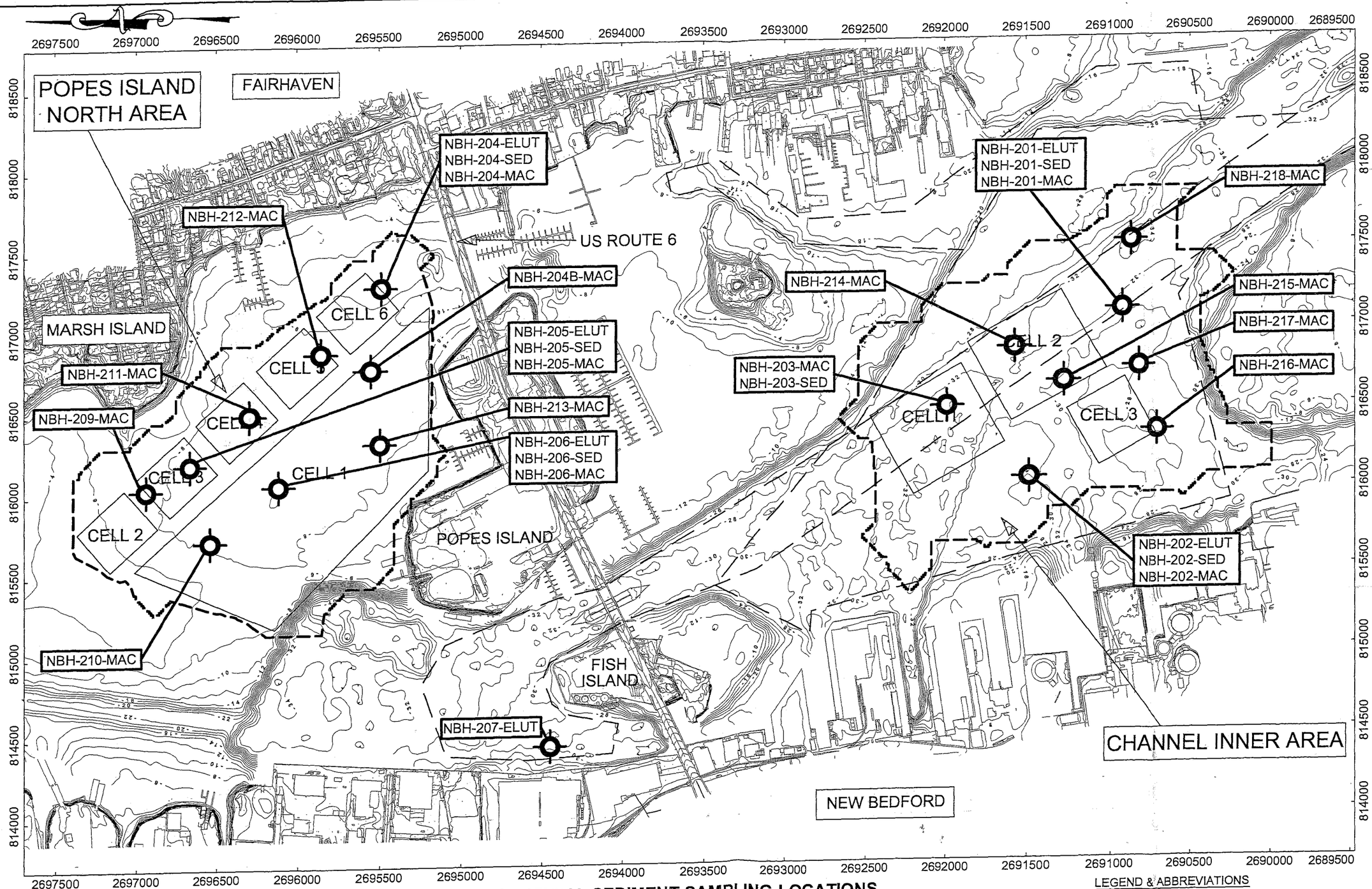
One set of surficial sediment data were collected in the CAD sites for chemistry at intervals using metals as indicator parameters to screen for a subsequent comprehensive suite of laboratory analyses (Maguire, 2003). Comprehensive laboratory analyses for PAHs, pesticides, dioxins, and PCBs were then performed to identify the extent of chemical contamination. This sampling plan was discussed and confirmed with the USACE New England Regulatory Division as practicable and sufficient for the purpose of State CAD Site designation (USACE, September 2002). In this discussion with the USACE, the collective assumption was that a deposition rate of approximately one centimeter per year over the last 150 years would limit the vertical extent of contamination to less than four feet. This assumption was based on the USACE contribution to the discussion that the annual sediment deposition rate of 1cm/yr over the past 150 years since the dawn of the industrial age in New England was typical (USACE, September 2002). This assumption was to be confirmed by the results of the sampling plan.

3.5.2 Description of Studies

3.5.2.1 Chemical

Twelve vibracore sediment sample probes were advanced in the preferred alternative CAD sites from the RV Cyprinodon, a 32-foot aluminum research vessel, on October 10, 2002, with oversight by Maguire personnel (Figure 3-13). Vibracore sample locations were selected on the basis of the following criteria; investigation history, access, adequate subsurface coverage within the CAD cell areas, and utility line locations. Vibracore borings were advanced to depths up to 12 feet below grade utilizing a suspended pneumatic vibratory hammer. The locations of vibracore borings are depicted in Figure 3-14.

Selected sediment samples were placed in clean glass jars for preliminary analysis of metals at a USACE-certified laboratory. On October 11, 2002, the following sediment samples were



NOTES:

1. Base Plan of the New Bedford Harbor area was obtained from the US Army Corps of Engineers and has not been field verified.
2. Coordinates are shown in the State Plane Coordinate System, Massachusetts Mainland Zone 2001, Referenced to the 1983 North American Datum (NAD83).

SURFICIAL SEDIMENT SAMPLING LOCATIONS AT CHANNEL INNER AND POPES ISLAND NORTH CAD CELL SITE ARES

0 600 1200 1800

SCALE: 1"=600' FEET

LEGEND & ABBREVIATIONS

SAMPLING LOCATION

W-ELUT = ELUTRIATE
WATER = SURFACE WATER

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FIGURE 3-14. SURFICIAL SEDIMENTARY SAMPLING LOCATIONS AT CHANNEL INNER AND POPES ISLAND NORTH CAD CELL SITE AREAS

PROJECT NO.:	16454
DESIGNED BY:	----
DRAWN BY:	----
CHK'D BY:	
DATE:	08/02/03
SCALE:	AS NOTED

submitted for metals analysis at AMRO Environmental Laboratories Corporation, located in Merrimack, NH.

3.5.2.2 Grain Size and TOC

The sediment grain-size and TOC samples were taken in CI and PIN from the same research vessel as the vibracores on a later date, October 30, 2002. One grab sample dedicated to grain size analysis and TOC was collected at each of seventeen stations; eight at CI and nine at PIN. Sediment grain-size samples were removed using a 2.5-cm diameter sub-corer and the sample placed in a WhirlPac®. Sediment for TOC was also removed from this sample with a stainless steel spoon and placed in a 125-ml glass jar. All sediment grain-size and TOC samples were stored on ice through the duration of the survey and for shipping. The locations of sediment grain size and TOC samples are depicted in Figure 3-14.

Figure 3-13. Maguire staff collecting marine surficial sediment samples.

3.5.3 Results

3.5.3.1 Chemical

Test vibracore borings indicated marine deposits of dark organic silt underlain by inorganic silt and clay. The dark organic silt included shell hash and other harbor bottom detritus. The inorganic silt and clay was observed to contain mostly silt, fine sand, and clay as well as trace gravel, coarse and medium sand. The hue of the underlying silt/clay strata was various shades of gray. Completed Vibracore Boring Reports are included in Appendix D. Bedrock and

significant evidence of boulders were not encountered during the surficial sediment investigation activities. The preliminary laboratory results were obtained on an accelerated schedule to facilitate the submittal of sediment samples for more detailed analysis (Table 3-4).

Table 3-4. Preliminary Sediment Analytical Results (PPM)

Sample Location	Cell	Depth	As	Ba	Cd	Cr	Cu	Pb	Ni	Se	Ag	Zn	Hg
NBH-201-1-SED	CI	0-1.5'	**35**	67	3.9	*280*	**560**	*180*	33	<1.4	4.5	*390*	*1*
NBH-201-2-SED	CI	1.5-3.3'	**37**	70	*5.7*	*270*	**670**	**240**	30	<1.4	2	**450**	**1.7**
NBH-201-3-SED	CI	3.3-5'	9.2	37	0.92	1.8	170	4.6	7.4	<0.92	2.6	3.7	0.077
NBH-202-1-SED	CI	0-2'	**35**	67	3.9	*280*	**560**	*180*	33	<1.4	4.5	*390*	*1*
NBH-202-2-SED	CI	2-4'	**37**	70	*5.7*	*270*	**670**	**240**	30	<1.4	2	**450**	**1.7**
NBH-202-3-SED	CI	4-6.25'	9.2	37	0.92	1.8	170	4.6	7.4	<0.92	2.6	3.7	0.077
NBH-203-1-SED	CI	0-1.7'	**29**	50	3.5	*260*	**460**	**200**	27	1.8	5.7	*360*	*0.9*
NBH-203-2-SED	CI	1.7-3.4'	**22**	29	<0.97	36	150	84	12	1	0.65	140	*0.6*
NBH-203-3-SED	CI	3.4-5'	4.8	2.3	<0.68	4.3	11	6.3	1.7	0.48	<0.19	13	0.058
NBH-204-1-SED	PIN	0-1.5'	6.7	4.3	<0.77	19	50	24	3	0.55	<2.1	33	0.17
NBH-204-2-SED	PIN	1.5-2.2'	6	2.7	<0.7	4.5	4.7	3.9	2.4	<0.7	<2	8.4	<0.056
NBH-204-3-SED	PIN	2.2-4.6'	*11*	2.6	<0.73	8.7	5.6	4	8	2.1	<2	20	<0.061

Table 3-4. Preliminary Sediment Analytical Results (PPM)

Sample Location	Cell	Depth	As	Ba	Cd	Cr	Cu	Pb	Ni	Se	Ag	Zn	Hg
NBH-205-1-SED	PIN	0-2'	**28**	49	<1.2	52	*290*	*140*	18	0.76	0.79	180	*0.62*
NBH-205-2-SED	PIN	2-4'	**25**	16	<1	23	9.7	7.7	12	<1	<2.8	35	<0.083
NBH-205-3-SED	PIN	4-6'	*15*	9.8	<0.91	17	6.4	5.3	9.2	<0.91	<2.5	27	<0.070
NBH-205-4-SED	PIN	6-8'	*17*	9.4	<0.88	16	6.2	4.8	8.8	<0.88	<2.5	32	<0.069
NBH-206-1-SED	PIN	0-2'	**35**	65	0.84	*250*	**610**	**250**	32	1.4	2.3	*290*	**2**
NBH-206-2-SED	PIN	2-4'	**25**	18	<1.1	27	19	17	14	0.64	<3.1	47	0.043
NBH-206-3-SED	PIN	4-6'	**29**	17	<1.1	28	9	8.1	15	0.52	<3.2	43	<0.091
NBH-206-4-SED	PIN	6-7'	**28**	15	<1	26	8	7.2	14	0.69	<2.8	39	<0.083
Category One			<10		<5	<100	<200	<100	<50			<200	<0.5
Category Two			*10-20*		*5-10*	*100-300*	*200-400*	*100-200*	*50-100*			*200-400*	*0.5-1.5*
Category Three			**>20**		**>10**	**>300**	**>400**	**>200**	**>100**			**>400**	**>1.5**

Notes: Categories for Chemical Constituents in Dredge Material as presented in 314 CMR 9.07 presented here for reference purposes only.
Yellow highlighted entries indicate samples submitted to detailed confirmatory analysis.

Selenium was not detected in sediment sample locations NBH-201 and NBH-202 obtained from the CI CAD cell area. Cadmium was not detected in sediment sample locations NBH-204 and NBH-205 obtained from the PIN CAD cell area. Arsenic, barium, cadmium, chromium, copper, lead, nickel, selenium, silver, zinc, and mercury were detected at various concentrations in every other sediment sample. Based on these preliminary results, sediment samples NBH-202-3-SED and NBH-206-3-SED were submitted for detailed confirmatory analysis.

Sediment samples NBH-202-3-SED and NBH 206-4-SED were identified for analysis of organochlorine pesticides, PAHs by EPA Method 8270, PCB Congeners by Method 8082, TOC by Lloyd Kahn Method, total solids, Particle Size by ASTM Method D422, and Moisture Content by ASTM Method D2216 (Table 3-5).

In the detailed confirmatory analysis, dioxins were not detected above laboratory quantification limits for sediment sample NBH-202-3-SED obtained from the CI area. Varieties of PAHs and PCB congeners were identified in NBH-202-3-SED. Endrin and endosulfan II (pesticides) were detected in the sediment sample NBH-202-3-SED at concentrations of 22 µg/kg and 27 µg/kg, respectively. Total solids and total organic carbon were respectively determined to be 63.3% and 158 mg/kg. The physical composition of sediment sample NBH-202-3-SED was determined to be a fine sandy clay silt.

Table 3-5. Confirmatory Sediment Sample Analytical Results

Laboratory Method	NBH-202-3-SED	NBH-206-3-SED
PAHs by EPA Method 8270	Naphthalene 79 µg/kg Acenaphthylene 100 Acenaphthene 83 Fluorene 80 Phenanthrene 460 Anthracene 180 Fluoranthene 620 Pyrene 940 Benz(a)anthracene 440 Chrysene 430 Benzo(b)fluoranthrene 420 Benzo(k)fluoranthrene 160 Benzo(a)pyrene 400 Indeno(1,2,3-cd)pyrene 240 Benzo(g,h,i)perylene 270	BQL
Organochlorine Pesticides by EPA SW8081A	Endrin 22 µg/kg Endosulfan II 27	BQL
Dioxins	BQL	BQL

Table 3-5. Confirmatory Sediment Sample Analytical Results

Laboratory Method	NBH-202-3-SED		NBH-206-3-SED	
PCB Congeners	BZ#28	39	BZ#66	4.2
	µg/kg		µg/kg	
	BZ#49	400		
	BZ#52	710		
	BZ#66	600		
	BZ#81	310		
	BZ#87	310		
	BZ#101	270		
	BZ#105	130		
	BZ#118	250		
	BZ#123	250		
	BZ#128	94		
	BZ#138	320		
	BZ#153	210		
	BZ#156	42		
	BZ#170	34		
	BZ#180	37		
Total Solids	63.3%		52.6%	
Total Organic Carbon	158 mg/kg		191 mg/kg	
Grainsize Analysis	Gravel	1.4%	Gravel	0.0%
	Sand	40.4	Sand	7.8
	Coarse 1.1		Coarse 0.0	
	Medium	7.7	Medium	1.7
	Fine 31.6		Fine 6.1	
	Silt	39.5	Silt	54.4
	Clay	18.7	Clay	37.8

Notes: Only concentrations detected above laboratory quantification limits are presented.
Units are as presented.
BQL = Below Laboratory Quantification Limits

Dioxins, PAHs, and pesticides were not detected above laboratory quantification limits for sediment sample NBH-206-3-SED obtained from the PIN area. Only one PCB congener (BZ#6 - Ballschmiter - "BZ Numbers") was detected above laboratory quantification limits. Total solids and total organic carbon were respectively determined to be 52.6% and 191 mg/kg. The physical composition of sediment sample NBH-206-3-SED was determined to be a clay silt. Table 3-6 presents a summary of confirmatory sediment sample analytical results. Original laboratory data, laboratory QA/QC, methods, and the chain-of-custody form are included in Appendix D.

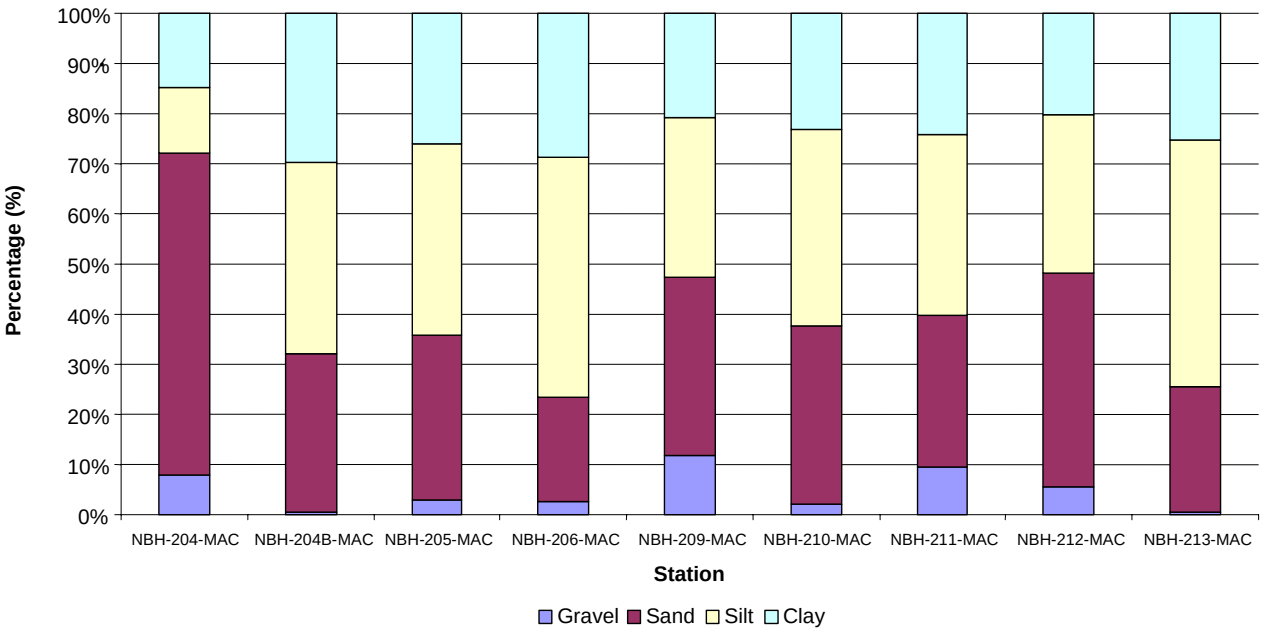


Figure 3-15. Sediment Composition at Channel Inner from grab samples.

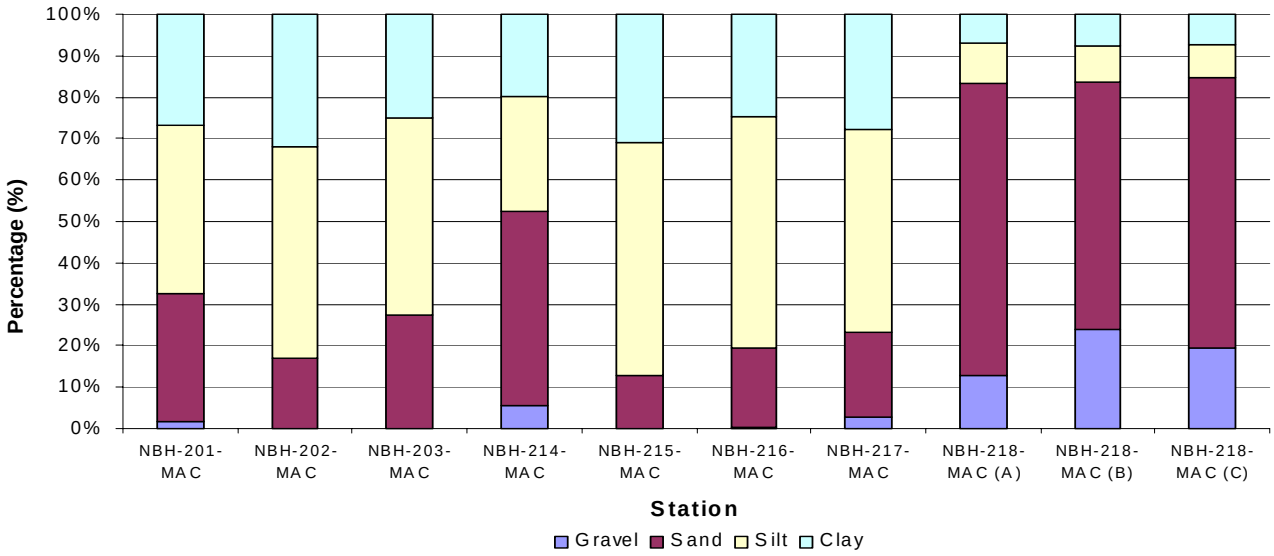


Figure 3-16. Sediment composition at Popes Island North from grab samples

3.5.4 Grain Size and TOC

Sediment grain-size composition was measured for each station sampled. Sediment grain-size composition for eight stations sampled in the CI proposed CAD cell site are found in Figure 3-15. Mean values of percent gravel, sand, silt and clay for nine stations sampled in the proposed PIN CAD cell site are shown in Figure 3-16. Sediments were comprised predominantly of silt and clay except station NBH-204-MAC which had more than 70% gravel and sand. Similar to the Popes Island North CAD cell sites, the composition of the sediment is predominantly silt and clay except at station NBH-218-MAC that was mostly sand (70%) with nearly 20% gravel. Station NBH-214-MAC had approximately 47% sand, 47% silt and clay, and 6% gravel.

The total organic carbon (TOC) found in the sediments collected from the proposed CAD cell sites generally paralleled the trend that sites with greater percentages of silt and clay had higher TOC values. For example, stations NBH-202-MAC from CI and NBH-206-MAC and NBH-210-MAC, located in PIN, had the highest TOC values. These sites also had sediments containing more than 50% silt and clay. Sediments from NBH-204-MAC had the lowest TOC value (mean 2.2% dry wt.) in the Popes Island North samples and the sediment texture for this station was greater than 50% sand (Figure 3-16).

Values for TOC analyzed from Channel Inner sediment ranged from 0.70 to 5.50% dry weight (wt.). Values for TOC analyzed from Popes Island North sediment ranged from 2.04 to 6.44 % dry wt. Average TOC at Popes Island North (4.74% dry wt.) was greater than at Channel Inner (4.02% dry wt.) but not significantly different (t-test 0.99; df=18; $p<0.05$) (ENSR, 2002).

3.5.5 Summary

3.5.5.1 Chemistry

One representative surficial sediment sample from each preferred alternative CAD cell site areas was analyzed in detail for physical and chemical character. From the approximately 90-acre CI CAD cell site area, sample NBH-202-3-SED was analyzed. This NBH-202-3-SED did not show a clear delineation between suitable and unsuitable sediment horizons at the sample location. The CI CAD cell site is in an active harbor area where harbor bottom surficial sediment is very likely disturbed from on-going operations. From approximately 80-acre PIN CAD cell site area sample NBH-206-3-SED was analyzed. The PIN CAD cell site area is not in an area of the harbor where the bottom has been operationally disturbed. The NBH-206-3-SED sample showed a clear delineation between suitable and unsuitable sediment horizons. Vibracore samples were taken at two-foot intervals. The concentrations of the predominant metal, copper, as well as those of other metals diminished by the third interval sampling station. This particular station was tested for the comprehensive laboratory suite of analysis at that third interval. For NBH-206-3-SED, dioxins PAH and pesticides were not detected above laboratory quantification limits in this latter interval sample. For the preferred alternative CAD sites area-wide surficial sediment investigation of this FEIR, a four-foot sediment layer was identified as unsuitable for unconfined aquatic disposal. The specific depth of the unsuitable layer over the extent of the CAD area may be refined based on project-specific testing.

3.5.5.2 Grain Size and TOC

Most of the stations sampled as part of this 2002 survey were comprised of silt and clay with high total organic carbon concentrations. Because contaminants typically bind to finer grain size particles it is likely that these stations have chemical contamination. The marine sediment of New Bedford/Fairhaven Harbor is historically contaminated with PCBs, PAHs, and heavy metals (ENSR 2001). Data for sediment chemistry is presented in the 1999 NBH LTM report (ENSR, 2001). The 1999 monitoring effort showed that PCB concentrations in the proposed CAD cell locations ranged between 1-50 ug/g dry weight. Copper concentrations found in the 1999 study ranged between 100 and >1000 ug/g dry weight. Sediment toxicity from the 1999 study was less than 60% survivability at all Segment 2 sites corresponding to the proposed CAD cell locations. This supports the surficial sediment chemistry findings noted above, that the sediment in the vicinity of the proposed CAD cell sites is anthropogenically affected and contaminated (MAGUIRE, 2003).

3.6 Macrobenthic Sampling and Identification

The Draft EIR proposed and DEIR Certificate concurred that a site-specific benthic macrofaunal assessment to supplement the benthic habitat information presented in the DEIR needed to be conducted for the FEIR. A macrobenthic survey, was conducted at the preferred alternative CAD sites on October 30, 2002 (ENSR, 2003). Benthic organism samples were collected to determine the macrofaunal diversity at both preferred CAD sites. Substrate grain size and TOC samples helpful in the benthic community characterization described in section 3-6 were collected concurrently. This detailed site-specific benthos characterization will serve as a baseline for future benthic community monitoring in the CAD cell areas. In addition, the findings are compared to previous characterization of Buzzards Bay benthic communities to further define the level of environmental degradation in the Harbor.

3.6.1 Goal

The goal of this study was to confirm previous harbor-wide findings presented in the DEIR that the benthic communities of the preferred alternative disposal sites CI and PIN will be impacted by development of CAD in the short-term but that in the long-term the impacted areas will recolonize (Maguire, 2002). This study was primarily expected to determine the macrofaunal diversity in the harbor-bottom surficial sediment. It has been anticipated that there would be close compatibility between Sediment Profile Images (SPI), shown in the DEIR, at the New Bedford/Fairhaven Harbor proposed CAD cell sites and the results from the benthic infaunal analysis of this FEIR (Maguire, 2002). The determined macrofaunal diversity will become the baseline for future benthic community monitoring at the CAD sites during and after CAD closure to ensure UDM is not recontaminating the Harbor environment.

3.6.2 Description of Study

The CAD cell site macrofaunal survey (October 30, 2002) sample collection and data analysis were performed consistent with the same methods employed for the New Bedford Harbor (NBH)

long-term monitoring (LTM) effort in 1999 to provide a consistent basis for comparison. This NBH LTM plan was developed by the Environmental Protection Agency's (EPA) Research Laboratory (Atlantic Ecology Division) in an effort to assess the effectiveness of the Superfund remedies. The LTM plan focuses on the ecological health of the sediments and includes collection of data on sediment chemistry, grain size, toxicity, and benthic infauna. The LTM plan methodology was based on a format originally developed as part of the Environmental Monitoring and Assessment Program (EMAP) as implemented for the baseline sampling conducted in 1993 (Nelson et al. 1996). The LTM plan divided the Harbor into three segments of which Segment 2, the lower Harbor, corresponds to the area where the proposed CAD cells will be placed. In 1999, 28 stations, within a hexagonal grid, were sampled in Segment 2. Nine of these sampling stations are in the vicinity of the proposed CAD cell sites. Figure 3-18 shows the hexagons sampled during the 1999 NBH Long Term Monitoring Study (in red) that correlates with the two proposed CAD cell sites.

Seventeen samples were taken from the proposed CAD cell areas. Eight replicated stations were deemed sufficient to represent the benthic macrofaunal communities. Segment 2 sediment samples from the 1999 LTM plan were used to supplement the data collected from the proposed CAD cell sites to provide further cost-effective information about this area. To be consistent with the sampling protocol in the LTM plan, a 0.04 m^2 Ted Young Modified Van Veen Grab was used to collect the benthic samples (Figure 3-18). Navigation was performed using a Hypack Differential Global Positioning System (DGPS). Stations were located using the target coordinates determined previous to the survey.

Each benthic biology grab sample was checked for depth of penetration (7 cm or greater was considered acceptable), depth of the apparent redox potential discontinuity (RPD), presence of surface biology, odor, sediment color, and texture. A rough description of the appearance of the sediment was included in the field notes. Samples were washed into a bucket, sieved through a 500-micron mesh screen, and fixed in 10% buffered formalin. These samples were later re-sieved, rinsed with freshwater, and preserved in 80% ethanol. The sediment grain-size and TOC samples were taken from a third grab, at each station, in order to preserve the integrity of the benthic biology samples. Extraction of TOC and laboratory grain-size analysis was performed. Benthic organism samples were sorted and identified by species under laboratory conditions. Sample processing generally followed protocols described in EMAP Near-Coastal Laboratory Procedures Macrobenthic Community Assessment (EPA, 1991) which was the same protocol used to identify the animals collected during the LTM study.

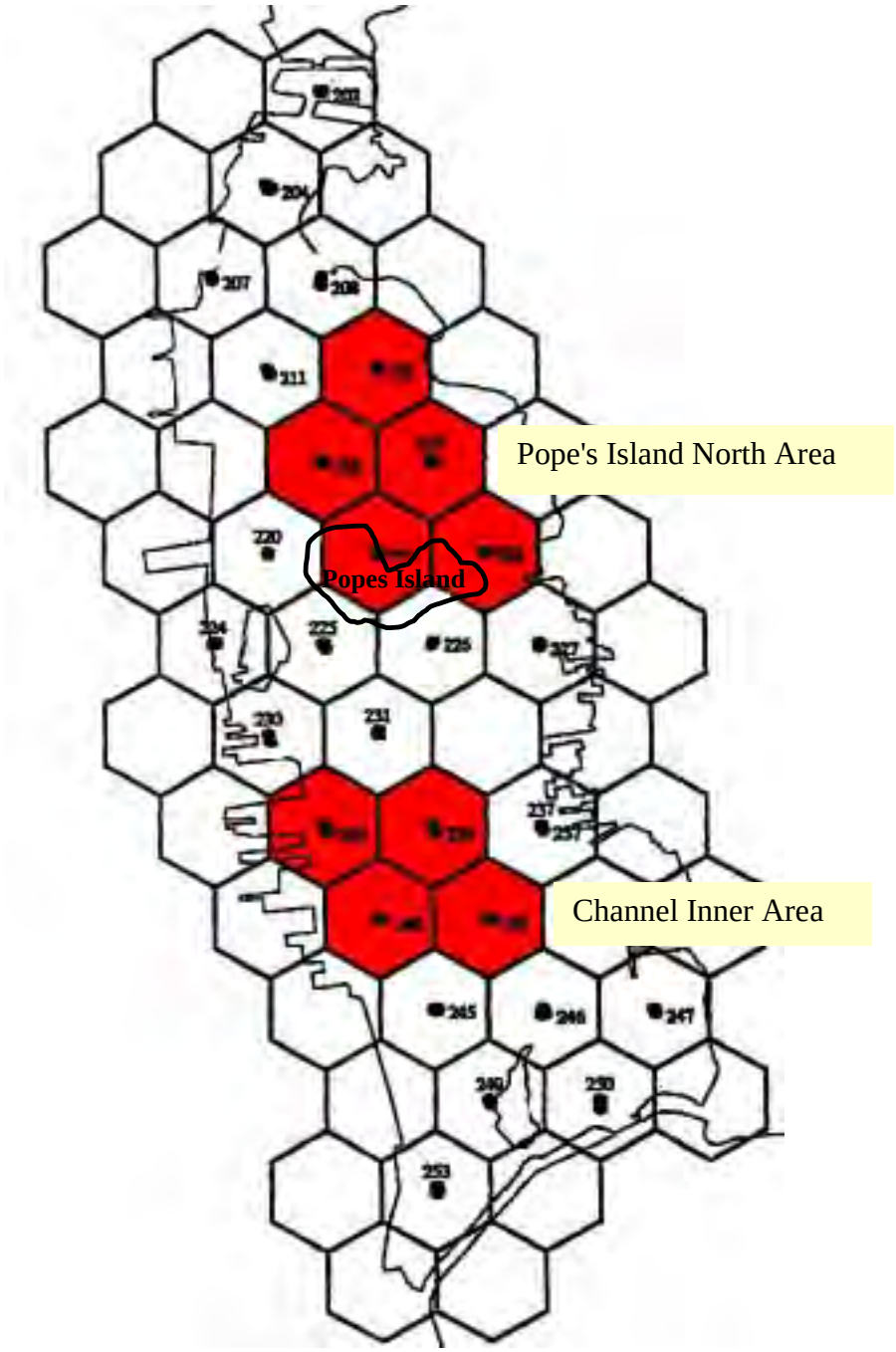


Figure 3-17. Map showing station numbering system for New Bedford Harbor Long Term Benthic Monitoring (USACE), Section 2. Areas highlighted in red are those previously sampled by the USACE in the vicinity of the proposed CAD cell locations.

Figure 3-18. Marine scientist tending the Ted Young Modified Van Veen Grab for this study in New Bedford Harbor.

3.6.3 Results

Each of the stations was analyzed for abundance, density, diversity and evenness. After the samples from the proposed CAD cell sites were completely analyzed the results were compared with the data obtained from Section 2 in the NBH LTM 1999 Harbor study (ENSR, 2001). For the present study, 16 stations were sampled and of these 8 were analyzed for benthic infaunal parameters with the thought that previous data from the Segment Two NBH LTM 1999 study could be used to supplement information and make comparisons to determine if anomalies exist. The Segment Two sampling areas of the Harbor correspond generally to the preferred alternative CAD areas. The results from the statistical comparisons conducted for this study supports the hypothesis that the number of individuals and species identified from the 1999 NBH LTM samples was not significantly different from the 2002 CAD cell results (ENSR, 2003, and see Appendix E).

Annelids (polychaetes and oligochaetes) were the most diverse fauna found at the proposed CAD cell sites and from the Segment 2 corresponding stations. In CI polycheates represented 40%, oligocheates 20%, gastropods 20%, nemerteans 10% and bivalves 10%. The proposed PIN CAD cell site had polychaetes representing 50%, oligocheates 20%, and bivalves 30%. Polychaetes comprised 80% of the top ten fauna at the Segment 2 PIN corresponding sites with oligochaetes and a bivalve species each with 10%.

The Shannon-Wiener diversity calculation (Lloyd *et al*., 1968) characterizes the diversity of a sample or community by a single number (Magurran, 1988). Species diversity involves two components: the number of species, or richness, and the distribution of individuals among species, or evenness. Shannon-Wiener diversity and Pielou's evenness were calculated for the 4 CI and the 4 PIN stations that were analyzed and an average of these parameters was calculated for the corresponding Segment 2 locations. Pielou's calculation for evenness was used for this analysis and evenness can be defined as the distribution of individuals among species or the calculation of the uniformity in species abundance within a certain assemblage (sampling station).

The evenness and diversity at the proposed CI stations was, on average, slightly higher than diversity at the proposed PIN stations but was not statistically significantly different ($t=0.69$, $p<0.05$, $df=6$; $t=0.82$, $p<0.05$, $df=6$, respectively). Average diversity and evenness found at the PIN proposed CAD cell samples were compared with corresponding stations sampled in Segment 2 during the NBH LTM monitoring effort. The results showed higher average diversity and evenness from the PIN CAD cell samples, however, these differences were not significantly different ($X^2=0.03$, $p<0.05$, $df=1$; $X^2=0.06$, $p<0.05$, $df=1$, respectively). A similar trend was observed when the results from the CI proposed CAD cell samples were compared with corresponding Segment 2 station data. The average evenness and diversity were slightly higher at the CI CAD cell sites but not significantly different ($X^2=0.09$, $p<0.05$, $df=1$; $X^2=0.08$, $p<0.05$, $df=1$, respectively).

3.6.4 Summary

From the sediment grain size analysis discussed in section 3.5, sites were comprised of silt and clay with high total organic carbon concentrations. Because contaminants typically bind to finer grain size particles, it is likely that these stations have chemical contamination. PCBs were detected above laboratory detection limits on both CAD sites in the surficial sediment chemistry analyses done for this FEIR (Maguire, 2003, and see Section 3.5) The results from the sediment grain-size analysis conducted as part of this latest survey for the FEIR showed that fine-grained silt and clay were the predominant sediment type found at the PIN and CIN stations and total organic carbon was high. These results agree with those found by the SPI survey in the DEIR conducted in 1999 by MA CZM.

The marine sediment of New Bedford/Fairhaven Harbor is historically contaminated with PCBs, PAHs, and heavy metals (ENSR 2001). Data for sediment chemistry is presented in the 1999 NBH LTM report (ENSR, 2001). Copper concentrations found in the 1999 study ranged between 100 and >1000 ug/g dry weight. Sediment toxicity from the 1999 study was less than 60% survivability at all Segment 2 sites corresponding to the proposed CAD cell locations. This suggests that the sediment in the vicinity of the proposed CAD cell sites is anthropogenically affected.

Composition and dominance of the benthic infauna of samples collected as part of the proposed CAD cell sampling effort (2002) were similar to those reported for the NBH LTM samples taken in 1993 (Nelson *et al*., 1996), 1995 (EPA unpublished data) and 1999 (ENSR, 2001). Polycheates; *Streblospio benedicti*, *Tharyx acutus*, *Leitoscoloplos* spp., and *Mediomastus ambiseta*, Oligochaete; *Oligochaeta spp.*, and Bivalve; *Mulinia lateralis* were the dominant species found at the proposed CAD cell stations. These same species were also found to dominate the benthic infauna of Segment 2 in 1995. Bivalve; *Mulinia lateralis* was very abundant in 1993 and 1999 but not in 1995. If *Mulinia lateralis* is removed from the 1993 and 1999 data then the species composition for these two years is even more similar to the 2002 monitoring results.

Differences in species abundance when comparing the 2002 data with the 1999 results could be attributed to differences in temporal sampling events. The NBH LTM samples were taken in the summer of 1999 while the samples for the monitoring of the proposed CAD cell sites were taken in the fall of 2002. As the water temperature and food supply decrease and storms appear more frequently during the fall the benthic population abundance tends to decrease. Comparison of NBH LTM data with the CAD cell results suggests that the benthic fauna populations remain statistically similar and suggest that community structure hasn't changed over the course of 10 years.

The dominant organisms that comprise the benthic community at the proposed CAD cell sites are classified as pioneering or opportunistic species (Rhoads and Germano, 1982). Pioneering organisms colonize the sediments quickly following a disturbance, and typically include dense aggregations of near-surface living, tube-dwelling polychaetes or opportunistic bivalves (Rhoads and Germano 1982, Santos and Simon 1980a). Stage I lower opportunistic stage assemblages

are associated with short-term disturbed environments not unlike the more anthropogenically degraded marine environments of working harbors like New Bedford/Fairhaven or Boston.

The results of the 1999 sediment profile survey demonstrates that the stations sampled within the navigational channel near Popes Island (the same sites that were revised for the benthic community survey in 2002) consisted of fine-grained, silt-clay sediments greater than 4 phi (phi are units of measurements geologists use for sediment). Of the images that were analyzed from this area (PIN and CIN), Stage I species (opportunistic polychaetes) were the predominant successional stage.

Similar opportunistic communities were observed at the Boston Harbor Navigational Improvement Project (BHNIP) CAD cell sites in 1999 (ENSR, 2001). This project included analyzing sites that were dredged, filled and capped as well as ambient localities and unfilled cells using sediment profile image and benthic infaunal analyses. The investigation at the BHNIP CAD cell site showed that, within a year of filling and capping, the opportunistic benthic infauna had re-colonized the sediment surfaces. The SPI survey (1999) and the benthic infaunal analysis (2002) are remarkably consistent with one another. The 1999 spi and 2002 surveys (SAIC, 1999, and ENSR, 2003) provide strong evidence to support the fact that the communities in the Lower New Bedford/Fairhaven Harbor, in the area of the two proposed CAD cell sites, are dominated by opportunistic species that can tolerate disturbed conditions.

It is highly likely that construction, filling, and capping events at the proposed Harbor CAD cell sites will temporarily impact the benthic communities. However, similar to BHNIP cells the CI and PIN cell surfaces will be recolonized rapidly by similar opportunistic species. Eventually, the benthic community will return to a pre-dredging composition. Adults and larvae from adjacent areas, which were not dredged, will provide recruits to the disturbed sites.

3.7 Fisheries Resources

A study conducted by Normandeau Associates Inc. (NAI) for the DEIR from June 1998 to May 1999 characterized the fisheries resources of the Harbor and results are applied to assess the two preferred alternative CAD cell sites between the two preferred alternative CAD cell sites, CI and PIN (NAI, 1999). Within the NAI study, Station NT-4 was located in the CI CAD cell area to the east of the New Bedford docks. Results of sampling at this location represented the fisheries resources of the CI site. Station NT-5 was located in the PIN site.

3.7.1 Goal

The goal of the Harbor fisheries resource study was to provide data that can be used to evaluate the effects of dredging and aquatic disposal on fisheries resources.

3.7.2 Description of Study

Fisheries sampling were conducted from June 1998 through May 1999 on trawl tracks coincidental with the areas of the preferred alternatives. The sampling frequency was bi-weekly

from June through October 1998 and May 1999 and monthly from November 1998 through April 1999. A thirty foot bottom trawl with 2 -inch stretch mesh in the body and 1 ½ inch-stretch mesh cod end lined with 1/4 –inch mesh was towed over the tracks for approximately 400 m (NAI, 1999).

3.7.3 Results

3.7.3.1 Channel Inner

At station NT4, the annual geometric mean catch per unit effort (CPUE) was determined to be 25.47 fish per 400 m trawl length. The catch at this station was dominated by cunner, scup, northern pipefish, Atlantic herring, and winter flounder. Scup, Atlantic herring, and winter flounder are species managed by the New England Fishery Management Council (NEFMC). The monthly geometric mean CPUE was highest in March due to a very large catch of Atlantic Herring (n=1,468) and in September due to the large catches of scup (NAI, 1999).

Cunner were captured during each month of sampling except the winter months from December to March. At this time cunner are thought to become inactive or migrate out of estuaries (Able and Fahay, 1998). In the NAI study, CPUE for this species was greatest in November and April. Sampling in April, and again from July to September revealed a recruitment of YOY cunner (i.e., <39mm) to the area (NAI, 1999).

Scup were captured from August to December with the highest CPUE occurring in September. YOY scup (i.e., those <40 mm) were first captured in August. In the Middle Atlantic Bight, they are reported to remain in estuaries until September when they begin migration out of the estuary (Able and Fahay, 1998). Catches of adult scup at NT4 were insignificant. The ingress of YOY scup to bays within the Mid Atlantic Bight is consistent with results of the National Marine Fisheries (NMFS) Marine Resources Monitoring, Assessment, and Prediction (MARMAP) surveys conducted between 1977 and 1987; the findings of Whitting (1995); and those of Whitting, et al. (1999).

Northern pipefish were absent form trawl catches during July, January, February, and May, with the highest occurring from August through November. The majority of pipefish captured were >100 mm. Since the YOY of this species are extremely variable in size (Able and Fahay, 1998) some individuals may have been YOY fish. Within the Mid Atlantic bight, they are reported to leave estuaries by November to winter in deeper oceanic waters of the continental shelf.

Catches of Atlantic herring occurred in January and March with the CPUE varying greatly between the two months (7 to 1,468, respectively). All Atlantic herring captured were YOY less than 50 mm, which is consistent with the findings reported for other estuaries in the Mid-Atlantic bight (Able and Fahay, 1998).

Winter flounder were captured in NT4 trawls during every month except November and December, with the highest CPUE occurring in June and July. Size class analysis of the catch revealed that June trawl captures represented recruitment of YOY fish less than 45 mm, which is

consistent with the findings reported for other estuaries in the Mid Atlantic bight (Able and Fahay, 1998).

black sea bass were captured during the August trawl. Although it was not among the five most abundant fish, it is important to note since it is a managed species. Fish captured within the trawl were found to be less than 30 mm. August was the only month black sea bass were captured. This species is reported to spawn during summer months, whereupon the larvae and early juveniles occur in both estuaries and adjacent coastal ocean waters for the remainder of the summer. After summer, they emigrate to deeper ocean waters (Able and Fahay, 1998).

3.7.3.2 Pope's Island North

At station NT5, the annual geometric mean catch per unit effort (CPUE) was determined to be 5.08 fish per 400 m trawl which shows substantially lower abundance at this station compared to the other trawl stations of the Harbor. The catch at this station was dominated, in order of abundance, by winter flounder (52.5 % of the CPUE), seaboard goby (9.5% of CPUE), Atlantic silverside (8.0 % CPUE), bay anchovy (6.5% CPUE), and windowpane (5.7% CPUE). Winter flounder and windowpane are species managed by the NEFMC. The monthly geometric mean CPUE was highest in August and October due to large catches of Atlantic silverside in August (6.18/trawl) and winter flounder in October.

Winter flounder were captured in trawls every month except July. Abundance peaked in October and remained high through December. YOY winter flounder recruitment appeared to occur in November when fish less than 100 mm were captured but were absent from trawls during other months. No recently settled flounder (<30 mm) were captured at Station NT5.

Seaboard goby, the second most abundant fish captured in the trawls at NT5 were all less than 52 mm and were only captured in November and December (NAI, 1999). Seasonal migration patterns and behavior of this fish have not been reported or described and it has been found in Mid Atlantic Bight estuaries during summer months (Able and Fahay, 1998). The reason for its appearance at NT5 only during the November and December months is unknown at this time.

Atlantic silverside, the third most abundant fish species captured in the trawl at NT5 were captured only in August and October; these fish being less than 86 mm. The smallest (27 mm) were captured in August. The pattern of abundance was consistent with other studies in the region (Hoff and Ibara, 1977; Ayvazian, et al., 1992)

Bay anchovy, were captured in August and September. The catch of this species was composed primarily of YOY less than 30 mm. The annual production of this species has been know to be of such magnitude that YOY may easily influence or dominate the total fish production of an estuary (Able and Fahay, 1998).

Windowpane were captured in September, October, and December. The catch of windowpane was composed of a mixture of YOY and yearlings, lending evidence to the possibility that New Bedford Harbor may provide a nursery for both spring and fall spawned windowpane.

3.7.4 Summary

3.7.4.1 Channel Inner

The fish community represented by Station NT4 was similar in composition to three additional trawl stations located within the Outer Harbor which were sampled as part of the same study (NAI, 1999). In addition, many of the fish species at Station NT4 exhibited similar patterns of abundance and recruitment patterns similar to those exhibited by the same species in the DMF nearshore (i.e., < 9m depth) trawl sampling data set for Buzzards Bay available from 1978-2000 (Carey and Haley, 2002). Despite the fact that the habitat found within New Bedford's Inner Harbor proximal to the Channel Inner site is considered degraded, it supports an ichthyofaunal composition similar to that of nearby, less disturbed estuaries. It provides nursery habitat for important recreational and commercial fish species such as scup, black sea bass, cunner, and winter flounder. The lack of presence of winter flounder in NT4 trawls for the months of November and December may be an indication that they had moved upstream. Bigelow and Shroeder indicate that in shallow enclosed harbors, winter flounder tend to desert shallow sun-warmed waters over flats in summer for deeper harbor basins. Conversely, these flatfish tend to return to the shoals over the flats in cooler moths of fall and winter (Bigelow and Shroeder, 1953) They are at their spawning peak from January to May in New England, and during February and March south of Cape Cod (Bigelow and Shroeder, 1953).

3.7.4.2 Pope's Island North

The fish community represented by Station NT5 differed in composition from NT4 and other deep water trawl stations located within New Bedford Outer Harbor, as well as the fish community and recruitment patterns represented by DMF trawl captures represented by data available from 1978-2000 (Carey and Haley, 2002). Despite the fact that the habitat found within New Bedford's Inner Harbor proximal to the Pope's Island North site is considered degraded, it provides nursery habitat for winter flounder and windowpane. However in contrast to both the lower reach of the Inner Harbor and the Outer Harbor, the ichthyofaunal community of the upper reach of the Inner Harbor (i.e., north of Pope's Island) as represented by trawl sampling at NT5 is dominated by less number of managed species, has a less diverse finfish community, and is relatively less productive for important commercial and recreational finfish species such as scup, black sea bass, and cunner. However, it is still an important nursery for winter flounder and windowpane and is a productive area for smaller prey species such as Atlantic silverside, bay anchovy, and seaboard goby. Winter flounder are noted as peculiar in that their eggs are not buoyant (Bigelow and Shroeder, 1953, and Able and Fahey, 1998). Eggs hatch in between two and three weeks and larvae develop in between 2.5 to 3.5 months (Bigelow and Shroeder, 1953). Larvae are thought to not occupy the surface waters, but rather the bottom (Bigelow and Shroeder, 1953 and Able and Fahey, 1998). Larval winter flounder tracked in a Mystic River Connecticut study were found most common from March to June earlier in the upper estuary and later in the lower estuary (Able and Fahey, 1998).

3.8 Water Quality Studies

Water column chemistry studies were important to the completion of the Harbor FEIR due to levels of chemicals in harbor bottom sediments that might have effects on dredging permitting. Surface water samples were collected for elutriate testing and for background analysis. Water quality thresholds studies were conducted to provide a proven approach to the establishment of toxic chemical concentrations in site-specific Harbor water for Water Quality Certificate requirements necessary for permittable CAD cell construction and related Harbor dredging. In this section of the FEIR, the surface water study will be presented first followed by the water quality thresholds study.

3.8.1 Goal of Surface Water Study

Surface water was analyzed to determine site-specific background water chemistry and turbidity values for the proposed alternatives CI and PIN.

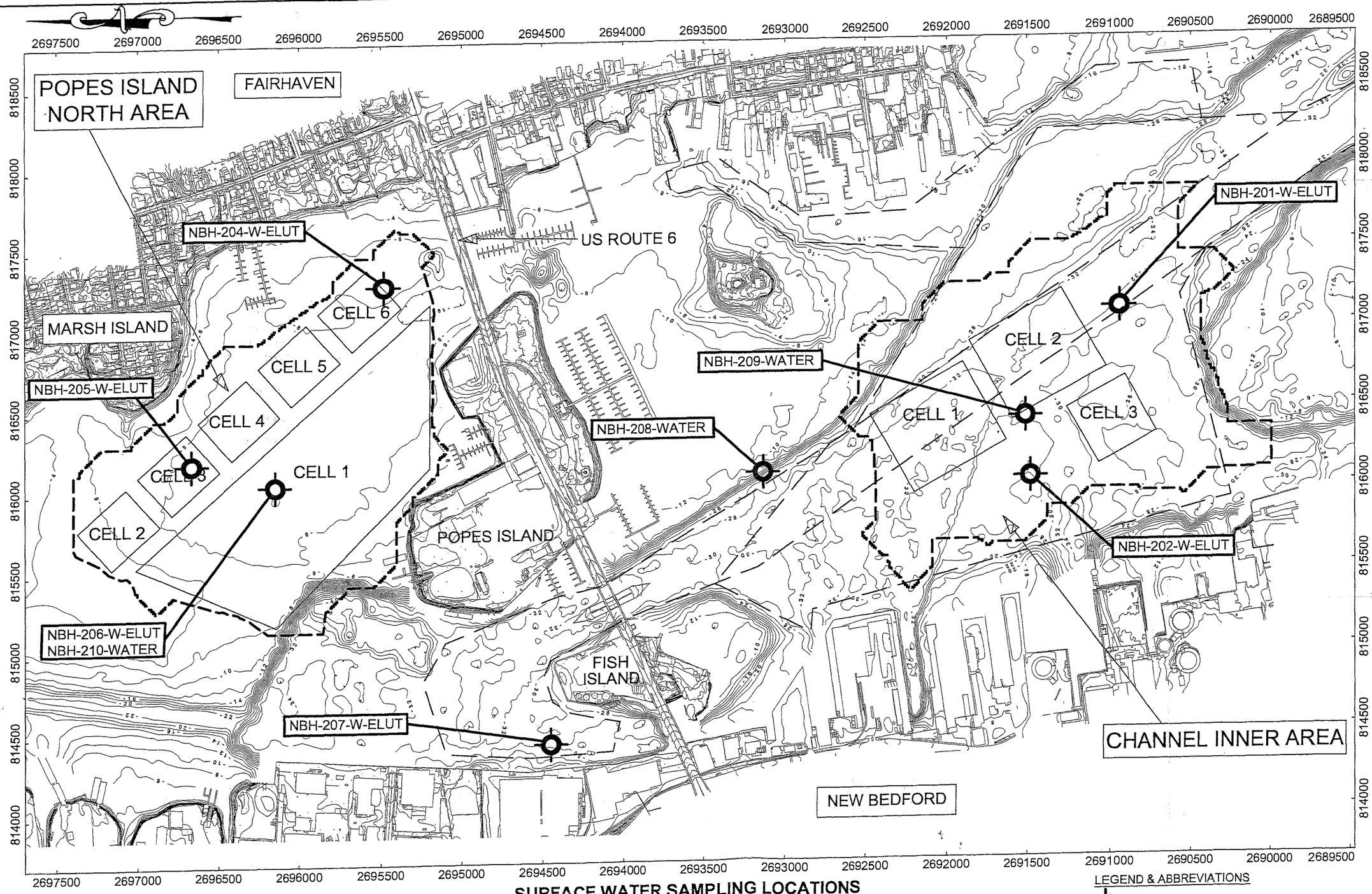
3.8.2 Description of Surface Water Study

On October 21, 2002, surface water in three locations was field screened at various depths for pH, conductivity, turbidity, dissolved oxygen, temperature, salinity, total dissolved solids, and oxidation reduction potential (Figure 3-19). Table 3-3 presents a summary of these surface water-screening results. The parameters obtained during the sampling indicate a relatively homogeneous environment with depth. If values had changed with depth, a stratification effect would have been assumed to be present. This was not the case with the information obtained during the surface water screening. The measurements obtained during the screening activities were compared to the Surface Water Quality Standards (SWQS) as presented in 314 CMR 4.00.

Surface water samples were also collected from the RV Cyprinodon, on October 10th and 21st, 2002. The first marine water samples were collected concurrently with vibracore activities. For the second set of surface water samples, three locations were field screened at various depths for pH, conductivity, turbidity, dissolved oxygen, temperature, salinity, total dissolved solids, and oxidation reduction potential to support detailed CAD cell dredging and event modeling and hydrodynamic analyses. Surface water sample NBH-208-Water was submitted to a USACE-certified laboratory for analysis of COD, BOD, total solids, RCRA (8)metals plus nickel, copper, lead, organochlorine pesticides, PAHs by EPA Method 8270, PCB Congeners by Method 8082, and TOC by Lloyd Kahn Method. The surface water sample was delivered to a certified laboratory on October 22, 2002.

Table 3-6. Surface Water Parameters

	Location						
Parameter	**NBH-208-Water**		**NBH-209-Water**			**NBH-210-Water**	
UTM Coordinates	816,092 mE 2,693,135 mN		816,420 mE 2,691,507 mN			816, 041 mE 2,696,149 mN	
Depth in meters	6	3	9	6	3	3	1.5
pH	5.62	5.78	5.90	5.91	5.92	6.11	6.05
Conductivity in µS/cm	42.3	42.2	42.5	42.3	42.3	37.0	42.0
Turbidity in NTU	-10	-4.7	-7.7	-5.4	-6.0	-10	-4.5
Dissolved Oxygen in mg/L	6.13	6.17	6.32	6.28	6.29	6.68	6.37
Temperature in °C	13.77	13.76	13.75	13.76	13.81	13.84	13.89
Salinity (%)	2.7	2.7	2.7	2.7	2.7	2.5	2.7
Total Dissolved Solids in g/L	26	26	26	26	26	23	26
Oxidation Reduction Potential in mV	101	96	89	85	84	-120	54
Notes:	Depth in meters is Depth below Water Surface						



NOTES:

1. Base Plan of the New Bedford Harbor area was obtained from the US Army Corps of Engineers and has not been field verified.
2. Coordinates are shown in the State Plane Coordinate System, Massachusetts Mainland Zone 2001, Referenced to the 1983 North American Datum (NAD83).

SURFACE WATER SAMPLING LOCATIONS AT CHANNEL INNER AND POPE ISLAND NORTH CAD CELL SITE AREAS

0 600 1200 1800

SCALE: 1"=600' FEET

LEGEND & ABBREVIATIONS

SAMPLING LOCATION

ELUT = ELUTRIATE
MAC = GRAIN SIZE AND T.O.C.
SED = CHEMISTRY

CZM

Maguire Group Inc.
Architects/Engineers/Planners
225 Foxborough Boulevard
Foxborough, Massachusetts 02035

MAGUIRE GROUP

NEW BEDFORD/FAIRHAVEN HARBOR DMMP FEIR

FIGURE 3-19. SURFACE WATER SAMPLING LOCATIONS AT CHANNEL INNER AND POPES ISLAND NORTH CAD CELL SITE AREAS

PROJECT NO.:	16454
DESIGNED BY:	----
DRAWN BY:	----
CHK'D BY:	
DATE:	06/02/03
SCALE:	AS NOTED

3.8.3 Results of Surface Water Study

PAHs, organochlorine pesticides, and dioxins were not detected above laboratory quantification limits in the surface water sample NBH-208-WATER. Arsenic, lead, selenium, and zinc were detected at concentrations of 4.2 µg/L, 4.7 µg/L, 2.3 µg/L, and 53 µg/L, respectively. Total solids, BOD, COD, and total organic carbon were respectively reported as 3.6%, 3.6 mg/L, 4,200 mg/L, and 1.6 mg/L.

The sampling areas of the preferred alternatives CI and PIN were observed to be free from floating, suspended and settleable solids. Excessive solids typically cause aesthetically objectionable conditions, and may potentially impair the benthic biota or degrade the chemical composition of the bottom. Although the turbidity readings were influenced by the sunlight, no visual evidence of color or turbidity abnormalities were present in the sampling areas. There were no observations of any visible sheen from oil, grease or petrochemicals the water surface.

The water quality classification of the Inner Harbor is Class SB, due to the presence of combined sewer overflows. The levels of measured dissolved oxygen were above the SWQS of 5.0 mg/L for Class SB Coastal Marine Water Body. The negative values for turbidity are likely due to sunlight interference. Since the range of pH values for class SB is between 6.3 and 8.3, the detected pH values of the sample set were not more than 0.5 units outside of the background range. Original laboratory data, laboratory QA/QC, methods, and the chain-of-custody form are included in Appendix D.

3.8.4 Summary of Surface Water Study

Surface water was collected from preferred alternative site-specific locations and one control location in the Harbor and samples were analyzed at a certified testing laboratory to detect any hazardous levels for chemical concentrations of concern. No laboratory detections appeared above laboratory quantification limits. The parameters tested for surface water quality indicate a relatively consistent, homogeneous setting with depth.

3.8.5 Goal of Water Quality Thresholds Study

The goal of this water column chemistry study is to determine if ambient water quality conditions influenced by resuspended sediment and chemicals from dredging operations of the preferred alternatives will be less restrictive to these operations than default water quality criteria. Site-specific allowable chemical concentrations values, protective of Harbor aquatic life, will then be applied to predictive dispersion modeling. Ultimately, the incorporation of these protective chemical concentrations values in the predictive dispersion modeling will be helpful to establishment of permitting thresholds important to CAD cell permit applicants, contractors, regulators and CAD cell managers.

3.8.6 Description of Water Quality Thresholds Study

The thresholds study was conducted for the proposed CI and PIN CAD cell areas. CAD cell construction activities typically result in resuspension and release of dissolved and particulate constituents into the water column. Resuspension of dredged sediments lead to contaminant concentrations that exceed thresholds posed by published ambient water quality criteria (WQC). The development of water quality standards or thresholds prior to dredging and disposal actives will provide target baseline conditions, which are not to be exceeded during operations. Failure to meet these thresholds will trigger avoidance and minimization responses to ensure that water quality conditions and marine resources within New Bedford/Fairhaven Harbor are not compromised.

Site-specific water quality thresholds were established through a set of three progressive water column chemistry studies with mysids and sea urchin larvae. Capsule summaries of the three progressive water quality studies are presented below; They include the Site Specific Water Quality Assessment Study (WQA), Suspended Particulate Phase (SPP) and Water-Effect Ratio (WER).

1. *Suspended Particulate Phase (SPP)/*elutriate testing assessed the bio-availability of measured chemical concentrations from field samples through aquatic toxicity testing, and compared these results with the default water quality criteria. SPP toxicity was observed and triggered toxicity identification evaluation of site-specific samples.

2. *Toxicity Identification Evaluation (TIE)* testing (US EPA, 1994) was conducted to determine if the source(s) of toxicity are attributable to metals, organics or confounding factors (e.g., suspended solids; ammonia). Site-specific toxicity was observed and triggered the water-effect ratio study.

3. *A "Water-Effect Ratio" (WER)* was used to derive *site-specific protective limits* that would be less restrictive than default WQC values for application beyond the mixing zone. This adjustment was obtained through laboratory testing, as prescribed by the EPA Water-Effect Ratio method (US EPA, 2001;1994).

3.8.7 Results of Water Quality Thresholds Study

3.8.7.1 SPP

Only elutriate test results conducted in an area of Channel Inner (NBH-202) demonstrated toxicity to one of the test organisms (mysids). For NBH-202, toxicity was observed in the 100% SPP, but not in any of the dilution series. Although the absence of toxicity in the dilutions for this sample indicates a relatively low level of toxicity, the toxicity required further evaluation utilizing toxicity identification evaluation (TIE) and water effects ratios (WER) to resolve potential source of the observed toxicity. Ammonia concentrations measured as a routine practice at the start of SPP testing indicate that NPH-202 had the highest concentration of total and unionized ammonia.

3.8.7.2 TIE

In the TIE study, results the analyses of the chemical exposures suggest that both copper and PCB concentrations are in the exposure range were toxicity could occur, depending on species sensitivity and site-specific water quality conditions. TIEs are used to identify cause and effect relationships between toxicity observed in toxicity tests and factors that have contributed to the observed effects. These relationships are revealed through the through manipulations that remove the toxicity of individual contaminant classes (e.g., metals, organics, or ammonia). Specific Hazard Quotients and TIE results generally both support the finding of multiple sources of toxicity. Copper and ammonia toxicity to one of the test organisms (sea urchins) appeared to have exceeded the capacity of the TIE treatment to sufficiently limited observed effects.

The *Ulva* treatment was applied to clear ammonia. For mysids, the concentration of ammonia added indicates that *Ulva* treatment had no adverse affect on survival. For the sea urchin, the *Ulva* treatment did not improve larval development, indicating that the treatment did not reduce ammonia to a non-toxic level *Ulva* treatment of the NB-202 site sample was performed to remove ammonia as a source of toxicity. In the NBH-202 sample, *Ulva* completely removed toxicity to mysids. Another test organism (mysids) was most affected by PCBs and ammonia, but their sensitivity to copper appears to increase with near toxic levels of PCBs. Associated reductions in toxicity are used to characterize causative factors. It was expected that the cause of acute toxicity in NHH-202 (Channel Inner) would be principally due to copper, PCBs, and compounding factors.

The role of PCBs was determined to be uncertain for the three toxicants due to the need to use toxicity values derived for specific PCB mixtures (e.g., Aroclor 1242) that are different from the mixture presented in the NBH sediment sample.

3.8.7.3 WER

The toxicity of contaminants can be altered by site-specific biogeochemical factors. One approach outlined by USEPA is the derivation of site-specific water quality criteria for contaminants involves the development of WERs (SAIC, 2003, and see Appendix I). This

approach entails multiplying national water quality criteria by an experimentally derived WER where the WER is defined as the ratio of the toxicity of a contaminant in the site water to the toxicity of the same contaminant in standard lab water. General equations depicting this relationship is presented below:

WER = LC50 (site water threshold value) / LC50 (lab water threshold value)
WER x AWQC= Site specific criterion
Note: LC50 = Lethal Concentration, 50%

3.8.8 Summary of Water Quality Thresholds Study

The SPP elutriate testing and the TIE indicate that acute exposure to copper was likely the most limiting water quality factor in instantaneous releases of dredged material. This water quality study utilized a test organism (sea urchins) that is sensitive to copper to determine a WER for the most limiting water quality factor associated with dredged material from New Bedford Harbor upon the instantaneous release of sediments to the proposed CAD cell sites. When the WER is applied to published water quality standards it will allow less restrictive site-specific water quality thresholds by broadening the standards based mixing zone limits and reducing the area of toxic impact to organisms. WER methodology used in this study is as prescribed by the EPA Water Effect-Ratio (US EPA, 2001;1994). DEP will set the water quality thresholds in response to dredging project applications.

See Section 5.0 for a discussion of the application of the Thresholds Study to water quality modeling and the determination of an appropriate mixing zone.

3.9 Hydrodynamics

In the DEIR a hydrodynamic analysis was conducted based on previous studies and existing literature (Maguire, 2002). The DEIR suggested and the DEIR Certificate concurred that site-specific hydrodynamic analysis should be conducted for the FEIR. A field program was conducted from October 23, through November 22, 2002 to monitor present hydrodynamic conditions of the Harbor relative to CI and PIN. Hydrodynamic conditions for the two proposed preferred alternative CAD site areas in relation to one control location near the hurricane barrier were monitored for a full diurnal tidal cycle for the purpose of sediment resuspension and instantaneous chemical release modeling (ASA, 2003, and section 5-0). The hydrodynamic modeling examined physical field data (surface elevations and velocities) to identify primary force that drive the circulation in New Bedford Harbor, which were characterized as nine typical Harbor scenarios of winds and tides. These nine hydrodynamic conditions were used to provide three dimensional velocity predictions to the contaminant and sediment transport model before and after the dredging excavation activity of the Popes Island North CAD facility.

3.9.1 Goal

The primary goal was to collect hydrodynamic field data for detailed hydrodynamic conditions characterizations. These field data included Harbor and site-specific information on tides (sea surface elevation) and currents (horizontal current strata throughout the water column). The

secondary goal of hydrodynamic study was to simulate characteristic circulation patterns in New Bedford Harbor for use in the subsequent pollutant and sediment transport modeling Section 5-0.

3.9.2 Description of Studies

Tide and current data were collected for use in the hydrodynamic calibration, sediment physical samples were obtained for use in the dredging modeling, and elutriate concentrations of sediment contaminants were collected to determine source strengths for the fate and transport modeling.

Current speed and direction, surface elevation and optical backscatter were measured continuously throughout the study period at two locations in New Bedford Harbor: the Popes Island and Channel Inner stations. This was accomplished through the deployment of Acoustic Doppler Current Profilers (ADCPs) and Acoustic Doppler Current Meters (ADCMs) at each of these two locations. Surface elevation and optical backscatter were also monitored at the Tide Gauge station, located outside of New Bedford Harbor, using a tide gauge and an Optical Backscatter Sensor (OBS).

3.9.2.1 Tides

Variations in sea surface elevation were measured at three stations within the study area. Pressure gauges on the ADCMs deployed at the Popes Island and Channel Inner stations recorded total pressure from the water column and atmosphere at 15-minute intervals. These data were corrected for atmospheric pressure and then demeaned to give variations relative to mean sea level. Sea surface elevation was measured outside of New Bedford Harbor at the Tide Gauge station. A tide gauge was used to record total pressure due to atmospheric pressure and water column height at 15-minute intervals. As with the ADCMs, these data were corrected for atmospheric pressure and demeaned to give variations relative to mean sea level.

3.9.2.2 Currents

Horizontal currents were measured throughout the water column at the Channel Inner and Popes Island stations using ADCPs from RD Instruments. A 600 kHz instrument, with a bin size of 0.50 m (1.6 ft), was used in the deeper waters at the Channel Inner site, while 1200 kHz instrument was used at the Popes Island site, with a bin size of 0.25 m (0.8 ft). The ADCPs recorded velocities at 15 minute intervals. The resulting data was subsequently low-pass filtered using a 5-hr window. To better resolve currents near the bottom, an Aquadopp ADCM was deployed in conjunction with each ADCP. Positioned approximately 0.6 m (2 ft) above the seafloor, or about one third of the distance to the first bin of ADCP data, the ADCMs recorded velocities at the bottom of the water column at 15 minute intervals. These data were low pass filtered with a 5-hr window.

The net flow of water at a given location can be estimated by considering the average current velocity over the entire depth of the water column. Depth-averaged currents at the Popes Island site were predominantly to the southeast during the study period, though periods of flow to the

north did occur during flood tides. Depth-averaged currents had a mean speed of 2.3 cm/s (0.08 ft/s) to southeast, with a maximum value 15.0 cm/s (0.49 ft/s) during this period.

3.9.3 Hydrodynamic Modeling

WQMAP, as the model system is known, uses a three dimensional boundary fitted finite difference hydrodynamic model (BFHYDRO) developed by Muin and Spaulding (1997a and b). The model has undergone extensive testing against analytical solutions and used for numerous water quality studies. The grid system used in the boundary-fitted coordinate model system is unique in that grid cells can be aligned to shorelines and bathymetric features (like dredged channels) to best characterize the study area. In addition, grid resolution can be refined to obtain more detail in areas of concern. This gridding flexibility is critical in representing the New Bedford Harbor waters where geometry is highly variable and complex.

3.9.4 Surface Wind Stress

Two wind data sets from New Bedford Municipal Airport (~5.3 km [3.3 mi] north-west of Popes Island) and Buzzards Bay NOAA Buoy (~29 km [18 mi] south-south-west of Popes Island) were considered. During the period of the field program, their directions were nearly identical, but speeds at the buoy were substantially larger. Although the NOAA Buzzards Bay Buoy provided a better estimate of the unobstructed wind, the wind record from the airport was selected because of its proximity to the Inner Harbor.

3.9.5 Results

3.9.5.1 Combined Forces Drive Hydrodynamic Conditions

The elevation and velocity spectrum distributions reveal that tides and winds are the primary causes that drive circulation in the region. This observation can also be inferred by examining the variations of elevation and velocity in time. Figure 3-21 shows observed winds (New Bedford municipal airport), elevation (outside of the Hurricane Barrier) and velocities (Channel Inner and Popes Island North) together on the same time axis. All forces drive the circulation with their own frequencies or random times: half daily tidal cycles, spring-neap fortnightly cycles and episodic wind events. Although the variation of velocities is very complex, the response to wind is particularly noticeable through time. Velocities in Figure 3-21 are shown for surface, vertically averaged, and bottom. At the CI station, with a 9.2 m (30 ft) water depth, the surface and bottom velocities are quite different. The surface velocities are larger, more variable, and generally flow to the south, while bottom velocities are smaller and show an oscillating north-south direction. Velocities at PIN, with a 2.6 m (8.5 ft) water depth, are more uniform vertically with somewhat higher speeds t the surface than at the bottom.

In general, typical driving forces in normal estuarine circulation are tide, wind, and density gradient. Tide and wind influence are clearly seen in the observations. The significance of the density gradient is based on freshwater inflows. If the amount of freshwater inflow is small relative to the estuary size, the density gradient is not expected to play a significant role. The evidence of density gradients can be seen in the longitudinal salinity. No salinity observation

were made for the period of field investigation, but other studies concluded the density driven flow would be much less than 1 cm/s (see the discussion in Abdelrhman [2002]) south of Coggeshall St./I-95 Bridge, the lower portion of the Inner Harbor where the dredging and disposal operations are planned.

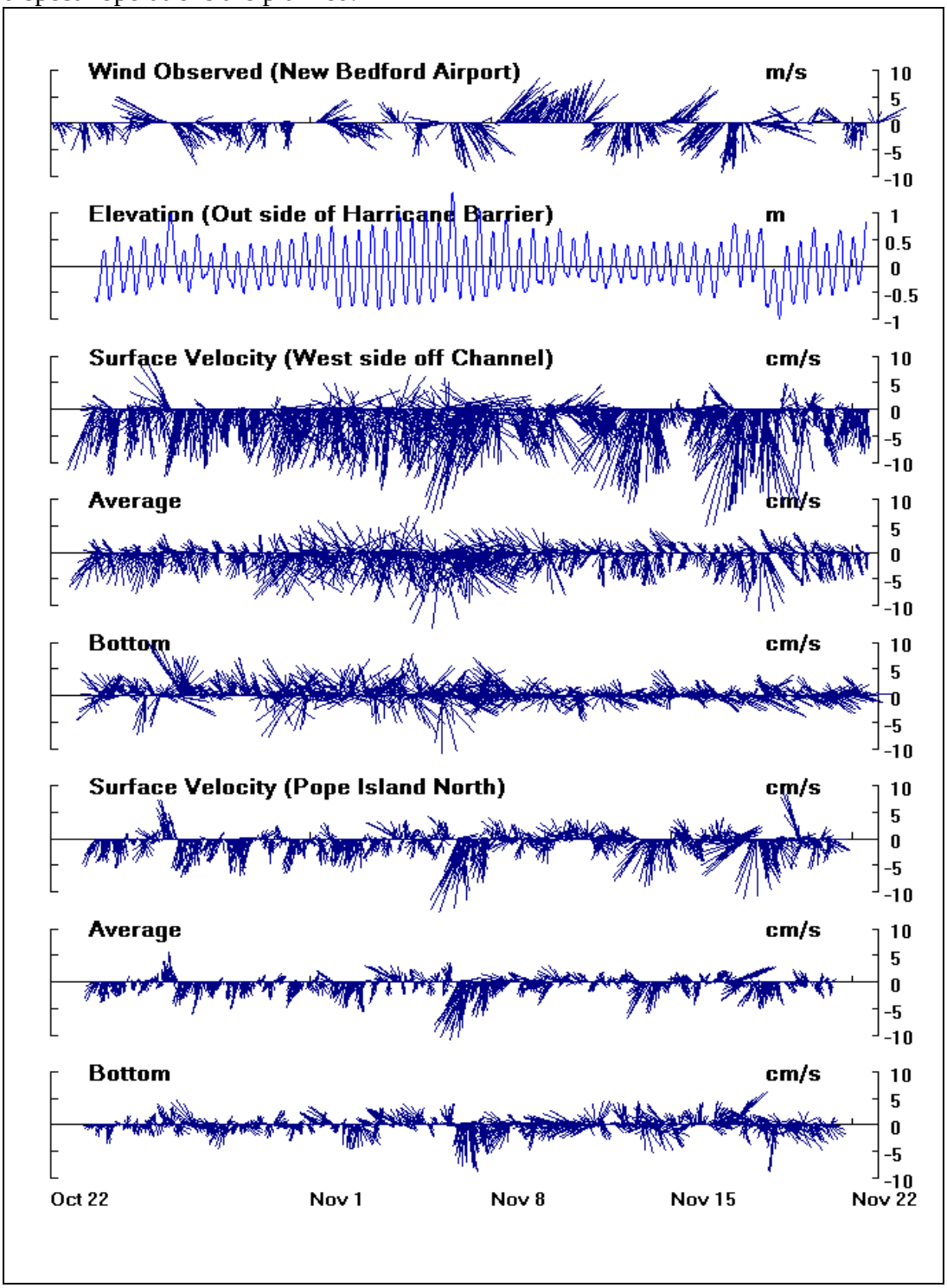


Figure 3-20. Time series stack plot of observed wind, elevation and velocity data.

3.9.6 Hydrodynamic Model Simulation Results

The hydrodynamic model simulated the circulation from 20 October to 20 November 2002, the period of the field program, with aforementioned model inputs and parameters. There was very little elevation gradient between Buzzards Bay and the Outer Harbor. Simulated elevations at Channel Inner and Popes Island are in good agreement in amplitude, but their phases slightly lead the observations.

When the observed data was compared with the simulated magnitudes of the velocities, it agreed well with the observations at the Channel Inner and Popes Island North stations, respectively. The flow directions, however, differed in various degrees during the simulation period. The apparent complexity is due to wind stress. During some periods, the currents strongly correlated with the wind. For example, during the period (Oct 24 – Oct 30), wind blew steadily from the NNW direction. The simulated current showed the surface currents were always positively correlated with the wind.

3.9.7 Characteristic Circulation Scenarios

The analysis of the field observations and hydrodynamic simulations confirmed that the major forces driving the circulation in New Bedford Harbor are astronomic tides and winds. The approach taken here was to develop a set of circulation scenarios that reflected most likely conditions. These scenarios were comprised of various tidal conditions and most probable wind conditions. Tidal variations considered were spring, mean and neap tides. Spring tides are the highest high tides and lowest low tides equating to the greatest sea surface elevation difference. Neap tides are the lowest high tides and the highest low tides equating to the least sea level difference. Unlike the astronomic tide, which is predictable, wind is very episodic.

3.9.8 Wind Climate for Inner New Bedford Harbor

The variability of the wind at the New Bedford Municipal Airport was examined. Figure 3-22 and Table 3.7 shows the seasonal probability of wind direction in 30° increments. The compass bearings used in this study were provided from NOAA in a scientific format slightly different than the common 360° compass card. Two prominent wind directions found were south-west-south (SWS) and north-west-west (NWW). Nearly 50% of the time wind blew from the SWS direction in summer and the NWW direction in winter. This tendency remained to a lesser degree during spring and autumn. The probability that wind speed was less than 3.0 m/s (6.7 mph), considered as calm wind, is ~10.7% on average.

Table 3.7. Variations of winds at New Bedford Municipal Airport by season.

	Chance wind blows from either SWS or NWW	**Calm wind (<3.0 m/s)**
Winter	45.5%	8.4%
Spring	35.4	11.1
Summer	50.9	13.8
Autumn	35.3	10.1

Wind speed was quite variable during the seasons. The average wind speed for both directions (excluding the calm wind period) was calculated to be 8.2 m/s (18.3 mph).

3.9.8.1 Circulation Scenarios

Three tidal conditions (neap, mean, and spring) and three wind conditions (calm, SWS, NWW at 8.2 m/s speed) were combined to make the nine circulation scenarios summarized in Table 3.8.

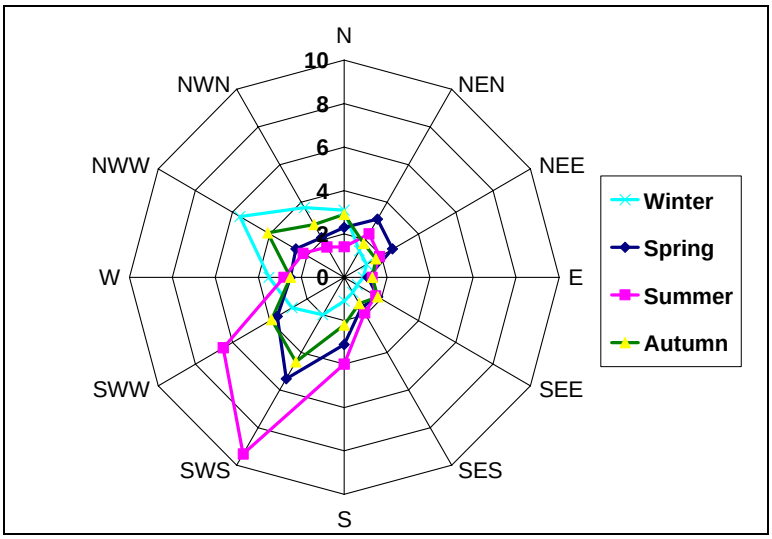


Figure 3-21. Probability of wind direction of the four seasons.

Table 3.8. Circulation scenarios based on tide and wind conditions.

Circulation Scenario	Tide Range	Wind
1	Neap (0.7 m [2.3 ft])	Calm
2	Mean (1.0 m [3.3 ft])	calm
3	Spring (1.4 m [4.6 ft])	calm
4	Neap (0.7 m [2.3 ft])	SWS 8.2 m/s
5	Mean (1.0 m [3.3 ft])	SWS 8.2 m/s
6	Spring (1.4 m [4.6 ft])	SWS 8.2 m/s
7	Neap (0.7 m [2.3 ft])	NWW 8.2 m/s
8	Mean (1.0 m [3.3 ft])	NWW 8.2 m/s
9	Spring (1.4 m [4.6 ft])	NWW 8.2 m/s

To assess the direct effect of tidal conditions and winds, hydrodynamic simulations were run separately for each component. As the tide range doubles from neap to spring conditions, the velocity also approximately doubles throughout the region. There is a strong surface flow heading downwind but modulated by the Inner Harbor geometry. The bottom flow is much lower in magnitude. Simulation results driven by the NWW wind and mean tide showed surface flow again downwind with a significant upwind flow along the bottom in the channel.

Nine hydrodynamic simulations using the combination of tide and wind conditions were then simulated. Table 3.9 compares the simulated speed (vertically averaged) at the two field stations. The result indicates flows driven only by tides are very weak, varying from 1.4 to 4.3 cm/s (0.046 to 0.14 ft/s). Wind substantially increases flow velocities, the SWS wind generating a range of speeds between 5.1 and 9.6 cm/s (0.17 to 0.32 ft/s) and the NWW wind generating a range of speeds between 6.5 and 15.7 cm/s (0.21 to 0.52 ft/s).

Table 3.9. Vertically averaged simulated speed at two field station locations for the nine circulation scenarios.

Circulation Tide	Scenario Wind	Channel Inner Speed (cm/s)	Popes Island North Speed (cm/s)
Neap	Calm	2.1	1.4
Mean	Calm	3.0	1.9
Spring	Calm	4.3	2.6
Neap	SWS @ 8.2 m/s	5.1	9.6
Mean	SWS @ 8.2 m/s	6.0	9.3
Spring	SWS @ 8.2 m/s	7.1	9.4
Neap	NWW @ 8.2 m/s	13.6	6.5
Mean	NWW @ 8.2 m/s	14.6	7.0
Spring	NWW @ 8.2 m/s	15.7	7.5

3.9.9 Summary

New Bedford Inner Harbor is morphologically complex due to two contractions at the Coggeshall St. and I-95 bridges in the upper estuary and it is semi-enclosed by the Hurricane Barrier at its southern end, connecting to the Outer Harbor with a 46 m (150 ft) wide opening. The hydrodynamics are hence complicated, exhibiting circulation governed by both winds and tides. Winds in the area are distinct by season, northwesterly in winter and southwesterly in summer. The currents in the Inner Harbor are dominated by semi-diurnal tides, on the order of 10 cm/s (0.2 kt). A small tributary at the north end of the Inner Harbor is the Acushnet River. Its annual average flow is 0.54 m^3/s (19.1 ft^3/s) (Abdelrhman and Dettmann, 1995). This discharge is too small to play a role in flushing of disposed materials.

The field-obtained elevations and velocities were examined to determine that tides and wind were the primary forces that drove the circulation in New Bedford Harbor. Hydrodynamic simulations were successfully conducted to verify model performance for the period of the field measurement program. Nine basic hydrodynamic conditions were prepared to provide the advection data that will be shown applied to pollutant and sediment transport models (ASA, 2003, and section 5-0) based on the combination of three tidal ranges (neap, mean and spring) and three most likely wind conditions (calm, southwesterly and northwesterly directions). In general, surface and shallow waters tend to move with the wind while flows in deeper areas adjust by compensating the flow to balance the direct wind-induced flows.

3.10 Human Uses

As detailed in the DEIR, existing commercial navigation in the harbor is largely divided into three primary categories:1) traffic related to commercial fishing, 2) fish processing industry and, 3) other maritime vessels and recreational boats (Maguire, 2002). Since the publication of the DEIR in June 2002, the New Bedford Harbor Development Commission has developed elements of the Harbor Plan especially regarding the State Pier and Fish Island. It is important to present new information on the increased commercial vessel traffic relative to the NBHDC developments on the proposed preferred alternative CAD cell sites CI and PIN, respectively.

3.10.1 Recent Harbor Developments Related to Navigation and Shipping

Since the publication of the DEIR, the City of New Bedford under the auspices of the New Bedford Harbor Development Commission (NBHDC) have completed maintenance dredging of the slip to the south of State Pier, the fairways leading thereto and a portion of the federal navigational and maintenance channel immediately northwest of the proposed CI CAD cell area (Apex, 2002).

The largest cruise ship ever to dock in the Harbor, 611 feet long by 79 feet wide, the Regal Empress, docked at the State Pier in summer 2002 (Kalisz, 2002). A total of thirty cruise ships were due to dock at the State Pier over 2002. In August 2004 a high-speed ferry is set to begin service between the State Pier and Martha's Vineyard (Providence Journal, 2003). The new high speed ferry operators expect to run as many as ten trips per day which could equates to as many as 20 Harbor passages per day, possibly some in darkness. The State Pier is located on the New Bedford waterfront just north west of the proposed alternative CI CAD cell site area, and well south of the other proposed alternative PIN CAD cell site area.

Deep-draft commercial fishing vessels as long as 150 feet have been servicing the new herring and mackerel processing plant located on Fish Island north of the CI area and south of the PIN CAD cell area (Commercial Fisheries News, 2002). This new small pelagic fish processing plant is expected to hire 75 employees at current capacity. The Fish Island processing plant is located on the New Bedford waterfront north of the proposed alternative CI CAD site area and south west of the proposed alternative PIN CAD cell area.

SECTION 4.0 – SELECTION OF THE PREFFERED ALTERNATIVE CAD CELL SITE

4.0 SELECTION OF THE PREFERRED ALTERNATIVE CAD CELL SITE

This section of the Harbor DMMP FEIR presents the process used to name the selected preferred alternative for the disposal of UDM in CI or PIN CAD cell(s). The construction of these CAD cells includes excavation of parent sediment, deposit of UDM in the cell in the most environmentally sound and cost-effective manner, and capping with clean cover material to permanently protect the harbor marine ecology from effects of contamination. This decision process is continued in an objective comparative assessment of the environmental impacts of each of the two proposed preferred alternative CAD cells presented in the DEIR. Both state and federal laws guide the development of the alternatives analysis contained in this section of the DEIR. The two principal statutes are:

(1) Massachusetts Environmental Policy Act (MEPA), Massachusetts General Laws (MGL) Chapter 30, Sections 61 and 62A-H. MEPA is the environmental review statute of the Commonwealth. The New Bedford/Fairhaven Harbor DMMP FEIR is being prepared under MEPA. This environmental legislation provides an opportunity for public review of potential environmental impacts in projects that require state agency actions (e.g., permits, funding, or agency-sponsored projects). Most important, MEPA functions as a vehicle to assist state agencies in using: "*... all feasible means to avoid damage to the environment or, to the extent damage to the environment cannot be avoided, to minimize and mitigate damage to the environment to the maximum extent practicable*." (MEPA, 1998)

MEPA requires an analysis of "*reasonable alternatives and methods to avoid or minimize potential environmental impacts*" (301 CMR 11.07(6)) and that all "feasible" alternatives be analyzed in an EIR. Feasible alternatives means those alternatives considered: "... in light of the objectives of the Proponent and the Mission of the Participating Agency, including relevant statutes, regulations, executive orders and other policy directives, and any applicable Federal, municipal, or regional plan formally adopted by an Agency or any Federal, municipal or regional governmental entity" (301 CMR 11.07(6)(f)). The Proponent shall ordinarily use the review and comments by any Person or Agency on the DEIR as an additional opportunity to improve the planning and design of the Project.

In accordance with 310 CMR 11.08(8)(b), the Secretary has determined that the draft EIR is adequate and the Proponent has prepared this final EIR. The scope of this FEIR is limited to additional site-specific information and analysis and response to agency comments. The FEIR presents a complete and definitive description and analysis of the Project and the two proposed preferred alternatives, an assessment of the potential environmental impacts and mitigation measures sufficient to allow a Participating Agency to fulfill its obligations in accordance with M. G. L. c. 30, section 61 and CMR 11.12(5).

2. Clean Water Act (CWA), in particular the Section 404(b)(1) guidelines of the US Environmental Protection Agency (Title 40, Code of Federal Regulations (CFR), Part 230), require that "practicable" alternatives to a proposed discharge to waters of the United States be considered, including avoiding such discharges, and considering alternative aquatic sites that are potentially less damaging to the aquatic environment. The goal of the Section 404(b)(1) guidelines is to provide a framework for arriving at the Least Environmentally Damaging

Practicable Alternative (LEDPA). While the alternative selected for implementation needs to be the least environmentally damaging, i.e. resulting in the least amount of human and natural environment impact of the alternatives studied, it also needs to be practicable. The term "*practicable*" means "*available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes*."

4.1 Analysis of CAD Cell Preferred Alternatives; Channel Inner and Popes Island North

4.1.1 Disposal Site Screening Process

The disposal site screening process begun in the DEIR assessed all possible alternatives through the sequential application of environmental, social and economic criteria. As potential sites with significant conflicts were removed from consideration, the assessment of remaining sites became more detailed. In the FEIR only the two proposed preferred alternative sites from the DEIR are subject to intensive evaluation to determine which remaining site best meets the goals of the Harbor DMMP (Figure 4-1).

A universe of disposal sites was developed during DMMP Phases I and II. The universe included historic dredged material disposal sites recommended by the USACE as well as sites suggested by the Harbor Dredged Material Management Committee. These sites were evaluated in a tiered process. The result of this process was the identification of a range of practicable and reasonable disposal site alternatives. These sites, determined through the evaluation process described below, were evaluated in detail in the DEIR.

There are two general types of screening criteria, exclusionary and discretionary. Exclusionary criteria are those that would unequivocally prohibit disposal of UDM at a particular site. Exclusionary criteria have a basis in federal or state law. For example, locating a disposal site in an area occupied by an endangered species would be prohibited under the federal Endangered Species Act.

Discretionary criteria are those factors that are used to weigh the relative attributes and drawbacks of sites. They do not prohibit use of a site for disposal of UDM, but they do, in total, allow for a comparative analysis of each site. Discretionary criteria in the DEIR were grouped into the following functional areas: physical, jurisdictional, biological, economic and other. In the FEIR discretionary factors include: physical, biological, chemical economic regulatory, practicability and human use.

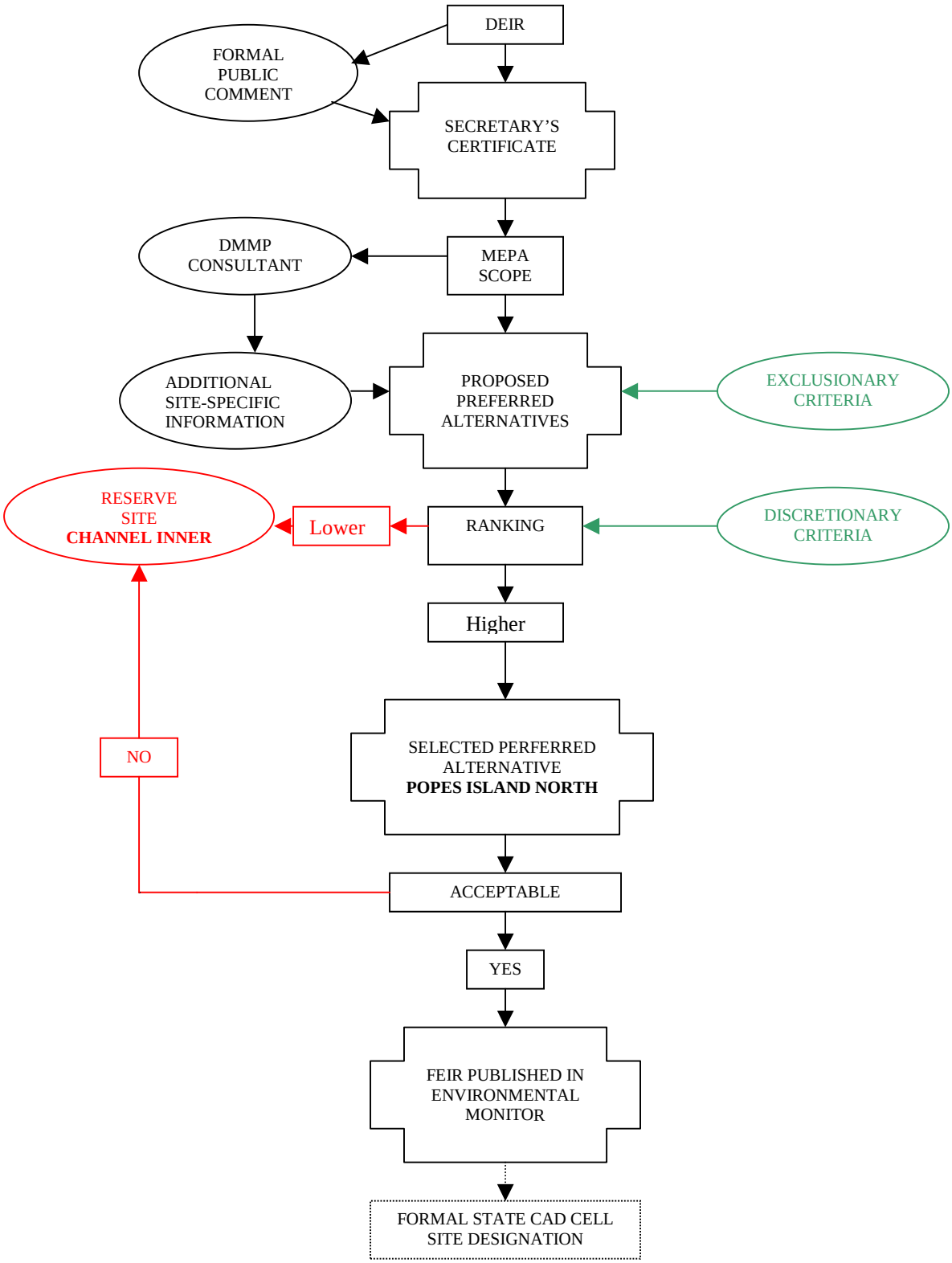


Figure 4-1. New Bedford/Fairhaven DMMP Preferred Alternative Screening Process

The FEIR applies site-specific field analysis to compare the two preferred alternative from the DEIR. A series of discretionary criteria appropriate for the additional site-specific information gathered for the FEIR were then applied to the CI and PIN CAD cell areas alternatives. At this stage in the process, both sites had potential as dredged material disposal site(s). Attributes and drawbacks of the proposed preferred alternative sites were considered. The result was the choice of the Popes Island North site as the preferred alternative.

4.1.2 Screening Results

The evaluation of the two preferred alternative sites with respect to the discretionary screening criteria are discussed below.

4.1.2.1 Discretionary Criteria

Character of Bedrock Profile - Bedrock surface irregularities like precipice formations present restrictions to UDM CAD cell disposal capacities by displacing the volume of the void. Fractured bedrock surfaces may give an illusive depth to bedrock interpretation, thus providing CAD cell design engineers with unreliable information for potential CAD cell depth design. Data from the four additional Phase II borings were applied to recalibrate the existing bedrock profile model for greater confidence. Profiles generated from the data indicated that the bedrock character in both the CI and PIN areas is similar, irregular, and marked by undulations of the bedrock surface.

Depth of Sediment to Bedrock - A more definite understanding of site-specific sediment depth provides CAD cell engineers critical inputs for CAD cell capacity design parameters. Phase II marine boring explorations included a more definite understanding of site-specific sediment depth provided CAD cell engineers critical inputs for CAD cell capacity design parameters (Table 4-1). In the investigation of the potential storage volume within the configured Channel Inner CAD cells, the average depth of sediment to bedrock was 27 feet. The following site-specific stratigraphic layers established this depth: five-foot average organic silts, 16-foot average interbedded silts, sands and gravels and 6-foot glacial till. It is apparent that the shallow depth of sediment to bedrock at the configured cells of the CI area will severely limit the potential capacity in this area.

In the configured Popes Island North CAD cells, the average depth of sediment to bedrock was 71 feet. This depth was established by the following site-specific stratigraphic layers 17-foot average organic silts, 49-foot average inter-bedded silts, sands and gravels and 5-foot glacial till. Contrary to the shallow average depth to bedrock at the CI area cells, it is apparent that the comparatively deep sediment to bedrock at the PIN cell area is satisfactory for the capacity of UDM in New Bedford Harbor.

Table 4-1. Summary of site-specific stratigraphic layers average thickness

	Organic Silts	Inter-bedded Silts, Sands, Gravels	Glacial Till	Total Depth to Bedrock
CI	5 ft.	16 ft.	6 ft.	27 ft.
PIN	17 ft.	49 ft.	5 ft.	71 ft.

Sediment Stratigraphy - Physical characteristics of the full depth of submarine soils to bedrock, is critical to the CAD cell side slope design. It is important to maintain the integrity of submarine CAD cell side slopes for the short-term of construction and the long-term to prevent CAD cell structural integrity. The boring information developed for the FEIR showed the two proposed CAD cell sites had similar geologic stratigraphy, from mudline (sea bottom) down. The recommended 1V: 3H CAD cell side slopes assumed the variety of sediment types involved. Stable and constructible CAD cell side slopes of 1Vertical: 3Horrizontal (1V: 3H) are feasible and appropriate at both the CI and PIN site areas.

Containment Characteristics - The depth and bathymetry (existing or after construction) were evaluated to assess containment characteristics. As described in section 3, CADs that will effectively contain contaminated sediment can be constructed at either the CI or PIN site.

Surficial Sediment Physical and Chemical Analyses - As described in Section 3.0, one representative surficial sediment sample from each of the preferred alternative CAD cell site areas was analyzed in detail for physical and chemical character. Vibracore samples were taken at two-foot intervals. The predominant metal, copper, as well as other metals concentrations diminish by the third interval sampling station. PCBs were detected above laboratory limits on both CAD sites in the surficial sediment chemistry analyses of this FEIR (Section 3.5). Site-specific third interval stations were tested for the comprehensive laboratory suite of analysis. A four-foot sediment layer was identified as UDM for the preferred alternative CAD sites area-wide surficial sediment investigation of this FEIR.

Ambient Sediment Conditions – The sediment type was recorded from surficial sediment grab samples and compared to the remotes surveys in the DEIR. Preferred alternative site specific surficial sediment grab samples were taken for the FEIR. The PIN and the CI sites are characterized by the predominance of fine-grained silt and clay (ENSR, 2003)(Maguire 2002). Two exceptions were found with CI stations NBH-218-MAC that was mostly sand (70%) with nearly 20% gravel and station NBH-214-MAC had approximately 47% sand, 47% silt and clay, and 6% gravel. One exception was found in PIN at station NBH-204-MAC which had more than 70% gravel and sand. Areas where sediment is similar to that of the UDM to be placed there, (i.e., soft, silty and homogenous), are preferred over areas where ambient sediment is coarse-grained or mixed.

Conceptual CAD Cell Engineering- CAD cell design parameters other than those mentioned above include; average bedrock elevation, average bathymetric elevation, sediment thickness, available dredged depth, total dredged volume, total storage capacity, bedrock buffer, and cap thickness.

Preliminary engineering design objectives for preferred alternative CAD cell configurations of this FEIR evolved from the conceptual CAD cell design of the DEIR. In the DEIR, the physical area of impact was an important factor in evaluating disposal sites. Because most of the biological activity in sediment is within the upper 2 feet, it is important to limit the disturbance to as small a footprint as possible. The DEIR presented the concept that a disposal area that is relatively small in area, with a large cell depth, is preferred over a site that is relatively large in area, but has a shallow cell depth. Also the DEIR mentioned the discriminating factor in determining physical area of impact, particularly for sites in the Harbor, is the depth to bedrock. In the DEIR site capacity was the most important consideration. It determined whether a single site or multiple sites would be needed to confine the material requiring dredging (Maguire Group Inc., 2002). In the FEIR specific CAD cell area capacity is the most important consideration. In the FEIR the CAD cell configuration approach was to provide a series of five moderate volume cells of approximately 50,000cy each, as well as a comprehensive large volume dredge project, of approximately 1,800,000cy (Table 4-2). The conceptual design approach of the FEIR was driven in the interest of the New Bedford Harbor Development Commission (NBHDC) request for moderate capacity cells appropriate for the incremental moderate scale dredging projects consistent with near-term goals of the Harbor Plan. The expanded high capacity cell was provided for future long-term harbor-wide comprehensive dredging disposal needs.

Uniformly shallow sediment depth to bedrock makes the CI site inefficient to develop. Moderate volume project CAD cells were configured for CI in the FEIR. However, the effort to sequester only ±50,000cy includes excavation of ±179,300cy parent material, roughly 3.51 times the UDM on average (Table 4-2). By maintaining a 100-foot surface buffer between the CAD cells only three moderate capacity cells fit within the CI CAD cell area footprint. The inefficiency is due to the limited five-foot depth for contaminated dredge project material after taking into consideration the following design parameters; ten-foot bedrock buffer, four-foot suitable cap, additional three-foot operational and maintenance contingency (for protection against over-dredging) and four-foot contaminated CAD cell footprint layer. Hence to accommodate dredged materials volumes the Channel Inner CAD cell footprints must be widely spread-out. The presence of Federal Navigation, Maneuvering and Anchorage areas in the vicinity of the Channel Inner site further complicate this area's development.

The PIN CAD cell area will accommodate at least five moderate volume dredge projects, ±50,000cy each, as well as a large volume dredge project, ±1,800,000cy. However, on average, the effort to sequester only ±50,000cy includes excavation of ±80,405cy parent material, roughly 1.6 times the UDM. The proposed PIN CAD cell depth profiles fit well with revealed subsurface conditions. The relatively shallow sediment depths along the area's eastern extent, near Marsh Island, favor the moderate project CAD cell approach. The deeper sediment depths along the western bedrock valley, adjacent to Popes Island, favor a high capacity project CAD cell approach. Development of moderate size CAD cells in the eastern PIN area will likely assume a multiple-step sequential approach where in-channel type CAD cell(s) can be constructed with completed depths to accommodate vessel traffic from the existing navigable channel to the Marsh Island side. Final CAD design will be determined by project-specific need and long-term management considerations.

Table 4-2. Comparison of average parent material volumes in Preferred Alternative CAD sites.

Site	Moderate CAD Cell Size	Parent Material	Level of Effort
CI	±50,000cy	±179,300cy	3.51
PIN	±50,000cy	±80,405cy	1.6
	(differences)	±98,895cy	1.91

Physical Area of Impact - The amount of sea floor in acres that would be directly affected by disposal activities was estimated. The CI CAD cell area will require a larger foot print than the PIN CAD cell to contain the same volume of material due the relatively shallow depth of sediment to bedrock. The depth of sediment to bedrock at PIN allows smaller CAD cell footprint areas due to deep cell geometry. Total estimated area of impact of each CAD cell area is approximately 90 acres for CI and 80 acres for PIN. Within those areas the footprint of the conceptual CAD cells at the CI site is approximately 20 acres; and 35 acres at the PIN site.

Historic/Archeological Sites - The two sites specifically were evaluated for potential cultural resource constraints through consultation with the Massachusetts Bureau of Underwater Archaeological Resources (MBUAR) and review of positions of shipwrecks and artifacts of maritime history. Because the disposal of UDM at a significant historic or archaeological site could be prohibited, a detailed analysis was prepared for this FEIR. No significant historic or archaeological sites were identified at either the CI or PIN areas.

Water Depths - The existing depths of the disposal sites were obtained from bathymetric surveys or NOAA charts. Final depths after construction or fill were estimated from this available existing depth data. The PIN Cad Cell area lies in shallow water, generally less than 20 feet, which requires a somewhat more complex approach to development than the CI site; however, shoal draft barges and/or in-channel CAD type approaches can address limited draft problems (GLDD, personal communication 2003).

Surface Water Analysis - Surface water was analyzed to determine what site-specific background water chemistry and turbidity values. Surface water was collected from preferred alternative site-specific locations and one control location in the Harbor and samples were analyzed at a certified testing laboratory to detect any hazardous levels for chemical concentrations of concern. The parameters tested for surface water quality indicate a relatively consistent, homogeneous setting with depth with no differences between the PI and PIN sites.

Hydrodynamics: Current Patterns, Water Characteristics - CAD cell construction and related dredging activities are likely to resuspend dredged materials through operations. Hydrodynamics of water bodies above CAD cell locations are important to predict resusspended sediment transport and instantaneous chemical release dispersion as well as future water quality monitoring. The hydrodynamic modeling examined physical field data (surface elevations and velocities) to identify primary force that drive the circulation in New Bedford Harbor.

Hydrodynamic conditions were modeled in the DEIR based on the inputs from existing literature. In the DEIR the semi-diurnal Harbor currents were thought to be on the order of 10 cm/s (0.2 kt.) (ASA, 2001). Modeling predicted current speed in the CI CAD cell area would be almost 2.5 times higher than at PIN. The modeling predicted that current directions at the CI site would be primarily unidirectional along the northwest-southeast direction and that PIN currents would be elliptic with more western orientation.

For the FEIR site-specific hydrodynamic data was acquired for each site. These data indicate that the depth-averaged currents at the CI site showed a regular response to the tides. Flow to the south during the ebb tide appeared slightly stronger and more sustained than the northward floe observed during the flood tide. Depth averaged currents averaged 4.0cm/s/(0.13 ft/s)(ASA, 2003) Depth averaged currents at PIN site were predominantly to the southeast during the fall study period, though flows to the north did occur during flood tides. Depth averaged currents had a mean speed of 2.3 cm/s (0.49 ft/s) (ASA, 2003).

After the preliminary screening analysis indicated that the PIN site would be the preferred alternative, modeling passed on the specific site inputs was conducted for the PIN Site. This confirmatory modeling is described in Section 5.0.

Potential for Sediment Resuspension and Erosion -The effect of currents, from tides, storms, and vessel traffic, can affect the movement of sediments. UDM disposal in areas where bottom currents from various hydrodynamic forces are low is preferred over areas of potential high velocity (i.e., erosive) currents. The Harbor is protected from storm related surge by a hurricane barrier and tidal and wind induced currents at both preferred alternatives are not erosional. The CI CAD cell area occupies a high vessel traffic area and is located partially within the federal channel. The PIN CAD cell area is in a protected location subject to much less commercial/industrial vessel (deep draft) traffic.

Navigation/Anchorage – The proximity and depth relative to shipping lanes, designated channels and anchorages was assessed for each site. Sites located within existing channels or anchorage areas are less preferred than areas more heavily used for navigation. The proximity and depth relative to shipping lanes, designated channels and anchorages was assessed for each site. Sites not located within existing channels or anchorages are preferred over areas used for navigation. As noted above the CI site located partially in the federal channel and in the vicinity of the heaviest commercial and industrial vessel traffic of the Harbor. Harbor developments will increase vessel traffic over the CI CAD cell area. In contrast the PIN CAD cell area is in a protected location subject to much less commercial/industrial vessel (deep draft) traffic.

Site Accessibility - Accessibility is determined by the following factors: Route; The most practical route for tugs and barges for transit to and from the dredging area and disposal site. Distance; The distance based on the practical route was calculated from the head of navigation of the proposed dredging project. Logistics; Any potential logistical problems that might be encountered in use or construction of the proposed site. As described above, the CI site is in deeper water, which facilitates disposal access, but is subject to greater vessel traffic, which complicates the logistics of disposal. The PIN site demonstrates the opposite characteristics.

State and Federal Permits and Licenses- Applicable State and federal permits and licenses and their applicability to the CI and PIN sites is discussed in Table 4-3, below. Both sites are permittable for the proposed use.

Table 4-3. Summary of Exclusionary (E) and Discretionary (D) Screening Factors for Aquatic Disposal

SCREENING FACTORS	EVALUATION CRITERIA	GOAL
Exclusionary Factors		
Rare and Endangered Species / Critical Habitat **E** - 16 USC 470 et seq. 16 USC 1531 et seq. MGL Chap. 131A 321 CMR 10.60	Amount and quality of habitat, species, time of year occupied	Protect habitat integrity, avoid disturbance during period of use/occupation
Federal Marine Sanctuaries **E -** 33 USC 1401	Type, distance, time of year restrictions	Meet Federal requirements
ACECs (Areas of Critical Environmental Concern) **E -** 301 CMR 12.00	Type, distance, time of year restrictions	Meet State requirements
Discretionary Factors		
Physical Characteristics		
Character of Bedrock Profile **D**	Surface conditions, presence of precipice formations	Find CAD cell capacity , rule out CAD cell construction impediments
Depth of Sediment to Bedrock **D**	Sediment depth	Sediment depths for engineering
Sediment Stratigraphy **D**	Stratigraphy	Soil properties for engineering
Containment Characteristics **D**	Currents, grain size, value of adjacent areas	Maximize long-term containment confidence
Surficial Sediment; Physical & Chemical Analysis **D**	Full suite laboratory analyses	Identify UDM layer/SDM layer
Ambient Sediment Conditions **D**	Grain size, existing quality	Minimize adverse change to existing bottom
CAD Cell Engineering **D**	Geotechnical, geophysical parameters	Meet moderate to high capacities
Physical Area of Impact **D**	Size of area affected	Minimize area adversely affected
Historic/Archeological Sites or Districts 16 USC 469 MGL Chap. 40C 312 CMR 2.0 – 2.15 **D** - Non-designated sites	Type of site, presence, significance of features	Protect site integrity
Water Depth **D**	Depth relative to environmental and navigational use	Protect navigation; maximize containment
A-14. Surface Water Analysis **D**	Background water quality, turbidity	Background, turbidity values for resuspended sediment dispersion modeling

Table 4-3: Summary of Exclusionary (E) and Discretionary (D) Screening Factors for Aquatic Disposal (continued).

SCREENING FACTORS	EVALUATION FACTORS	GOAL
A-15. Hydrodynamics; Current Patterns, Water Circulation **D**	Current speed, transport direction	Avoid, minimize, mitigate adverse impacts
A-17. Potential for Sediment Resuspension and Erosion **D**	Wave heights, direction, fetch	Maximize long-term containment confidence
A-18. Navigation/Anchorage **D**	Amount, type, draft	Avoid, minimize, mitigate adverse impacts
A-19. Site Accessibility ***Route*** ***Distance*** ***Logistics*** **D**	Navigation limitations Length, time to transport Re-handling, storage	Minimize disruptions Maximize efficiency Reduce risks of Re-handling
Jurisdictional Considerations		
State Jurisdictions		
A-20. **D** ***MEPA FEIR Certificate*** *Site Designation*, CZM *Chapter 91 License*, DEM; Dredging and/or filling within flowed tidelands *401 Water Quality Certificate*, DEP; Fill or excavation in State Territorial tidelands**,** ***Wetlands Protection Act ,*** DEP; Land Under the Ocean, Land Containing Shellfish Anadramous/Catadromous Fish Runs	Amount, type, benefits, impacts, recovery potential	Avoid, minimize, mitigate adverse impacts
Federal Jurisdiction		
A-21. **D** ***Coastal Zone Management Act*** ; Federal financial and technical support CZM; Ensure Federal Consistency with Federally approved coastal State management programs, actions including natural resource or water use ***Clean Water Act Section 404*** , Federal Jurisdiction - EPA; Oversight, USACOE; Implementation ***Rivers and Harbors Act Section 10***; USACOE regulates, work in or effecting navigable waters	Amount, type, benefits, impacts, recovery potential	Avoid, minimize, mitigate adverse impacts

Table 4-3: Summary of Exclusionary (E) and Discretionary (D) Screening Factors for Aquatic Disposal (continued).

Biological Use Factors		
A-16.. Duration of Potential, Adverse Long-term Impacts **D**	Time, severity, recovery period	Avoid, minimize, mitigate
A-22. Present Habitat Types **D** ***-Benthic Habitat*** ***- Shellfish beds*** ***- Nursery and Spawning Potential*** ***- Finfish***	 Species abundance, density, diversity, and evenness, recolonization potential Habitat type, quality, heterogeneity, recovery potential, time of year issues Amount, type, benefits, impacts, recovery potential, distance, time of year issues abundance, benefits, impacts, recovery potential, time of year issues	 Avoid, minimize, mitigate adverse impacts
Economic Factors		
A-23. Commercial and Recreational Fisheries **D**	Amount, type, quality	Avoid or minimize loss and long-term impacts
A-24. Water-dependent Recreation **D**	Amount, type, quality	Maximize retention of opportunities
Regulatory/Practicability/Human Factors		
A-25. Ability to Obtain Permit **D**	Consistency with federal and state regulations	Meet all federal and state guidelines for permits
A-26. Water Quality Thresholds **D**	EPA designed toxicity testing of ambient water on marine organisms	Provide site-specific water quality thresholds
A-27. Mitigation Potential **D**	Amount, type of avoidance, minimization, mitigation required/possible through site use.	Avoid, minimize, adverse impacts for finfish Maximize potential for mitigation of existing shellfish
A-28. Consistency with Port Plan **D**	Values and site-specific uses in port plan	Maximize consistency with near-term to long-term port plans
A-29. Harbor Use	Recent harbor use developments	Allow safest, Most environmentally sound, cost-effective Cad
A-30. Cost **D**	Near-term to long-term costs of construction and maintenance, including monitoring	Minimize long-term costs

Duration of Potential Adverse Impacts – The CI and PIN sites are generally chemically, physically, and biologically similar; impacts and recovery can be expected to be similar for both sites. Both the CI and PIN sites will directly impact shellfish, and while required mitigation will replicate the resource lost at either site, the CI site will effect a potential DMF shellfish relay area. The CI site may also experience greater stress on benthic recovery from more frequent

vessel impact to the CAD surface than the PIN site. As discussed in the DEIR and below the PIN site appears to provide more significant winter flounder spawning habitat. Existing spawning habitat will be removed through CAD construction but future accumulation of sediment over the cap is expected to eventually replicate existing habitat assuming an annualized sedimentation rate of 1 cm./yr. derived from a meeting with USACE (USACE, personal communication, 2002).

Habitat

Area of Impact- The CI site covers approximately 90 acres overall; the PIN site approximately 80 acres overall. Within these general CAD site areas, the footprint of the specific conceptual Cad cells in CI is approximately 20 acres and in PIN is approximately 35 acres.

Benthic Habitat- The preferred alternatives have comparable benthic communities comprised of opportunistic species. There is a source of organisms in the Harbor water that will promote recovery of both preferred alternatives benthic communities. The study of the macrofaunal diversity in the harbor-bottom surficial sediment for this FEIR demonstrates that the macrobenthic species community structure has not changed over the course of ten years (ENSR, 2003). The predominant surficial sediment of CI and PIN was silt and clay with high total organic carbon concentrations. The dominant organisms found in the study for the two Preferred Alternative CAD cell areas of this FEIR are classified as pioneering or opportunistic species. The investigation at the Boston Harbor Navigational Improvement Project (BHNIP) CAD cell site showed that within a year of filling and capping the opportunistic benthic infauna had re-colonized the sediment surfaces (ENSR, 2003). It is highly likely that construction, filling, and capping events at Harbor proposed CI and PIN CAD cell sites will only temporarily impact the benthic communities. From this evidence presented in the FEIR, it is expected that CAD cells in the CI and PIN areas, similar to BHNIP cell surfaces, will be recolonized equally rapidly by similar opportunistic species. Eventually, the benthic community will return to a pre-dredging composition. Adults and larvae from adjacent areas, which were not dredged, will provide recruits to the disturbed sites. involves temporary interruption of existing site-specific harbor bottom benthic communities will be recolonized equally rapidly by similar opportunistic species.

Shellfish Beds - Sites within or near areas of shellfish concentration, as indicated by DMF and other available sources, are least preferred. Shellfish resources in the CI CAD cell area are likely to include a valuable number of cherrystone quahogs along the western edge off the New Bedford fishing fleet docks (DMF, 1999). The DMF Standing Quahog Study identified shellfish nearest to the western edge of CI as having .58 ppm PCBs., well under the 2.00 ppm. tolerance set by the U. S. Food and Drug Administration and Department of Health (DMF, 1999). Shellfish within CI would likely have commercial and ecological value. Chowder sized quahogs and soft-shell clams were identified as abundant in the PIN CAD cell area by the DMF study (DMF 1999). Shellfish of this area were found to have PCBs levels of 3.60 ppm., well above the standard level mentioned above. Shellfish of the PIN CAD cell have ecological value.

Nursery and Spawning Potential - CI showed evidence of nursery habitat for several commercially important species of finfish (i.e., cunner, scup, and black sea bass). PIN site area contained substantial winter flounder spawning and nursery habitat.

Finfish- The CI CAD cell area, like other areas of the Harbor, showed a predominance of non-demersal species (i.e., cunner, scup, black sea bass, and Atlantic herring). The PIN CAD cell area supported a different fish community than the CI and other Harbor areas. At the PIN site a lower abundance of juvenile fishes were observed in trawls at the NT 5 station. However, winter flounder frequently collected in the NT5 trawl station of the PIN CAD cell area included variety of life-stages, including young-of-the-year (YOY) winter flounder. The seasonal abundance of fishes and fish assemblages should be considered in the management of either preferred alternative. Seasonal windows should be implemented to limit impacts on spawning and juvenile recruitment.

Commercial and Recreational Fisheries - Areas that are not fished, commercially or recreationally, are preferred over those that are actively fished. Both areas of the preferred alternatives are closed to commercial and recreational fishing due to contamination in the Harbor**.**

Water-Dependent Recreation - These activities include: fishing, boating, scuba diving, swimming. Sites are preferred in areas with little or no recreational activity. The CI CAD cell area straddles the federal channel in the Harbor and therefore is used by recreational vessel traffic leaving and entering the Harbor. The PIN CAD cell area is not within harbor channels, and has some recreational vessel traffic. Recreational boating is the only safe recreational activity in the Harbor.

Ability to Obtain Permit – Both the CAD and PIN sites are permittable.

Water Quality Thresholds - The dredging and disposal at both th eCI and PIN sites can be managed to meet tDEP water quality thresholds (See Section 5.0).

Mitigation Potential - Commercially and ecologically important shellfish occupying the CAD development areas of the CI area would likely be relayed to a depuration center. This would entail employment of a force of shellfish rakers or possibly a hydraulic shellfish harvester vessel (DMF, personal communication 2003). There is a predicted loss of sedentary shellfish populations of PIN Cad cell area. Shellfish of the PIN CAD cell are contaminated by PCBs above allowable levels for human consumption (MA DMF 1999). Shellfish of the PIN CAD cell area are of ecological value and those lost in the PIN CAD cell development will require replacement conditional to project permitting through fisheries resource agencies.

The seasonal abundance of fishes and fish assemblages should be considered in the management of either preferred alternative. Seasonal windows should be implemented to avoid and minimize impacts on spawning and juvenile recruitment.

Consistency with Harbor Plan – Both proposed disposal sites are generally consistent with the New Bedford Harbor Plan in that they provide capacity for proposed dredging projects. The PIN site best meets the intent of the plan, as it provides greater capacity, maximum design flexibility, and does not significantly effect commercial/industrial vessel traffic.

Harbor Use - As detailed in the DEIR, existing commercial navigation in the harbor is largely divided into three primary categories: 1) traffic related to commercial fishing, 2) fish processing industry and, 3) other maritime vessels and recreational boats (Maguire, 2002).

Since the publication of the DEIR, the City of New Bedford, under the auspices of the New Bedford Harbor Development Commission (NBHDC) have completed maintenance dredging of the slip to the south of State Pier, the fairways leading thereto and a portion of the federal navigational and maintenance channel immediately northwest of the proposed CI CAD cell area (Apex, 2002). Ships approaching the State Pier would have to be routed around any dredging operational obstructions of the CI CAD cell. This navigational interruption to ships may be possible, though likely with increased costs. In August 2004 a high-speed ferry is set to begin service between the State Pier and Martha's Vineyard (Providence Journal, 2003). The new high speed ferry operators expect to run as many as ten trips per day, which could equates to as many as 20 course deviations per day, some in darkness, around dredging operations at the CI cell area. Deep draft commercial fishing vessels and frozen fish freighters associated with the Atlantic herring industry frequent a shore fish processing location north of the CI CAD cell area in New Bedford. Increased deep-draft fishing vessel traffic associated with this fish processing plant would face the obstruction posed by dredging operations in the CI CAD cell area.

Due to the location within the navigation channel, development of the CI site will require redirection of vessel traffic around the 24-hour per day dredging operations including tugs and barges. Many vessels may be able to circumvent CAD cell operational obstructions, however for larger vessels with less maneuverability these obstructions pose a greater safety hazard. This risk can be avoided and minimized through by placement of lighted marker buoys around the work area and notifications to mariners through Coast Guard advisories. Issuance of navigational advisories will help place infrequent maritime harbor visitors on notice of disposal activities. Additionally, because disposal will only take place for one season during each planning horizon, opportunity for adequate public notice to frequent harbor users will be provided.

The nature of the construction of CAD disposal cells will not result in any reduction of navigable depth in the Harbor. The four-foot thick sand caps proposed for all of the disposal cells of the CAD preferred alternative sites will maintain existing bottom depths and not protrude into the water column any higher than existing conditions. After the completion of disposal activities for each planning horizon, navigational and shipping conditions in the vicinity of the disposal cells will return to pre-existing conditions.

Cost - The cost to develop a series of CAD cells in a specific area in the context of an EIR is best estimated within a range of costs. More accurate estimates will be developed with specific future Harbor projects.

In the DEIR, the cost to develop a CAD cell and subsequent disposal of UDM was estimated to be approximately $40/cy. In the preliminary CAD cell engineering of the FEIR, the efficiency to excavate and handle parent material became more obvious as an important variable in the cost structure of CAD cell development. For the moderate ±50,000 cy CI CAD cell development the level of effort is calculated to be 3.51 cy parent material/ cy sequestered UDM. For the PIN CAD

site, and moderate ±50,000 cy CI CAD cell development the level of effort to is calculated to be 1.6 cy parent material/cy sequestered UDM.

Recent conversations with dredgers have provided inputs helpful to estimate the relative costs of developing the preferred alternatives (GLDD, personal communication, 2003) (Burnham Associates, personal communication, 2003). Increased handling of dredged parent material will step up cost of CI CAD cell area projects to the high end of the estimated cost range shown below in Table 4-4. Development of moderate size CAD cells in the eastern PIN area will likely assume a multiple-step sequential approach where in-channel type CAD cell(s) can be constructed with completed depths to accommodate vessel traffic from the existing navigable channel to the Marsh Island side. Use of the high capacity cell in PIN will likely reflect an economy of scale lower cost (Table 4.4). Moderate volume project time estimates reflect the use of shoal draft moderate capacity scows and tidal cycles and likely cost more per cubic yard than development of the high capacity cell.

Table 4- 4. Estimated cost per cubic yard to dispose of UDM with preferred alternatives

Range	**$35 - $55**
CI	**$55**
PIN	**$40 - $45**

4.1.3 Summary of Screening Results

After an assessment of the two sites under the screening criteria described above, the PIN demonstrates the following advantages over the CI site:

- *Greatest Capacity*
- *Maximum management flexibility*
- *Less impacts to harbor operations, commercial/industrial vessel traffic*
- *Less potential for cap disruption*
- *Better recolonization potential for absence of repeated impact from vessel traffic*
- *Lower cost per cy*
- *Less impact to habitat and resources per unit disposed*

The PIN site appears to contain better winter flounder habitat.

The PIN site is selected as the preferred alternative.

4.1.4 Attributes of the Preferred Alternative

Attributes of the selected preferred alternative PIN CAD cell site area are summarized below.

- ***Greatest capacity–***PIN CAD cell configuration provides a series of five moderate volume cells of approximately 50,000cy each, as well as a comprehensive large volume dredge project, of approximately 1,800,000cy In PIN. Even though the capacity is higher than CI, physical area of impact in the PIN CAD cell footprint is lower compared to the CI

CAD site. To create the PIN CAD moderate volume cells the parent material that must be excavated and handled is less than half the requirement for CI CAD cells of comparable capacity.

The proposed PIN CAD cell depth profiles fit well with revealed subsurface conditions. The relatively shallow sediment depths along the area's eastern extent, near Marsh Island, favor the moderate project CAD cell approach. The deeper sediment depths along the western bedrock valley, adjacent to Popes Island, favor a high capacity project CAD cell approach.

Recognizable precipice formations have been identified as not impediments to cell capacity. In the configured Popes Island North CAD cells, the average modeled bedrock depth was 58 feet compared to 26 feet at CI. PIN average modeled bedrock depth was a full 26 feet lower than the CI area. In the western "bedrock valley" portion of the PIN CAD cell site, the lowest depth to bedrock is minus 95 feet. Contrary to the shallow average depth to bedrock at the CI area cells, it is apparent that the comparatively deep sediment to bedrock at the PIN cell area is satisfactory for the full capacity of UDM in the Harbor. Physical characteristics of the full depth of sub-marine soils to bedrock at PIN CAD area supports stable and constructible CAD cell side slopes of 1Vertical: 3Horrizontal (1V: 3H). The 1V: 3H slope design is considered feasible and appropriate for the PIN Selected Preferred Alternative CAD site area.

According to the sampling plan accepted by the USACE, for the selected preferred alternative PIN CAD site, a four-foot sediment layer was identified as UDM. Identification of this site-specific four-foot UDM layer is critical to identify the horizons of UDM as a prerequisite for preliminary CAD cell design engineering.

- ***Maximum management flexibility*** – The PIN CAD cell area allows safe containment of moderate to high capacity UDM volumes generated in future Harbor dredging projects of up to the twenty-year planning horizon. Depth to bedrock allows significant design flexibility for CAD Managers.

- ***Less impacts to harbor operations, commercial/industrial vessel traffic*** – Since the PIN CAD cell area is situated in the northern end of the Harbor and out of navigation channels, development activities will have less impacts to present and future Harbor operations, especially commercial/industrial vessel activity.

- ***Less potential for cap disruption*** –The PIN CAD cell area has less potential for CAD cap disruption than the CI CAD cell area that straddles the federal channel of the Harbor. The CI area is in an area of the Harbor heavily traveled by deep draft commercial/industrial vessel traffic. Propeller wash from deep draft vessels may disrupt capping material in the CI area. The federal channel will be periodically dredged in coming years. Therefore, its capping material, designed to safeguard against UDM recontamination of the environment, is more vulnerable to disruption from over-dredging. The shallower PIN area outside Harbor channel areas is not subject to deep draft commercial/industrial traffic. Capping material in the PIN area is much less likely to be

disturbed than that of the CI area. PIN is not in an area requiring regular maintenance dredging; therefore, its capping material will not be disturbed by dredging in the future.

- ***Better recolonization potential for absence of repeated impact from vessel traffic*** – The dominant organisms for the selected preferred alternative CAD cell are classified as pioneering or opportunistic species. From this evidence, it is expected that adults and larvae from adjacent undisturbed areas will recolonize CAD cells in the PIN area rapidly through recruitment from surrounding areas. Eventually, the benthic community will return to a pre-dredging composition. As discussed above the PIN Harbor bottom area will not be impacted by regular deep draft commercial/industrial vessel traffic. Therefore, benthic communities inhabiting the PIN cell capping material will not be impacted repeatedly from over-passing vessel propeller wash energy.

- ***Lower cost per cy*** - The CAD cell development options available for the PIN CAD cell area are estimated to cost less than those of CI. In CI the highest cost per cubic yard is due to the extra parent materials handling required to complete the wide and shallow cells. In PIN CAD cell are the moderate capacity approach is estimate to be slightly higher than the high capacity approach though either option is estimated to be below the cost per cy at CI.

- ***Less impact to habitat per unit disposed*** – Conceptual CAD cell designs for CI and PIN are presented in this FEIR. Table 4-5 below shows approximate values for impacted habitat per unit disposed in preferred alternatives. The PIN impacts less habitat per unit disposed by approximately half.

Table 4-5. Approximate values for impacted habitat per unit disposed in preferred alternatives

	Acres of Habitat	CYs UDM disposal	Acres/cy disposal
CI	20	150,000	.0001333
PIN	35	2,050,000	.0000017
Difference			.0001263

SECTION 5.0 – DETAILED CAD CELL DREDGING DISPOSAL EVENT MODELING AND HYDRODYNAMIC ANALYSES

5.0 DETAILED CAD CELL DREDGING DISPOSAL EVENT MODELING AND HYDRODYNAMIC ANALYSES

The conceptual approach taken for the preliminary dredged material transport modeling in the Harbor was sufficient for the initial general purposes of the DEIR in the MEPA process. For the two preferred alternative confined aquatic disposal (CAD) cells in the DEIR, CI and PIN baseline hydrodynamics information was collected from historical databases for conceptual hydrodynamic analyses. This historical data was considered inadequate for the modeling requested by the MEPA Certificate in response to the DEIR. The MEPA Certificate concurred with the DEIR on the need for a detailed CAD cell dredging disposal event modeling and hydrodynamic analyses for this FEIR. The MEPA Certificate states that if the site-specific information indicates the preferred alternative, in whole or part, is not suitable, the FEIR will provide the same level of information on any alternative site or methodology that might be chosen. Since the CI CAD site area was found less satisfactory than the PIN CAD site area, the PIN CAD area was selected for detailed study (Section 4.0 of this FEIR). Therefore, site-specific detailed CAD cell dredging disposal event modeling and hydrodynamic analyses was applied to the PIN site.

A series of computer simulations was performed to estimate the water quality from dredging and disposal operations at the PIN site. Computer models BFHYDRO (Boundary Fitted Hydro-dynamic model), SSFATE (Suspended Sediment FATE model), STFATE (Short-Term FATE dredged material disposal model) and BFMASS (Boundary Fitted Mass Transport model), were employed for hydrodynamic, dredging and disposal modeling, respectively.

This PIN area study consisted of two parts: 1, a field program to monitor present conditions was presented in Section 3.0 (Appendix J) and 2, extension of previous modeling that characterized the transport and fate of the dredged sediment and associated pollutants during disposal operations (Appendix K).

As presented in Section 3.0, physical field data that included surface elevations and velocities at multiple sites were examined to quantify wind and tide forces that drive the circulation in the Harbor. Hydrodynamic simulations were conducted to verify the model performance during the period of the field measurement program. Then a set of simulations was performed, based on the combination of three tidal ranges (neap, mean and spring) and three wind conditions (calm, southwesterly [SWS] and northwesterly [NWW]). These nine hydrodynamic conditions were used to provide three-dimensional velocity predictions to the pollutant and sediment transport model both before and after excavation of the CAD facility.

Presented in this Section 5.0, the SSFATE model was used to simulate TSS (Total Suspended Solids) concentrations due to construction excavation of the proposed CAD cells to be located north of Popes Island and disposal operations into the cells. Combinations of the wind-induced circulation and bathymetry were found to play a key role. When the sediment plumes were carried into the deeper sections of the Harbor, the duration and size of sediment cloud were more extensive than the case in which the sediment plumes were carried into shallower sections, where the sediment settled to the bottom more quickly.

A series of pollutant fate and transport simulations were performed to estimate the water quality impacts using BFMASS. Simulations were run using measured pollutant levels found at six representative sites for constituents whose elutriate concentrations exceeded the U.S. EPA water quality criteria. These included metals (aluminum, copper, nickel and silver), and polychlorinated biphenyls (PCBs). The dredged material disposal operation was assumed to last for 6 days with disposal taking place twice a day following the tidal cycle period of 12.42 hrs. Each release volume of dredged material was assumed to be 1,530 m^3 (2,000 yd^3), a possible barge capacity suited for moderate volume projects.

None of pollutant elutriate concentrations exceeded the U. S. EPA water quality acute criteria except copper (4.8 ug/L) at two stations. Al, Cu, Ni, Ag, and PCB exceeded chronic levels at all stations. The dilution of elutriate concentration for PCB to meet the chronic criteria ranged between 11 and 767, Cu had the next highest required dilutions (1 to 32) followed by Al (2 to 27), Ag (14) and Ni (2). One proposed site, Station NBH-202 had the highest concentrations for all constituents. Station NBH-207 was second highest.

The BFMASS simulation results indicated that the contaminant distribution patterns in the horizontal and vertical were similar for the three tide ranges; neap mean and spring. Neap tides are the highest low and the lowest highs equating to the smallest tidal range. Mean tides are normal tides. Spring tides are extreme lows and extreme highs equating to the largest tidal range. Concentration levels, however, were higher in the near field for neap tides than for spring tides because more energetic currents during the spring tides promote more dispersion and mixing. Different wind conditions resulted in different spatial distribution patterns and coverages. Among the nine environmental scenarios, the largest spatial coverage (area) was predicted for neap tides and calm wind conditions. The smallest coverage occurred for neap tides and northwesterly winds. This finding was consistent among three different release locations in the high capacity PIN CAD cell.

According to toxicity tests using sediments from the NBH-202 station, the combination of multiple pollutants was the cause of the observed acute toxicity effects. For example, half the toxicity to mysids was due to PCBs and the other half was due to a combination of copper and ammonia. From analysis of these results it was concluded that a dilution to less than 2.2% of the elutriate concentration would be protective. The model results showed that for any environmental condition, area coverage for a concentration of 2.2% of the elutriate level was always smaller than the PIN-CAD area (1.67×10^5 m^2 [41 ac]). The largest area coverage (1.2×10^5 m^2 [30 ac]) of the 2.2% elutriate concentration occurred for a release during calm conditions while the smallest coverage (1.0×10^4 m^2 [2.5 ac]) occurred for a release during northwesterly winds. Other sediments with lower elutriate concentrations, and presumably lower toxicity, will affect smaller areas.

5.1 Background

The field program was conducted for the analysis of both CI and PIN CAD site areas from 23 October through 22 November 2002. (See Appendix J). The field program and data were supportive of both Preferred Alternative CAD sites. Detailed hydrodynamic modeling of

resusspended sediment was directed to the PIN CAD cell site as the Selected Alternative in the FEIR (See Appendix K).

Data considered here derive from a field survey conducted for this FEIR in the Harbor from 23 October through 22 November 2002. Current speed and direction, surface elevation and optical backscatter were measured continuously throughout the study period at two locations in New Bedford Harbor: the CI and PIN stations (Figure 5-1, Table 5-1). This was accomplished through the deployment of Acoustic Doppler Current Profilers (ADCPs) and Acoustic Doppler Current Meters (ADCMs) at each of these two locations. Surface elevation and optical backscatter were also monitored at the Tide Gauge (TG) station, located outside the Harbor, using a tide gauge and an Optical Backscatter Sensor (OBS). In addition to the long-term instrument deployments, a series of water samples was taken at each of the three stations mentioned above to measure suspended sediment concentrations. Sediment samples were obtained from seventeen locations within the study area and analyzed to provide sediment grain size composition (Section 3-5). Finally, elutriate analyses were performed on sediment samples from three locations at the proposed CI CAD site, two locations at the proposed PIN CAD site, and one location northwest of Fish Island in the Inner Harbor to determine levels for a number of pollutants (Section 3-8).

5.1.1 Total Suspended Sediments

Optical backscatter are data collected by electronic reflections of particles suspended in the water column moving in current strata. Optical backscatter was measured at 15-minute intervals continuously at each of the three long-term deployment stations using D+A Optical Backscatter Sensors (OBSs). Measurements of optical backscatter were generally low, averaging 2.7 (Nephelometric Turbidity Units (NTU) at PIN, 9.1 NTU at CI and 4.3 NTU at the TG station. In order to relate optical backscatter to sediment levels in the water column, measurements of total suspended sediment (TSS) concentrations were made at the three station locations on five occasions during the study period (Table 5-1). Multiple samples were taken at a height of approximately 1 m (3.3 ft) above the seafloor on each occasion.

Table 5-1. Total suspended sediment-sampling schedule. Times are given as Local Standard Time (LST).

	Date				
Site	**23 Oct**	**1 Nov**	**7 Nov**	**14 Nov**	**22 Nov**
Popes Island	9:50	8:58	13:50	8:50	11:30
Channel Inner	11:50	9:15	13:00	9:10	9:38
Tide Gauge	11:00	9:30	15:00	9:30	8:50

5.1.2 Chemistry

Elutriate tests are typically performed to estimate the release of soluble contaminants during dredging operations for setting operations parameters in permits. In elutriate tests, a combination

of 20% sediment and 80% site water is mixed and allowed to settle. The liquid component is then analyzed for contaminant concentrations. This protocol was designed to accurately mimic the initial concentration levels when sediments are released in the water column (Averett, 1989). Elutriate analyses were performed on samples from six stations within New Bedford Harbor to determine background pollutant levels for resusspended sediments (Table 5-2) and reported in Section 3-8 Water Column Chemistry. Aluminum, copper, nickel, silver and Total PCBs registered above the chronic exposure levels established by the United States Environmental Protection Agency (EPA) at all sites for which analyses were performed. Lead exceeded chronic exposure levels at the NBH-202 station, Benzo(b)fluoranthene exceeded chronic exposure levels at the NBH-202 and NBH-207 stations, and Benzo(k)fluoranthene exceeded chronic exposure levels at NBH-202, NBH-205, NBH-206 and NBH-207. In addition, acute exposure levels were exceeded for aluminum at NBH-202 and NBH-207, and for copper at NBH-201, NBH-202, NBH-205, NBH-206 and NBH-207. Stations NBH-202 and NBH-207, the Fish Island site, showed generally higher concentrations than the other sites.

Table 5-2. Results of elutriate analyses from the NBH Water Quality Study. Values given in bold red italics exceed chronic exposure levels as established by the EPA (chronic and acute values are listed to the right).

		Station (NBH-)						EPA Criteria	
Class	**Analyte**	**201**	**202**	**204**	**205**	**206**	**207**	**Chronic**	**Acute**
MET	Aluminum	***161***	B ***2320***	***577***	***346***	***216***	***853***	87	750
MET	Antimony	3.50	U 3.50	U 3.50	U 3.50	U 3.50	U 5.80 B		
MET	Arsenic	5.20	B 18	3.80	B 24	13	5.10 B	36	69
MET	Cadmium	0.30	U 0.45	B 0.30	U 0.30	U 0.30	U 0.30 U	9.3	43
MET	Chromium	4.60	U 35	4.60	U 4.60	U 4.60	U 10	50	1100
MET	Copper	***7.10***	B ***98***	***4.00***	B ***11***	B ***7.10***	B ***39***	3.1	4.8
MET	Iron	214	2630	587	218	212	995		
MET	Lead	1.10	U ***13***	1.10	U 1.10	U 1.10	U 1.10 U	8.1	220
MET	Manganese	2.50	U 2.50	U 27	2.50	U 2.50	U 2.50 U		
MET	Mercury								
MET	Nickel	***14***	U ***14***	U ***14***	U ***14***	U ***14***	U ***14*** U	8.2	74
MET	Silver	***1.40***	U ***1.40***	U ***1.40***	U ***1.40***	U ***1.40***	U ***1.40*** U	0.1	1.9
MET	Zinc	6.90	U 40	6.90	U 6.90	U 6.90	U 16 B	81	90
PAH	Benzo(b)fluoranthene	0.02	J ***0.14***	0.02	J 0.03	0.04	***0.11***	0.04	0.38
PAH	Benzo(k)fluoranthene	0.02	J ***0.14***	0.01	J ***0.03***	***0.03***	***0.07***	0.02	0.17
PCB	Total PCBs	***1.72***	***23***	***0.34***	***0.88***	***1.22***	***5.69***	0.03	10

Units: µg/L.

Data Qualifiers: "B" (metals) ≤ Contract Detection Limit but > Instrument Detection Limit; "J" = estimated (result is between 1/2 reporting limit (RL) and RL); "U"=not detected above reporting limit.

Total PCBs - Sum PCB congeners (8, 18, 28, 44, 52, 66, 101, 105, 118, 128, 138, 153, 170, 180, 187, 195, 206, 209) x 2; list of congeners analyzed by NOAA Status and Trends Program (listed in NOAA, 1993; revised NOAA, 1998).

5.2 Dredged Material Modeling Using SSFATE

5.2.1 Sediment Characteristics Near the CAD Cell Site

One of the major factors that controls TSS concentration is how fast the sediment settles from the water column back to the bottom. In general, coarser materials have higher settling velocities while the finer materials stay in the water column much longer. By examining size fractions of sediment for the site, basic settling characteristics can be determined. The SSFATE model treats sediments as having five distinct size classes (Johnson, et. al., 2000).

Table 5-3. SSFATE sediment size classes.

Class	Size (micron)	Description
1	0 – 7 micron	clay
2	8-35	fine silt
3	36-74	medium fine silt
4	75-130	fine sand
5	>130	coarse sand

5.2.2 Predicted TSS Concentrations

SSFATE simulations that represent CAD cell excavations using clamshell bucket dredging were performed for the nine typical hydrodynamic conditions described above. The center coordinate of the largest CAD cell, Cell 1was designated as a representative dredging operation location, which was fixed for the duration of the simulation. TSS concentration distributions due to the clamshell dredging reached a quasi-steady state within two tidal cycles (~1 day). All simulations were run for 3 days.

Presentation of simulation results are shown by:

- Horizontal and vertical views of TSS concentration distribution
- Acreage of the area exceeding various concentration levels
- Sediment mass balance

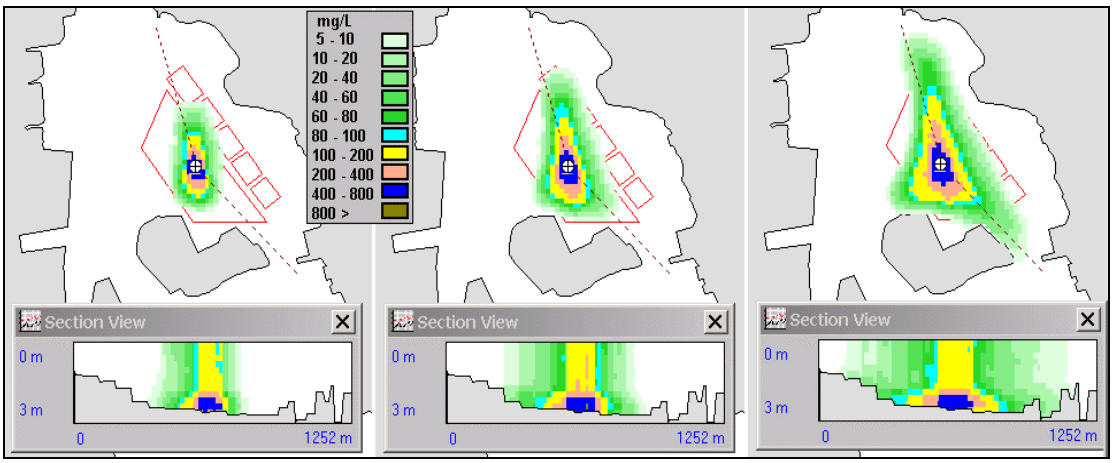
Figure 5-1 shows contours of the maximum TSS concentrations throughout the water column over the 3-day simulation period. A vertical section of the concentration distribution was inserted at the base of each plan view. Frames in the figure are organized such that rows display simulations for the three wind conditions and columns for the three different tides. See Appendix N for quantitative comparisons.

For the neap tides only condition (1st row), all TSS distributions appeared to be centered in the dredge site. Overall sediment plume sizes correspond to the tide strength. For the NWW wind cases, all sediment plumes trail to the lee side of the wind direction, whereas the opposite is

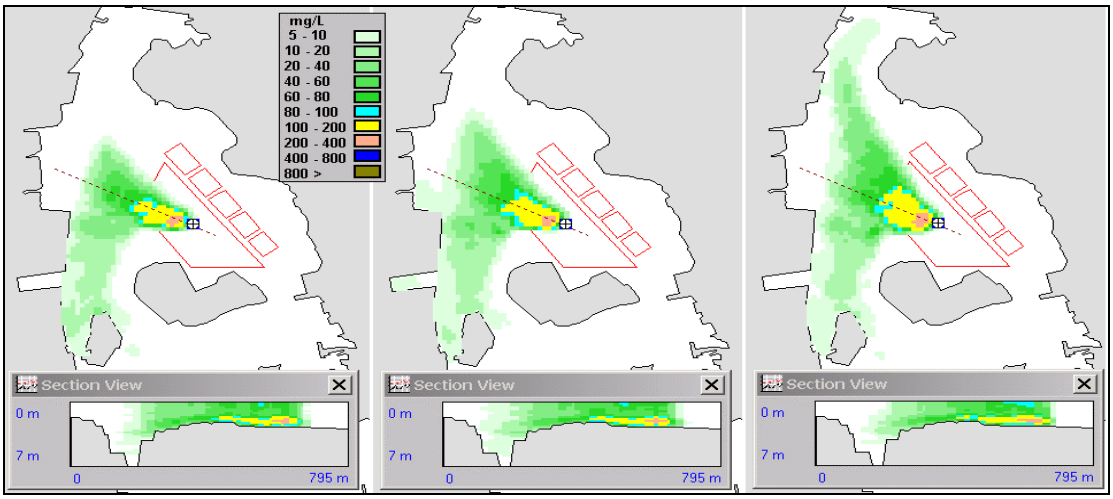
found for the SWS wind cases. Similar results are obtained for mean and spring tidal conditions, except the size of plume increases with increasing tide range.

It is important to note that the instantaneous concentrations, which vary widely in time, are significantly smaller than the maximum TSS concentrations presented here. Neap tide also results in smaller areas and spring tide results in larger areas than the mean tide. The analysis presented here did not include the ambient or background TSS concentrations that were sampled during the field program and typically ranged from 3 to 10 mg/L.

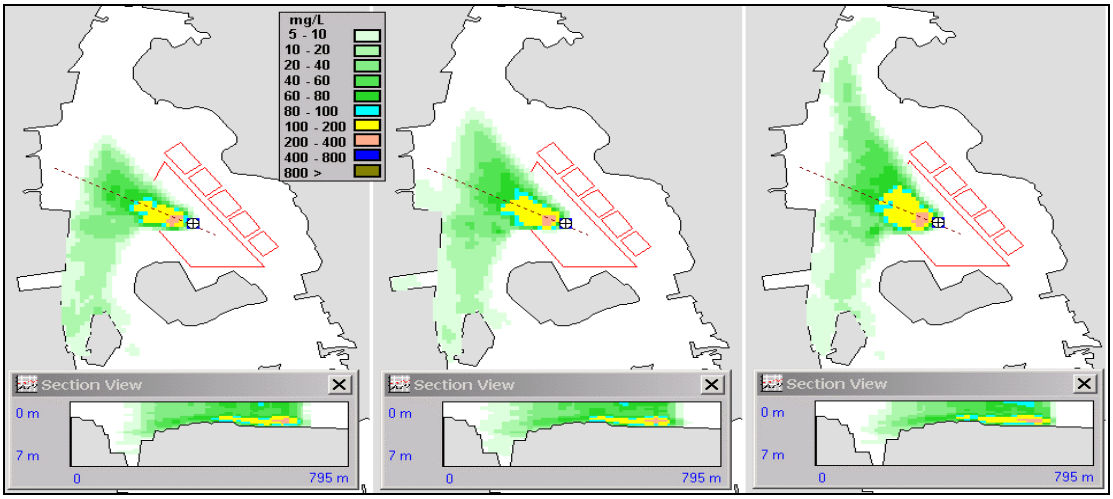
Figure 5-2 presents the mass of the fine fractions of sediment remaining in the water column after all settling has occurred. When the system reaches a quasi-steady state, the sediment mass introduced by dredging equals the mass that settles out, so the fraction of sediment that remains waterborne becomes constant. This water column sediment fraction is uniquely distributed by overall size and concentration among the hydrodynamic conditions. For example, the water column sediment fractions in the NWW case and SWS case are ~2% and ~3%, respectively. This number indicates that the SWS case produces a larger sediment plume and a higher sediment fraction remaining in the water column, compared to the NWW case. This is caused by advection carrying sediments to the deeper waters, in contrast to the NWW case, in which sediments are transported to shallow water where faster settling takes place. In the case of calm wind conditions, the higher tide conditions have the higher water column sediment fraction.



Neap/Calm wind **Mean/Calm wind** **Spring/Calm wind**



Neap/NWW wind **Mean/NWW wind** **Spring/NWW wind**



Neap/SWS wind **Mean/SWS wind** **Spring/SWS wind**

Figure 5.1. Maximum TSS concentrations for the nine circulation scenarios. Section inserted.

The reason is not obvious. However, there are two possible explanations: 1) the smaller tide range tends to form higher sediment concentrations, which in turn enhance the aggregative settling, 2) the lower tidal current (lower velocity) provides higher deposition probability.

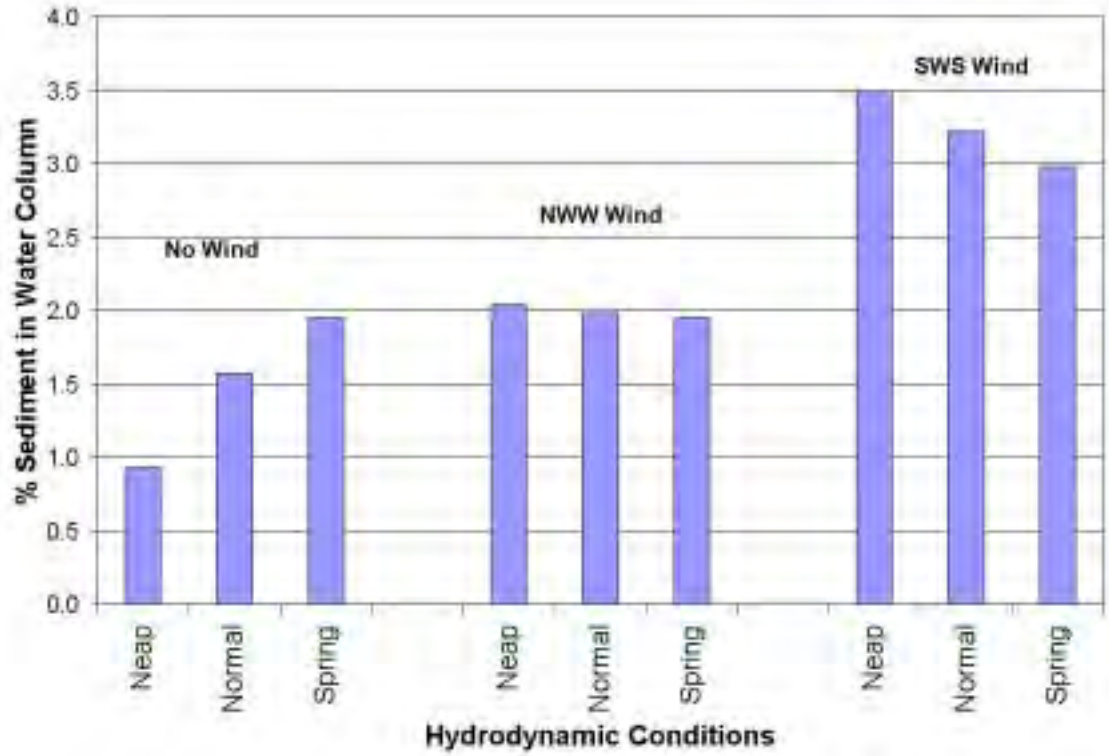


Figure 5-2. Sediment fractions in water column for various hydrodynamic conditions

5.2.3 Single Event Disposal into Popes Island CAD Cell

In the previous section, TSS increases due to sediments in the water column from repetitive clamshell bucket operation were simulated. In this section, TSS concentration increases due to sediment disposal from a scow into the CAD cell are presented. Sediments dredged from the top layer of PIN CAD cell(s) will be stowed in barges until the CAD cells are fully dredged when they will be released into the CAD cell(s). Other unsuitable sediments dredged for channel maintenance and improvement projects are planned to be placed in a scow after the clamshell bucket removes sediments from the seafloor. When these scows are considered loaded by operations managers, they will be shipped from the dredging site to a predetermined specific location above the specifically designated CAD cell. When in the proper location, operators open the scow bottom to release the entire payload. As the sediment descends to the CAD cell floor, approximately 15% of the sediment remains suspended unevenly in the water column (see Table 5.4). The occurrence of those scow-load disposal events is controlled by the clamshell dredging speed of 214 m^3/hr (280 yd^3/hr) and the scow capacity of 1,530 m^3 (2,000 yd^3). At this rate, a scow-load disposal event will occur every ~12 hours. The approach to simulate TSS concentrations caused by a single scow disposal follows the same procedure employed in the previous section.

5.2.4 Source Strength Estimation Due to Scow Disposal Events

Although excavated CAD cells have much deeper water depths (~17 m [56 ft]) than the original undisturbed depth (~2.6 m), the time for most of the sediment to reach the bottom is still very

short (< 120 sec). This short time span cannot be directly simulated by SSFATE. Instead, the USACE model STFATE (Short-Term Fate dredged material disposal model) was used with equivalent input and environmental conditions. STFATE has various operational modes. Convective descent and sediment cloud collapse phase were simulated. This output was used to estimate initial source strengths and vertical distribution of waterborne unsuitable sediment mass.

The estimated stripped portion of the sediment that remains near the surface in the water column during descent has been estimated to be 1% of total sediment in the bucket (ENSR, 2002). Clamshell-dredged, cohesive material has a high proportion of clump content that tends to reach the bottom intact. This stripped loss estimate is comparable to those used in similar CAD cell projects in Providence and Boston. The vertical distribution of waterborne sediment mass predicted from the STFATE model is given in Table 5.4. Most (85%) of the material immediately falls to the bottom.

Table 5.4. The vertical distribution of waterborne sediment mass.

Percent of water column	Percent of sediment mass
90 (near surface)	1
70	2
50	4
30	8
10 (near bottom)	85

5.2.5 Sediment Characteristics of Dredged Materials

Figure 5-3 shows locations of the sediment samples obtained from the CI CAD cell site exemplary of maintenance-dredged materials in the New Bedford Harbor Plan. Some of the dredging is expected to take place at this location. Averaged values of size distributions from these sampling stations were considered to be representative (Table 5.5). The distribution is very similar to PIN.

Table 5.5. Representative sediment size class distribution.

Class	Description	Distribution %
1	Clay	20.1
2	Fine silt	17.7
3	Medium fine silt	17.7
4	Fine sand	20.1
5	Coarse sand	24.5

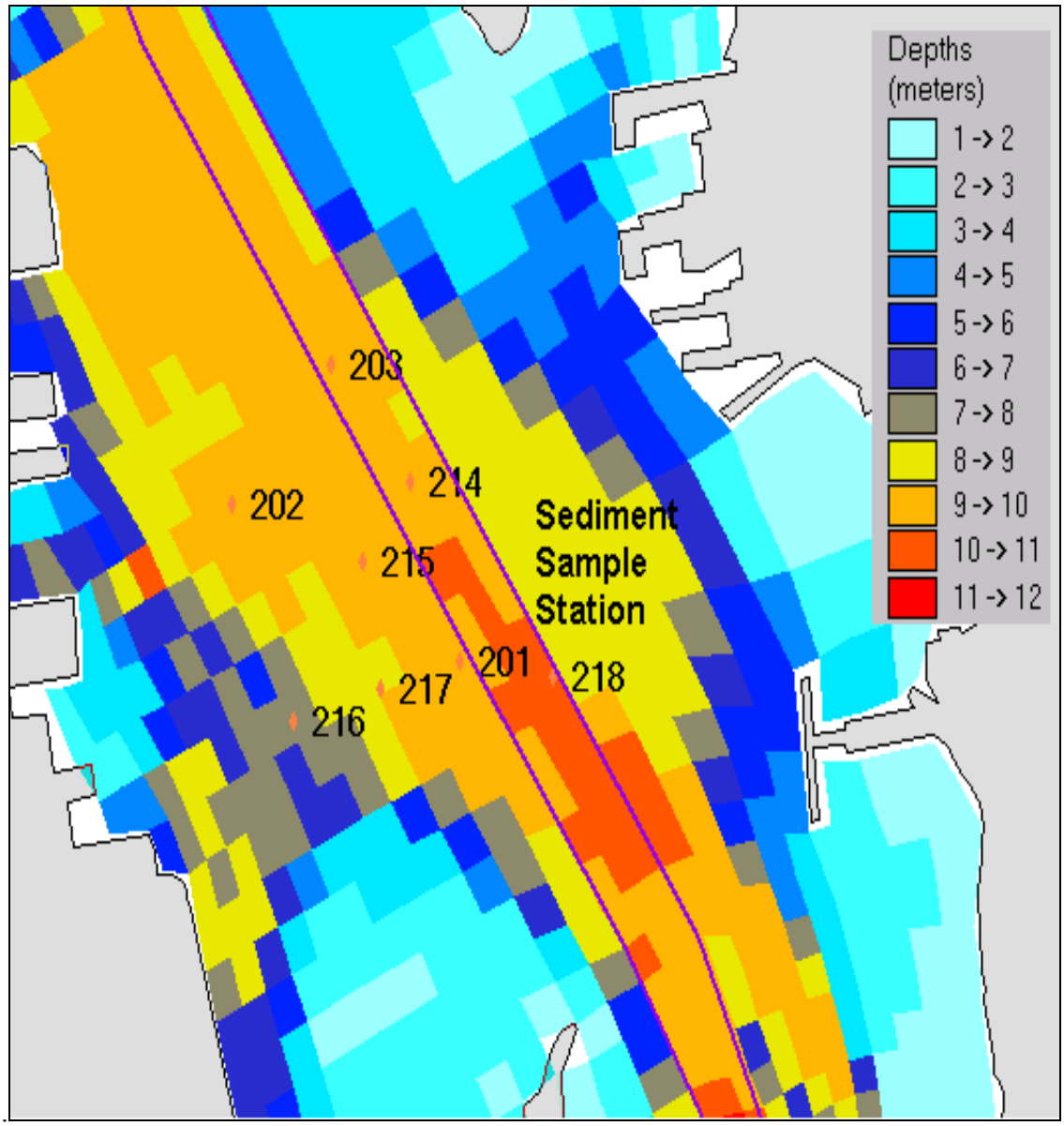


Figure 5-3. Map showing sediment sampling stations near Channel Inner dredge site.

5.2.6 Model Results for Dredged Material Disposal Operation

SSFATE simulations that represented the fate of the dredged material from disposal operations were performed for the nine hydrodynamic conditions. The bathymetry in which the circulation field was created is substantially deeper (~17 m [50 ft]) at the disposal site than the one used (~2.6 m [8.5 ft]) in the previous PIN-CAD cell excavation simulation. The center coordinate of the largest CAD cell was used as the representative disposal site. Unlike the more methodical pace of dredging operations, split-hull scow sediment release is fast. The simulation period was 12 hours.

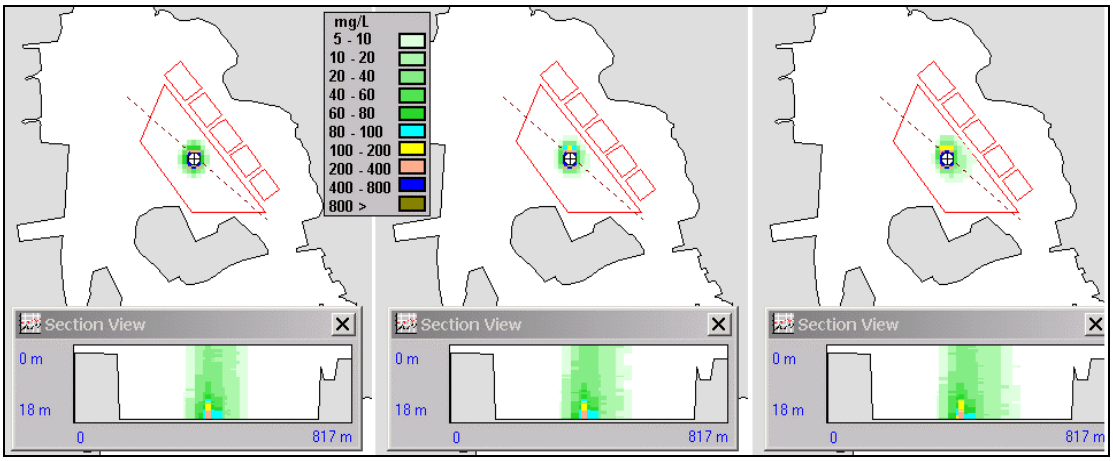
The simulation results presented in this section include:

- Horizontal and vertical view of TSS distribution
- Time series of acreage of exceeding 10 mg/L concentration levels

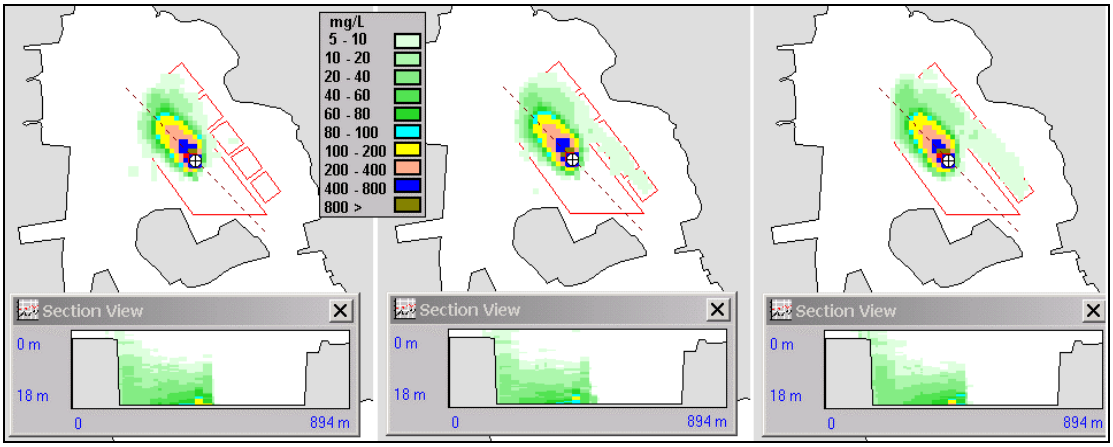
Figure 5-4 shows a plan view of the maximum predicted TSS concentrations throughout the water column during the 12-hour simulation period. Vertical section views of the concentration are inserted in the figure. The frames in the figure are organized by row (wind conditions) and columns (tide conditions). The rows correspond to calm wind, NWW wind and SWS wind from top to bottom, and the columns correspond to neap, mean, and spring tide from left to right.

All TSS concentration distributions for the tide only scenarios were confined within the PIN-CAD cell since the circulation is too weak to transport material very far. For the NWW and SWW wind cases, sediment clouds reach the edge of the CAD cells, although most of the sediment remained in the cell. The direction of sediment drift corresponded to the flow guided by a combination of the surface wind stress and the bathymetry of the CAD cell. The NWW wind case transported the bottom sediment to the northwest and the SWS wind case transported the sediment to the southwest. It is important to note that the instantaneous concentrations, which varied widely in time, were significantly smaller than the maximum TSS concentrations presented here.

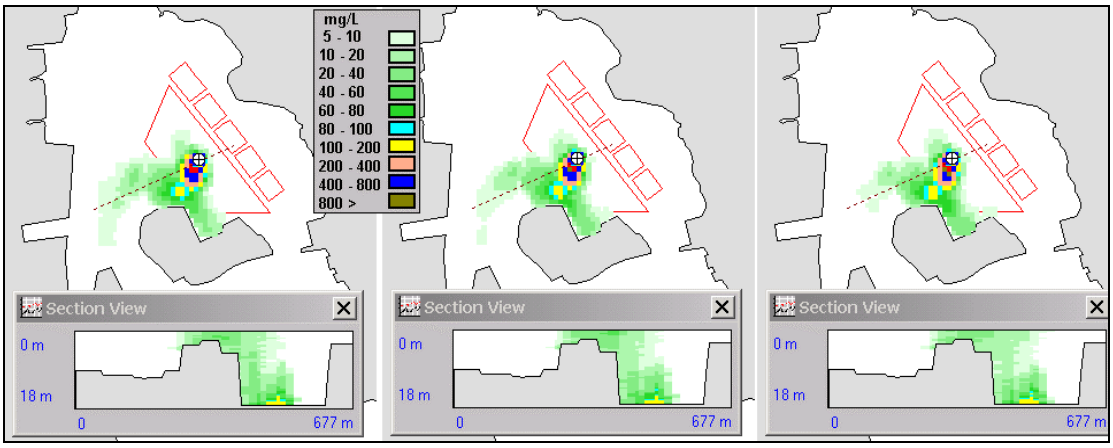
Figure 5-5 shows the area coverage that exceeds a TSS concentration of 10 mg/L (approximately the background threshold) in time. For the case of wind driven circulation, the sediment cloud dissipates within ~ 3 hours. The calm wind tide cases take much longer to settle as most sediment stays in the deep area (~17 m) and so the vertical travel time is increased.



Neap/Calm wind **Mean / Calm wind** **Spring/Calm wind**



Neap/NWW wind **Mean/NWW wind** **Spring/NWW wind**



Neap/SWS wind **Mean/SWS wind** **Spring/SWS wind**

Figure 5-4. Maximum TSS concentrations throughout water column and duration of simulation for the nine hydrodynamic scenarios.

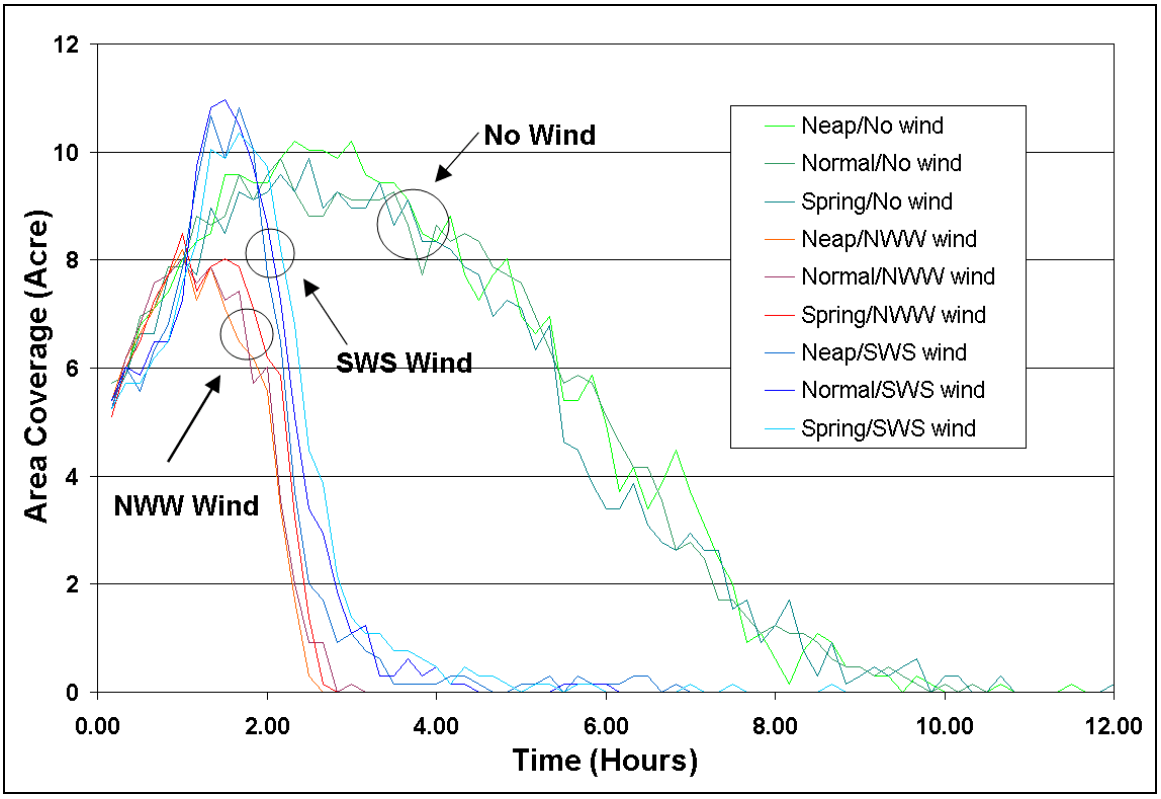


Figure 5-5. Time series of area coverage (acre) (encircled) that exceeds TSS concentration of 10mg/L for the nine hydrodynamic scenarios**.**

5.3 Pollutant Transport Modeling Using BFMASS Model Applications

5.3.1 Disposal Operations

In BFMASS the two- or three-dimensional advection-diffusion equation is solved on the same boundary conforming grid as the hydrodynamic model, BFHYDRO (See Appendix K). There are two types of dredging operations that will use the PIN CAD cell(s) that are classified high and moderate volume projects. Since moderate volume projects are more certain at this time, pollutant transport and fate simulations were focused on disposal activity for a moderate project whose volume is on the order of 30,600 m^3 (40,000 cy). Table 5-6 lists the details of a likely disposal activity in addition to the associated dredging operation for this modeling. These details were developed to best represent moderate volume projects, consistent with intermediate goals of the New Bedford Harbor Plan. It was assumed that two split-hull scows will work in tandem, alternating to haul and dispose unsuitable dredged material during two 12-hr shifts per day. Dimensions of each barge were 3 m (10 ft) wide by 76 m (250 ft) long with a holding capacity of 1,530 m^3 (2,000 yd^3).

Table 5-6. Assumed details for modeling of dredging and disposal operations in New Bedford Harbor.

Operation	Parameter		Detail
Dredging	Dredging Sites		Maneuvering channel, berth, wharf, inner federal navigation channel
	Dredging Project Volume		30,600 m (40,000 yd^3)
	Composition of dredged material (%)	Contaminated material	90
	Types of dredging operation for	Contaminated material	Continuous
	Dredging equipment used for	Contaminated material	Environmental bucket
	Bucket capacity	Environmental bucket	5.4 m^3 (7 cy)
	Dredging rate (min/grab)		1.5
	Duration of dredging operation (day)		6
	Number of concurrent dredging operations		One
	Time of dredge operations		1 June 2003 ~ 1 January 2004
	Loss rate during dredging operation		1.5%
Disposal	Disposal Site Location		Popes Island North
	Number of scows		2
	Scow Capacity (cy)		1,530 m^3 (2,000 cy)
	Dimension of scow		3 m (10 ft) wide × 76 m (250 ft) long
	Type of scow		Split-hull
	Duration of disposal operation (sec)		5
	Typical cycle from barge loading to disposal (hour)		12

5.3.2 Source Strength and Settling Velocity

The source strength is the mass of pollutant entering the system from released unsuitable sediments on a rate basis. Three types of source strengths can be specified in BFMASS: 1), an instantaneous release; 2), a constant release over time; and 3), variable release over time. An instantaneous source release is the mass of material released to the water column from an entire split-hull barge load in a second. A constant source is defined as the mean loading to the water column from multiple barge releases over time. A variable source is the time varying loading to the water column as individual barge releases occur according to a time schedule.

The disposal operation of dredged material in New Bedford Harbor is assumed to take place twice a day over a 6-day period for a typical small project (Table 5-6). To simulate the operation, a series of 12 instantaneous releases of a volume of 1,529 m^3 (2,000 yd^3) was assumed to occur once every 12 hours.

A conservative estimate of the mass of pollutant released from the disposal of dredged material can be determined from elutriate analysis data (EPA, 1991). Since elutriate testing was designed to measure the dissolved fraction of pollutant in liquid portion, the mass of pollutant is approximated as the product of the elutriate concentration E and the volume of water (see Section 3-8). The settling velocity acts as a mechanism to remove suspended sediment from the water column.

5.3.3 Release Location

The PIN-CAD facility will be excavated to an average depth between 11.6 m (38 ft) and 17.4 m (57 ft), to accommodate 734,000 m^3 (960,000 cy) of dredged material in a total of 6 cells generated from New Bedford Harbor maintenance dredging projects over the next 10 years. Cell 1 is the highest capacity CAD cell, with potential capacity of 1,408,000 m^3 (1,841,000 cy) of sediment. Cells 2 through 6 are similar in size and each can hold approximately 39,000 m^3 (51,000 cy) volume (Section 3-3). Since the preliminary CAD cell configuration for moderate capacity CAD cells (86 m long by 65 m wide) is slightly larger than a typical model grid cell at the PIN CAD facility, the moderate capacity cell size is too small to accurately simulate. Therefore, simulations of disposal operations will focus on the high capacity Cell 1 (Section 3.3).

Since Cell 1 will be filled progressively, disposal operations were simulated as three separate operations these operations were representative of the continuous activity having release locations at the center, the northwest and southeast corners of the CAD-site (Figure 5-6).

5.3.4 Toxic Pollutants

Simulations of the fate and transport of pollutants were performed on constituents whose elutriate concentrations exceeded U. S. EPA water quality chronic levels. Analysis of elutriate samples in New Bedford Harbor (SAIC, 2003) showed that most of the stations located at dredging and disposal sites contained elevated concentrations of Aluminum (Al), Copper (Cu), Nickel (Ni), Silver (Ag) and Polychlorinated Biphenyls (PCB). Benzo(a)fluoranthene and Benzo(k)fluoranthene, part of high molecular weight (HMW) (Petroleum Aromatic Hydrocarbon), also exceeded the USEPA chronic levels at some stations.

As part of modeling input, the mass of the pollutant source is required for each contaminant. None of pollutants exceed the U. S. EPA water quality acute level except copper (4.8 ug/L) at NBH-202 and NBH-207 stations. Only Al, Cu, Ag and PCB exceed the chronic levels. The dilution elutriate concentration needed for PCB to meet the chronic level ranges between 11 and of 67. Copper has the next highest required dilutions (1 to 32) followed by silver (14). Station NBH-202, has the highest concentrations for all constituents shown in the table. The next highest concentrations are from station NBH-207, located at Fish Island.

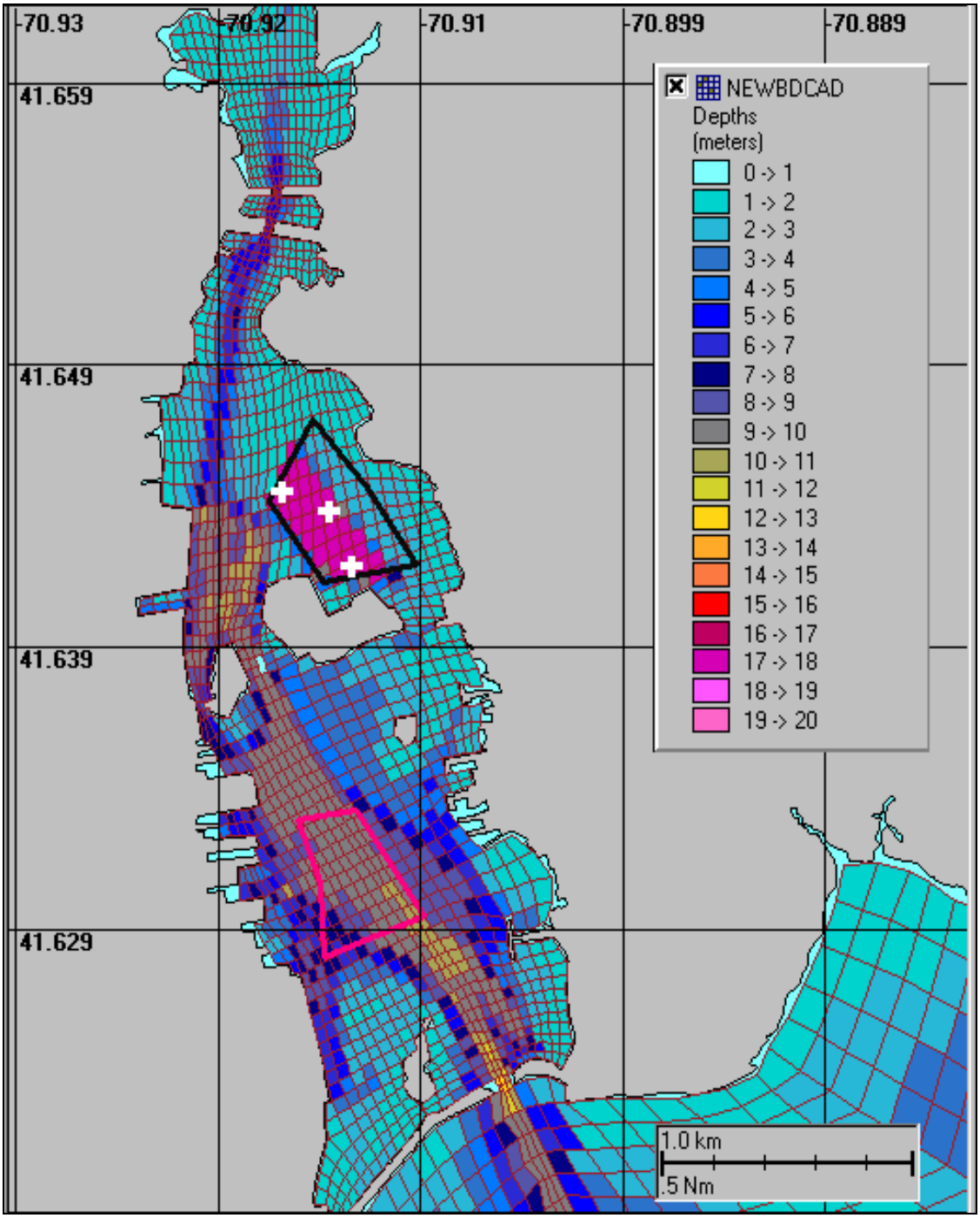


Figure 5-6. Modeled mass load locations (white crosses) used to simulate disposal operations in PIN-CAD site (black polygon), superimposed on bathymetry.

5.3.5 Other Model Parameters

Primary physical processes governing the fate and transport of disposed material are advection and diffusion. Advection is due to the currents that are predicted from the hydrodynamic modeling. Diffusion includes horizontal and vertical diffusion that are specified as model inputs.

5.3.6 BFMASS Modeling Results

This section documents the results of the fate and transport simulations of contaminants of unsuitable dredged materials disposed at the PIN-CAD site in the Harbor. Simulations were performed using a three-dimensional (7-layer) application of BFMASS. Three different tides (spring, neap and mean tides), and three wind conditions (calm, northwesterly and southwesterly winds) were chosen as representative of the range of likely environmental conditions. All modeled constituents were released at the end of flood portion of the M_2 tidal cycle, so that the subsequent ebb currents transported the constituents in the water column south toward the Hurricane Barrier.

UDM from station NBH-202 was more highly contaminated compared to the other stations. For example, the PCB elutriate concentration was 767 times the U.S. EPA chronic level (U. S. EPA, 2002). This is four times higher than the next highest PCB concentration found at station NBH-207 (located at Fish Island) and 70 times higher than the lowest at station NBH-204. This section documents model results in detail for the worst contaminant case, NBH-202 PCBs, and then presents the results in more generalized format for the rest of contaminants and stations.

Among the nine environmental scenarios, the largest spatial coverage was predicted for neap tides and calm wind conditions. On the other hand, the smallest coverage occurred for neap tides and northwesterly winds. This finding was consistent among the three different release locations in the PIN-Cad cell. Figures 5-7 and 5-8 show the maximum area affected (coverage) due to released NBH-202 PCB as a function of concentration for the neap tide and no wind condition and the neap tide and northwesterly wind condition, respectively. The area of the PIN-CAD is shown for reference as is the U. S. EPA chronic water quality (WQ) concentration for PCB.

Under calm winds (Figure 5-7), the area coverage is always larger than the CAD area for concentrations less than 0.4 μg/L. The coverages at the PCB chronic level (0.03 μg/L) are 1×10^6 m^2 (southeast corner release) and 1.2×10^6 m^2 (center and northwest corner releases), which are between 6 and 7 times larger than the CAD cell area, respectively. The concentrations for an area the same as the CAD site area are 0.42 μg/L, 0.44 μg/L and 0.35 μg/L for a center, northwest and southeast release, respectively. While the calm wind condition simulates very similar coverages for the three release locations (Figure 5-8), a northwest release with northwesterly winds generates the largest coverage and a southeast release yields the smallest coverage (Figure 5-9). Spatial coverage for the 0.03μg/L chronic concentration with wind is 0.3×10^6 m^2, 1.9×10^5 m^2, and 3.3×10^6 m^2 with southeast, center and northwest releases, respectively. The concentrations for areas equivalent to the CAD site area are 0.015 μg/L for a southeast release, 0.035 μg/L for a center release and 0.08 μg/L for a northwest release.

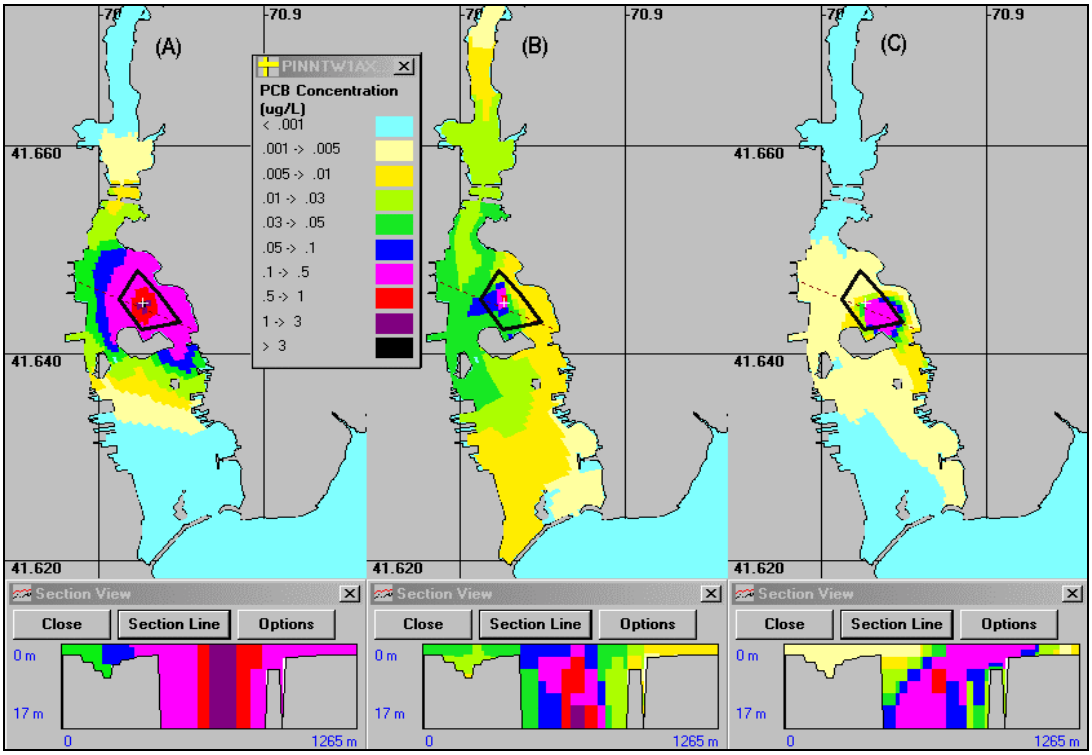


Figure 5-7. Simulated PCB distributions for calm wind (a), southwesterly (b) and northwesterly winds (c). Distributions are shown 1 hour after the final disposal event.

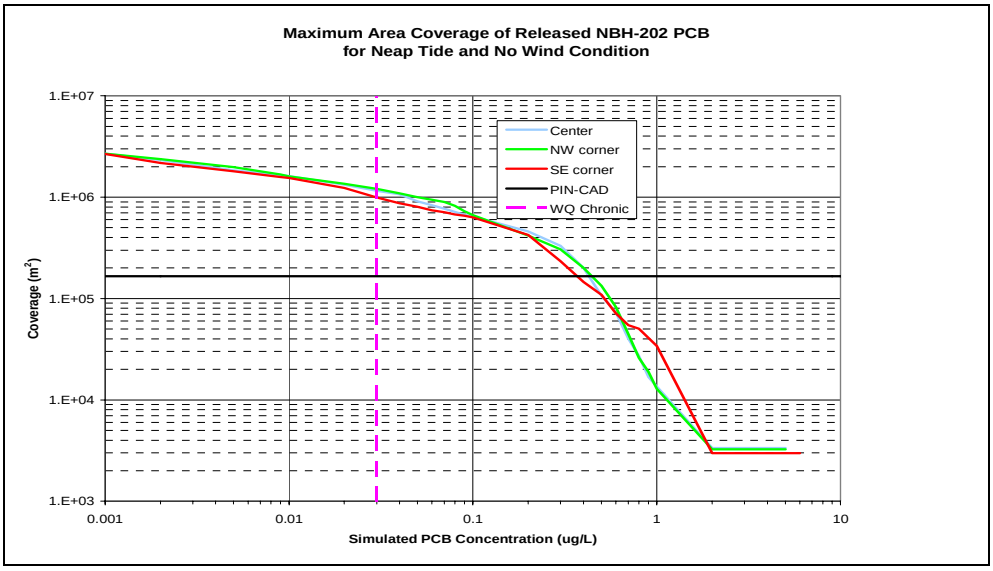


Figure 5-8. Maximum area coverages (y-axis) of PCBs vs. concentrations for neap tides and calm winds for three release sites using the NBH-202 station source strength. The PIN-CAD cell area (1.67×10^5 m^2) is a black horizontal line and the U. S. EPA WQ chronic value for PCB (0.03 µg/L) is a dashed purple vertical line.

According to toxicity tests using sediments from the sampling stations with mysids and sea urchins reported by SAIC (2003), the cause of acute toxicity was the combination of multiple pollutants. For example, half the toxicity to mysids was due to PCBs and the other half was due to a combination of copper and ammonia. From these results, SAIC suggested that a dilution to at least 2.2% of the elutriate concentration would be protective.

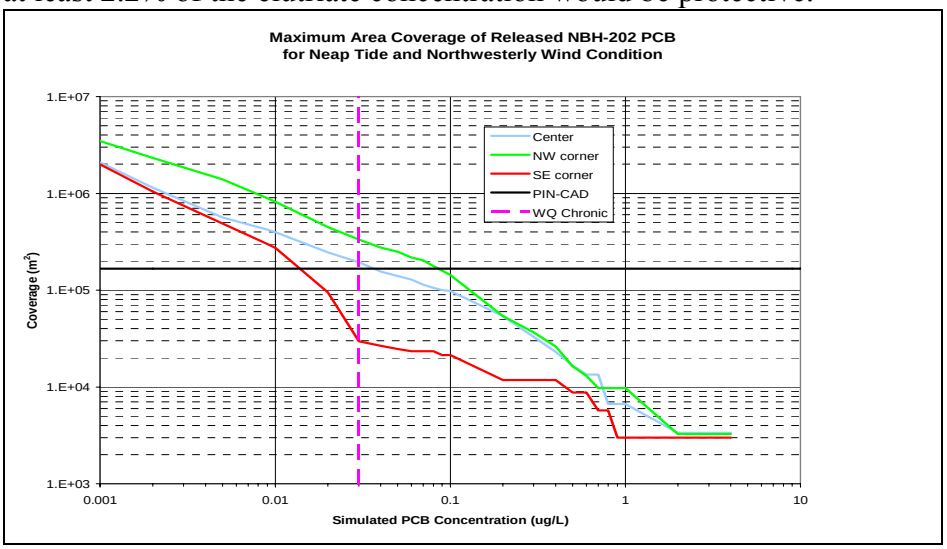


Figure 5-9. Maximum area coverages (y-axis) of PCBs vs. concentrations for neap tides and northwesterly winds for three release sites using the NBH-202 station source strength. The PIN-CAD cell area (1.67×10^5 m^2) a black horizontal line and the U. S. EPA WQ chronic value for PCB (0.03 µg/L) is a dashed purple vertical line.

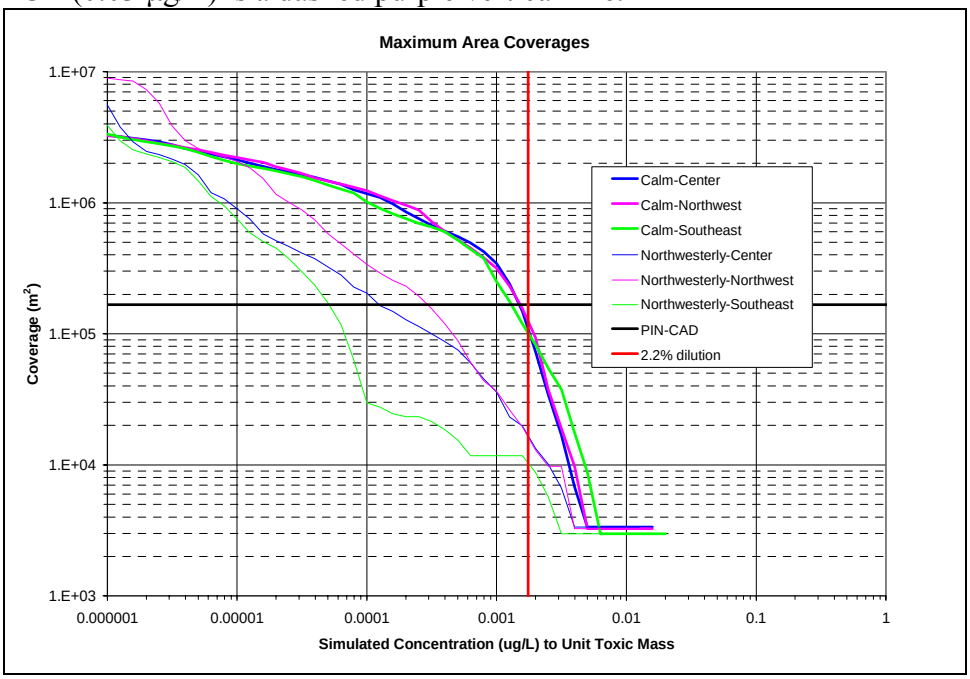


Figure 5-10. Maximum area coverage for released toxic material for calm and northwesterly winds.

Figure 5-10 shows maximum area coverages for a release of 1g of a combination of toxic pollutants. Presented are the coverages for the worst conditions (neap tide and calm wind) and the most favorable conditions (neap tide and northwesterly wind). For both conditions, area coverage for a concentration of 2.2% of the elutriate level was always smaller than the PIN-CAD area. The largest area coverage for the 2.2% elutriate concentration occurred for a northwest release during calm winds, 1.2×10^5 m^2. The smallest coverage for the protective dilution level occurred for a southeast release during northwesterly winds, 1.0×10^4 m^2.

5.4 Summary

The field-obtained elevations and velocities were examined to determine that tides and wind were the primary forces that drove the circulation in New Bedford Harbor. Hydrodynamic simulations were successfully conducted to verify model performance for the period of the field measurement program. Nine basic hydrodynamic conditions were prepared to provide the advection data to the pollutant and sediment transport models based on the combination of three tidal ranges (neap, mean and spring) and three most likely wind conditions (calm, southwesterly and northwesterly directions).

The SSFATE (Suspended Sediment Fate) model was used to simulate TSS (Total Suspended Solid) concentrations due to the proposed excavation of the CAD (Confined Aquatic Disposal) cells and the disposal of dredged material into one of the cells. Resultant TSS distributions showed that combinations of the wind induced circulation and bathymetry played a key role. When the sediment plumes were carried into the deeper sections of the harbor, the duration and size of sediment cloud were more extensive than when the sediment plumes were carried into the shallower sections, where the sediment settled out more quickly.

A series of dissolved phase pollutant fate and transport simulations were performed to estimate the water quality impacts in the water column at north of PIN, using BFMASS (Boundary Fitted Mass Transport Model). Simulations were performed for various pollutant constituents whose elutriate concentrations exceeded the U. S. EPA water quality guidance levels: metals (aluminum, copper, nickel and silver), and polychlorinated biphenyls (PCBs). The model simulated the fate and transport of disposal of dredged material at the PIN CAD site. Disposal operations were assumed to last for 6 days and disposal taking place twice a day following the M_2 tidal cycle. Each release volume of dredged material was assumed to be 1,530 m^3 (2,000 yd^3).

A series of dissolved phase pollutant fate and transport simulations were performed to estimate the water quality impacts in the water column at north of Popes Island, using BFMASS (Boundary Fitted Mass Transport Model). Simulations were performed for various pollutant constituents whose elutriate concentrations exceeded the U. S. EPA water quality guidance levels: metals (aluminum, copper, nickel and silver), and polychlorinated biphenyls (PCBs). The model simulated the fate and transport of disposal of dredged material at the PIN-CAD site (north of Popes Island). Disposal operations were assumed to last for 6 days with disposal taking place twice a day following the M_2 tidal cycle. Each release volume of dredged material was assumed to be 1,530 m^3 (2,000 yd^3).

The BFMASS simulation results indicated that the contaminant distribution patterns in the horizontal and vertical were similar for the three tide ranges. Concentration levels, however, were higher in the near field for neap tides than for spring tides because more energetic currents during the spring tides promote more dispersion and mixing. Different wind conditions resulted in different spatial distribution patterns and coverages. Among the nine environmental scenarios, the largest spatial coverage (area) was predicted for neap tides and calm wind conditions. The smallest coverage occurred for neap tides and northwesterly winds. This finding was consistent among three different release locations in the high capacity PIN CAD Cell 1.

According to toxicity tests using sediments from the NBH-202 station sampled at CAD-CI, the combination of multiple pollutants was the cause of the observed acute toxicity effects. For example, half the toxicity to mysids was due to PCBs and the other half was due to a combination of copper and ammonia. From these results application of the WER developed for water quality thresholds in Section 3.8, concluded a dilution to less than 2.2% of the elutriate concentration would be protective of marine organisms. The model results showed that for any environmental condition, area coverage for a concentration of 2.2% of the elutriate level was always smaller than the PIN-CAD area (1.67×10^5 m^2 [41 ac]). This finding provides confidence that construction of the preferred alternative and related disposal events modeled in this section of the FEIR can be limited to the area of the CAD footprint. Impacts to the vicinity can be managed within the water quality thresholds set by DEP. The largest area coverage (1.2×10^5 m^2 [30 ac]) of the 2.2% elutriate concentration occurred for a release during calm conditions while the smallest coverage (1.0×10^4 m^2 [2.5 ac]) occurred for a release during northwesterly winds. Other sediments with lower elutriate concentrations, and presumably lower toxicity, would affect smaller areas.

SECTION 6.0 – COMPLIANCE WITH REGULATORY STANDARDS AND REQUIREMENTS

6.0 COMPLIANCE WITH REGULATORY STANDARDS AND REQUIREMENTS

This section includes a description of the primary regulations associated with the implementation of the preferred alternative aquatic disposal sites. Compliance with state and federal standards and regulations for aquatic disposal are discussed as they relate to the preferred alternatives. The preferred alternative for the New Bedford/Fairhaven Harbor includes one CAD disposal site, PIN. Each of the following sections describes the relationship of the standards and requirements discussed as they relate to CAD disposal.

6.1 Compliance with State Standards/Regulations

6.1.1 Wetlands Protection Act and Regulations (310 CMR 10.00)

The preferred alternative CAD site PIN is located in a resource area protected by the Massachusetts Wetlands Protection Act (WPA), specifically Land Under the Ocean (LUO). The PIN site also lies within Designated Port Areas (DPAs). The WPA is administered on the local level by the Conservation Commission, which implements the Massachusetts Wetlands Regulations at 310 CMR 10.00.

CAD Disposal - A Notice of Intent (NOI) application to the New Bedford and Fairhaven Conservation Commissions will be required for proposed CAD disposal activities at the PIN sites, as the current configuration lie in both jurisdictions. Orders of Conditions (OOC) need to be issued by the appropriate Conservation Commission(s) to permit the work for the PIN alternative.

6.1.1.1 Designated Port Areas

The Wetlands Regulations at 310 CMR 10.26 state that LUO in DPAs is likely to be significant to marine fisheries, storm damage prevention and flood control. LUO in DPAs often serves to provide support for coastal engineering structures such as seawalls and bulkheads, which have replaced natural protection for upland areas from storm damage and flooding. Projects affecting LUO in DPAs should not result in alteration of wave and current patterns so as to affect the stability of such structures. The preferred alternative PIN site western planning edge is very near the DPA so that specific PIN CAD developments on that side of the area should pay close attention to surveyed project boundaries.

CAD Disposal - Water column depth at the PIN CAD disposal site may play an important role in determining localized current velocities. Current velocities typically behave in a logarithmic relationship with water column depth. Therefore, currents further from the surface experience increasing frictional retardation, particularly as currents approach the sediment boundary layer. Given this phenomena, the CAD preferred alternative site will be exposed to smaller current velocities and less potential sediment resuspension forces than sites at shallower depths. Coarser grained cohesive material also has the effect of greater frictional and gravitational forces holding the grains on the seabed. Thus a greater critical shear stress would be required to resuspend coarse grain cap material than fine grain silty sediments.

Reduced circulation may be beneficial from the standpoint of cap integrity since resuspension is less likely, but by the same effect this localized condition may also contribute to reduced water quality. Typically, the impact to water quality from dredged material disposal is short-term. These impacts typically include localized degradation in dissolved oxygen (DO), total suspended solids (TSS), pH, light penetration, and contaminant concentrations. Conditions typically return to ambient conditions within hours to days, depending on the amount, composition, and frequency of the disposed material. Total suspended solids may increase dramatically due to the entrainment of fine material in the water column. A plume typically forms whereby material may be advected short distances from the disposal site. A reduction in DO is typical as common constituents of sediments are oxidized and organic material is metabolized by microbial activity at the sediment-water interface. High suspended solid concentrations have the effect of attenuating ambient light, thereby reducing penetration. Finally, contaminants sorbed to sediment particles may be dissolved by the aquatic environment through physical disturbance of the material as the sediment stream is released from the scow.

Detailed modeling of dredged material disposal events was performed for the FEIR to determine short term local water quality impacts associated with CAD options in Section 5-0 (ASA, 2003). The preferred alternative site has been located so as to provide a sufficient distance to the nearest coastal engineering structure. No impact on the stability of the harbor bottom that would affect the support of the nearby coastal engineering structures is expected, and therefore no adverse effect on any structure's ability to serve a storm damage prevention or flood control functions in the area.

6.1.1.2 Land Under the Ocean

Land Under the Ocean (LUO) is defined as *"... land extending from the mean low water line seaward to the boundary of a municipality's jurisdiction and includes land under estuaries,"* within the Wetlands Regulations at 310 CMR 10.25(2). LUO is significant to the protection of marine fisheries and projects which affect LUO shall not cause adverse effects by altering the bottom topography so as to increase storm damage or erosion of coastal beaches, banks, dunes, of marshes. They must, among other things, also have no adverse effects on marine fisheries or wildlife habitat caused by alterations in water circulation, destruction of eelgrass beds, alterations in the distribution of sediment grain size, changes in water quality, or alterations of shallow submerged lands with high densities of polychaetes, mollusks, or macrophytic algae.

As described above, the aquatic preferred alternative site is expected to have no long-term adverse effect on marine fisheries caused by localized alterations in water circulation or changes in water quality. The sites are not located in existing eelgrass beds.

CAD Disposal - Any impacts to benthic organisms at the CAD disposal site will be temporary and reversible (Section 3.6). Immediately after disposal, the sites will be devoid of benthic populations, because the benthos will have been removed by overdredging or buried under disposed sediments. However, most benthic species are capable of rapid dispersal and colonization by means of planktonic larvae, and will quickly recolonize disturbed areas.

6.1.1.3 Land Containing Shellfish

Land Containing Shellfish (LCS) is defined as *"... land under the ocean, tidal flats, rocky intertidal shores, slat marshes or land under salt ponds when any such land contains shellfish,"* within the Wetlands Regulations at 310 CMR 10.34(2). LCS is found to be significant to the protection of marine fisheries, when such areas have been identified and mapped by the local conservation commission or by DEP in consultation with DMF. Documentation required for this designation includes recording the density of shellfish, size of the area and the historical and current importance of the area to commercial and recreational fishing.

CAD Disposal - The preferred alternative disposal site is located within areas that have been designated as areas of LCS as specified in the Wetlands Protection Act and Regulations. As described above, the preferred CAD alternative disposal sites are not expected to have an adverse permanent effect on marine fisheries caused by localized alterations in water circulation, alterations in relief elevation, sediment grain size or changes in water quality. Implementation of either of the preferred CAD disposal alternatives will require mitigation for impacts to LCS (to be developed with regulatory agencies).

6.1.2 Water Quality Certification (314 CMR 9.00)

The federal Clean Water Act (CWA) gives states the authority to review projects that must obtain federal licenses or permits and result in a discharge to state waters, and requires a 401 Water Quality Certification to ensure that the project complies with state water quality standards and other appropriate requirements of state law. As a project which will require disposal of more than 5,000 cubic yards of dredged material, the DMMP will require a major dredge project certification (BRP WW 07) from the Department of Environmental Protection, Division of Wetlands and Waterways. The application will require a description of the proposed activity, detailed plan view and section, sediment analysis, and description of the characteristics of the proposed disposal site. The DEP may then put conditions on the dredging and disposal process designed to ensure compliance with water quality standards.

Per the provisions of 314 CMR 9.06(1), no discharge of dredged material will be allowed if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic environment than the proposed discharge. As documented in this FEIR, the proposed preferred alternative aquatic disposal site in New Bedford/Fairhaven Harbor is the least environmentally damaging practicable alternative (LEDPA) for the aquatic disposal of UDM from the dredging projects identified in the harbor.

Per the requirements of 314 CMR 9.06(2), the proposed discharge of dredged material will not be permitted unless the "appropriate and practical steps" are taken to minimize potential adverse impacts to land under water. The discharge of UDM and subsequent capping of the material at the PIN CAD preferred alternative disposal site in New Bedford/Fairhaven Harbor will result in the cleanup and capping of contaminated sediments at the site, and will result in a cleaner harbor bottom.

Per the requirements of 314 CMR 9.06(3), no discharge of dredged material will be allowed in Outstanding Resource Waters. The selected preferred alternative aquatic disposal site PIN in New Bedford/Fairhaven Harbor is not located in Outstanding Resource Waters, as the water quality classification of the Inner Harbor is Class SB, due to the presence of combined sewer overflows and is a restricted shellfishing area. The classification of the Outer Harbor, east of the New Bedford/Fairhaven boundary is SA and open to shellfishing (314 CMR 4.06, Table 28).

Finally, no discharge of dredged material will be allowed, per the provisions of 314 CMR 9.06(7), where the discharge meets the criteria for evaluation as specified above, but would result in "substantial adverse impacts" to the physical, chemical or biological integrity of surface waters of the Commonwealth. As described in this FEIR, disposal of UDM at the preferred alternative disposal sites in New Bedford/Fairhaven Harbor will not result in substantial adverse impacts to surface waters in the harbor.

6.1.3 MGL Chapter 91 (Public Waterfront Act) and Waterways Regulations (310 CMR 9.00)

Dredging activities to create a CAD site for UDM, involving the subaqueous placement of unconsolidated material below the mean low water mark, requires a waterways permit, under the provisions of the Waterways Regulations at 310 CMR 9.05(2). Regulatory requirements for a Waterways permit are less stringent than those for a Waterways License, required for activities involving fill or structures in tidelands. Dredging activities for purposes such as navigation channels, boat basins, and other water-dependent purposes, and the subaqueous placement of unconsolidated material from those dredging projects below the mean low water mark, are considered a water-dependent project, under the provisions of 310 CMR 9.12(2)(a).

Waterways permits are issued only if certain requirements specified in the Waterways Regulations at 310 CMR 9.31 to 9.40 are met. Section 9.31 states that no permit shall be issued unless the project serves a "proper public purpose which provides greater public benefit than detriment to the rights of the public" in tidelands. As a water-dependent use project, the construction and use of the proposed preferred sites in New Bedford/Fairhaven Harbor are presumed to meet this standard.

Because the dredging related activities of alternative site requires Waterways permits, the provisions of 310 CMR 9.32, Categorical Restrictions on Fill and Structures, do not apply. As required under section 9.33, Environmental Protection Standards, construction and use of the proposed aquatic sites will comply with the applicable environmental regulatory programs of the Commonwealth, including: MEPA; the Wetlands Protection Act; the Massachusetts Clean Waters Act (MGL c. 21, s. 26-53 and the regulations for Water Quality Certifications, 314 CMR 9.00); Marine Fisheries Laws (MGL Chapter 130); and the Underwater Archaeological Resources Act (MGL c. 91 and c. 6, s. 179-180 and 310 CMR 22.00).

The preferred alternative site is not located on private tidelands or filled Commonwealth tidelands and do not need to be deemed in compliance with the Zoning Ordinance. The preferred alternative disposal site for New Bedford/Fairhaven Harbor conform to the provisions of Harbor Plan, in that the construction and use of the sites for the disposal of UDM from the dredging projects in Harbor supports the stated goals of the Harbor Plan to encourage identified

maintenance and improvement dredging projects. The provisions of 310 CMR 9.34, Conformance with Municipal Zoning and Harbor Plans, are met by construction and use of the sites.

The provisions 310 CMR 9.35, Standards to Preserve Water-Related Public Rights, are applicable to the proposed alternative site in New Bedford/Fairhaven Harbor. Construction and use of the disposal sites will not significantly interfere with existing navigation. Use of the sites will also not significantly interfere with the public rights of free passage over the water, nor will it interfere with access to any city landings, easements or any other form of public access to New Bedford/Fairhaven Harbor. Use of the preferred alternative PIN site will not significantly interfere with the public rights of fishing and fowling, and being a subaqueous site, will not interfere with on-foot passage, swimming or boating around the site.

Section 9.36, Standards to Protect Water-Dependent Uses, also applies to a portion of the preferred alternative site in New Bedford/Fairhaven Harbor. Construction and use of the preferred alternative will result in the preservation of the availability and suitability of tidelands in New Bedford/Fairhaven Harbor which are reserved as locations for maritime industrial uses and other water-dependent uses in New Bedford/Fairhaven Harbor. The site is located so that there will be no interference with private access to littoral property from New Bedford/Fairhaven Harbor, or to approach the harbor from the private property. Use of the PIN CAD site will not result in disruption to existing water-dependent uses in New Bedford/Fairhaven Harbor, nor will it displace any existing water-dependent uses. The preferred alternative does not include fill or structures for nonwater-dependent or water-dependent non-industrial uses which preempt any water-dependent industrial use within the New Bedford/Fairhaven Harbor DPA.

The provisions of section 9.37, Engineering and Construction Standards, will be met through the development of a sound engineering design for the aquatic preferred alternative disposal site. Construction and use of the proposed aquatic sites will not interfere with the ability to perform future maintenance dredging of the federal channel.

The preferred alternative disposal site ism not a Recreational Boating Facility nor a Marina, Boatyard or Boat Ramp, therefore the provisions of 310 CMR 9.39 and 9.39 do not apply.

Finally, the provisions of Section 9.40, Standards for Dredging and Dredged Material Disposal, also apply to the proposed alternative disposal PIN CAD site in New Bedford/Fairhaven Harbor. If the western edge of PIN CAD site overlaps the DPA, the prohibition on dredging to a mean low water depth greater than 20 feet in 310 CMR 9.40(1)(a) does not apply, otherwise the prohibition applies. The final capping will be equivalent to natural as found conditions when finally completed which are very unlikely to be deeper than 20 feet. The project also serves a commercial navigation purpose of federal and state significance, allowing the maintenance dredging of the main federal channel. The sites have been located so as to avoid shellfish beds to the extent possible, significant fisheries resources, and submerged aquatic vegetation such as eelgrass beds. Shellfish mitigation plans have been recommended in Section 7-0 of this FEIR. DMF will set the mitigation plan in coordination with New Bedford and/or Fairhaven Shellfish Constable(s). Dredging activities necessary to construct any specific project CAD cell at PIN

will comply with the operational requirements specified in section 9.40(3), in that the depth of the disposal sites will be that necessary to accommodate the anticipated volume of UDM from New Bedford/Fairhaven Harbor, therefore accommodating the navigational dredging needs of the harbor users.

Operational procedures will be established for use of the PIN CAD site which will meet the intent of the requirements specified in section 9.40(4), Operational Requirements for Dredged Material Disposal and 9.40(5), Supervision of Dredging and Disposal Activity. Section 8.0 of this FEIR outlines the monitoring and management guidelines to be used to confirm compliance with permit standards and long-term sequestering of UDM for the preferred alternative site.

6.1.4 Coastal Zone Management (301 CMR 21.00)

This project will be required to complete a federal consistency certification for review by CZM, describing the project and demonstrating consistency with CZM's program policies and management principles. The CZM Program Plan establishes program policies which embody coastal policy for the Commonwealth of Massachusetts. Recognition of these statements as Massachusetts coastal policy is formalized in Memoranda of Understanding (MOU) between CZM and state environmental agencies. Projects subject to federal consistency review must be consistent with CZM program policies. CZM enforces its program policies through existing Massachusetts statutes and their implementing regulations.

In addition, the federally-approved CZM Program Plan lists management principles. These policy statements are not currently enforceable through existing state statutes and regulations. They are published as guidance to proponents of activities in the Coastal Zone, representing CZM's preferred policy direction.

Program policies cover issue areas such as Water Quality (Section 7.1.4.1), Habitat (Section 7.1.4.2), Protected Areas (Section 7.1.4.3), Coastal Hazards (Section 7.1.4.4), Port and Harbor Infrastructure (Section 7.1.4.5), Public Access (Section 7.1.4.6), Energy (Section 7.1.4.7), Ocean Resources (Section 7.1.4.8), and Growth Management (Section 7.1.4.9). Construction and use of the preferred alternative aquatic disposal site within New Bedford/Fairhaven Harbor involve the CZM policies on Water Quality and Habitat.

6.1.4.1 Water Quality

Water Quality Policy #1 - Ensure that point-source discharges in or affecting the coastal zone are consistent with federally approved state effluent limitations and water quality standards.

Water Quality Policy #2 - Ensure that nonpoint pollution controls promote the attainment of state surface water quality standards in the coastal zone.

Water Quality Policy #3 - Ensure that activities in or affecting the coastal zone conform to applicable state and federal requirements governing subsurface waste discharges.

Conformance: Use of the aquatic preferred alternative disposal site in New Bedford/Fairhaven Harbor will be consistent with the Water Quality Policies. Disposal of UDM at a subaqueous site is not considered to be a subsurface discharge of waste.

6.1.4.2 Habitat

Habitat Policy #1 - Protect coastal resource areas including salt marshes, shellfish beds, dunes, beaches, barrier beaches, salt ponds, eelgrass beds, and fresh water wetlands for their important role as natural habitats.

Habitat Policy #2 - Restore degraded or former wetland resources in coastal areas and ensure that activities in coastal areas do not further wetland degradation but instead take advantage of opportunities to engage in wetland restoration.

Conformance: The preferred site is located in areas of New Bedford/Fairhaven Harbor which avoids most of the protected coastal resource areas, including subtidal resources such as eelgrass beds, to the greatest extent practicable. There are no nearby salt marshes, dunes, beaches or barrier beaches, salt ponds or freshwater wetlands which would be affected by use of the disposal site.

However, direct impacts to shellfish beds in the vicinity would result from the disposal of UDM. The effects of the preferred alternative to quahogs, soft shell clams and oyster habitat would be temporary because of the relatively strong recolonization rate of these species, especially if seed stock is used in the rehabilitation of the resource. Monitoring the success of the rehabilitation would be necessary during the recovery period.

6.1.4.3 Protected Areas

Protected Areas Policy #1 - Preserve, restore, and enhance complexes of coastal resources of regional or statewide significance through the Areas of Critical Environmental Concern program.

Protected Areas Policy #2 - Protect state and locally designated scenic rivers and state classified scenic rivers in the coastal zone.

Protected Areas Policy #3 - Ensure that proposed developments in or near designated or registered historic districts or sites respect the preservation intent of the designation and that potential adverse effects are minimized.

Conformance: Per the requirements of 314 CMR 9.06(3), no discharge of dredged material will be allowed in Outstanding Resource Waters. The PIN preferred alternative aquatic disposal site in New Bedford/Fairhaven Harbor are not located in Outstanding Resource Waters, as the water quality classification of the Inner Harbor is Class SB, due to the presence of combined sewer overflows and is a restricted shellfishing area.

6.1.4.4 Coastal Hazards

Coastal Hazards Policy #1 - Preserve, protect, restore, and enhance the beneficial functions of storm damage prevention and flood control provided by natural coastal landforms, such as dunes, beaches, barrier beaches, coastal banks, land subject to coastal storm flowage, salt marshes, and land under the ocean.

Coastal Hazards Policy #2 - Ensure construction in water bodies and contiguous land areas will minimize interference with water circulation and sediment transport. Approve permits for flood or erosion control projects only when it has been determined that there will be no significant adverse effects on the project site or adjacent or downcoast areas.

Coastal Hazards Policy #3 - Ensure that state and federally funded public works projects proposed for location within the coastal zone will:

- not exacerbate existing hazards or damage natural buffers or other natural resources,
- be reasonably safe from flood and erosion related damage, and
- not promote growth and development in hazard-prone or buffer areas, especially in Velocity zones and ACECs, and
- not be used on Coastal Barrier Resource Units for new or substantial reconstruction of structures in a manner inconsistent with the Coastal Barrier Resource/Improvement Acts.

Coastal Hazards Policy #4 - Prioritize public funds for acquisition of hazardous coastal areas for conservation or recreation use, and relocation of structures out of coastal high hazard areas, giving due consideration to the effects of coastal hazards at the location to the use and manageability of the area.

Conformance: To ensure that construction in the harbor will minimize interference with the water circulation and sediment transport, the bottom elevation at the PIN site following construction of the disposal site, disposal activities and final placement of capping materials, will not be higher than the existing bottom elevation. This proposed construction will likely be slightly recessed compared to existing bottom elevations. The effect of this recessed pit is expected to be reduced water column mixing with surrounding waters, and active sedimentation within the pit. In addition, the location of the CAD site outside the main navigation channel will also minimize localized changes in water circulation. The preferred alternative sites have been located so as to provide a sufficient distance to the nearest coastal engineering structure. No impact on the stability of the harbor bottom that would affect the support of the nearby coastal engineering structures is expected, and therefore no adverse effect on any structure's ability to serve a storm damage prevention or flood control functions in the area.

6.1.4.5 Port and Harbor Infrastructure

Ports Policy #1 - Ensure that dredging and disposal of dredged material minimize adverse effects on water quality, physical processes, marine productivity and public health.

Ports Policy #2 - Obtain the widest possible public benefit from channel dredging, ensuring that designated ports and developed harbors are given highest priority in the allocation of federal and state dredging funds. Ensure that this dredging is consistent with marine environment policies.

Ports Policy #3 - Preserve and enhance the capacity of Designated Port Areas (DPAs) to accommodate water-dependent industrial uses, and prevent the exclusion of such uses from tidelands and any other DPA lands over which a state agency exerts control by virtue of ownership, regulatory authority, or other legal jurisdiction.

Ports Management Principle #1 - Encourage, through technical and financial assistance, expansion of water dependent uses in designated ports and developed harbors, re-development of urban waterfronts, and expansion of visual access.

Conformance: The majority of the PIN preferred alternative site is unlikely to be located within New Bedford/Fairhaven Harbor's DPA. Typically, the impact to water quality from dredged material is short-term. Conditions return to ambient conditions within hours to days, depending on the amount, composition, and frequency of the disposed material.

6.1.4.6 Public Access

Public Access Policy #1 - Ensure that developments proposed near existing public recreation sites minimize their adverse effects.

Public Access Management Principle #1 - Improve public access to coastal recreation facilities and alleviate auto traffic and parking problems through improvements in public transportation. Link existing coastal recreation sites to each other or to nearby coastal inland facilities via trails for bicyclists, hikers, and equestrians, and via rivers for boaters.

Public Access Management Principle #2 - Increase capacity of existing recreation areas by facilitating multiple use and by improving management, maintenance and public support facilities. Resolve conflicting uses whenever possible through improved management rather than through exclusion of uses.

Public Access Management Principle #3 - Provide technical assistance to developers of private recreational facilities and sites that increase public access to the shoreline

Public Access Management Principle #4 - Expand existing recreation facilities and acquire and develop new public areas for coastal recreational activities. Give highest priority to expansions or new acquisitions in regions of high need or limited site availability. Assure that both transportation access and the recreational facilities are compatible with social and environmental characteristics of surrounding communities.

Conformance: Construction and use of the PIN CAD site will not significantly interfere with existing navigation. Use of the PIN site will also not significantly interfere with the public rights of free passage over the water, nor will it interfere with access to any city landings, easements or any other form of public access to New Bedford/Fairhaven Harbor. Use of the

preferred alternative site will not significantly interfere with the public rights of fishing and fowling, and being a subaqueous site, will not interfere with on-foot passage, swimming or boating around the site.

6.1.4.7 Energy Policy

Energy Policy #1 - For coastally dependent energy facilities, consider siting in alternative coastal locations. For non-coastally dependent energy facilities, consider siting in areas outside of the coastal zone. Weigh the environmental and safety impacts of locating proposed energy facilities at alternative sites.

Energy Management Principle #1 -Encourage energy conservation and the use of alternative sources such as solar and wind power in order to assist in meeting the energy needs of the Commonwealth.

Conformance: The preferred alternative site is not coastally dependent energy facilities and does not require a power source.

6.1.4.8 Ocean Resources

Ocean Resources Policy #1 - Support the development of environmentally sustainable aquaculture, both for commercial and enhancement (public shellfish stocking) purposes. Ensure that the review process regulating aquaculture facility sites (and access routes to those areas) protects ecologically significant resources (salt marshes, dunes, beaches, barrier beaches, and salt ponds) and minimizes adverse impacts upon the coastal and marine environment.

Ocean Resources Policy #2 - Extraction of marine minerals will be considered in areas of state jurisdiction, except where prohibited by the MA Ocean Sanctuaries Act, where and when the protection of fisheries, air and marine water quality, marine resources, navigation and recreation can be assured.

Ocean Resources Policy #3 - Accommodate offshore sand and gravel mining needs in areas and in ways that will not adversely affect shorelines areas due to alteration of wave direction and dynamics, marine resources and navigation. Mining of sand and gravel, when and where permitted, will be primarily for the purpose of beach nourishment.

Conformance: The preferred alternative disposal site is located within areas that have been designated as areas of LCS as specified in the Wetlands Protection Act and Regulations. As described above, the preferred CAD alternative disposal site is not expected to have an adverse permanent effect on marine fisheries caused by localized alterations in water circulation, alterations in relief elevation, sediment grain size or changes in water quality. Implementation of the preferred CAD cell alternative will require mitigation for impacts to LCS (to be developed with regulatory agencies).

6.1.4.9 Growth Management

Growth Management Principle #1 - Encourage, through technical assistance and review of publicly funded development, compatibility of proposed development with local community character and scenic resources.

Growth Management Principle #2 - Ensure that state and federally funded transportation and wastewater projects primarily serve existing developed areas, assigning highest priority to projects that meet the needs of urban and community development centers.

Growth Management Principle #3 - Encourage the revitalization and enhancement of existing development centers in the coastal zone through technical assistance and federal and state financial support for residential, commercial and industrial development.

Conformance: The preferred alternative site is located in areas of New Bedford/Fairhaven Harbor to support the vision of the Harbor Plan to maintain and develop the harbor as an asset for the communities and region.

6.2 Compliance with Federal Regulations/Standards - Aquatic Disposal

6.2.1 Clean Water Act Section 404(b)(1) Analysis

The Code of Federal Regulations at 40 CFR 230 specifies guidelines for implementing the policies of Section 404(b)(1) of the federal Clean Water Act. The guidelines apply to discharges of dredged or fill materials into navigable waters, and their purpose is to restore and maintain the chemical, physical, and biological integrity of waters of the United States. The guidelines are divided into Subparts A through I. Subpart A is a general discussion of the guidelines. Compliance with more specific requirements is discussed below.

6.2.1.1 Subpart B - Compliance with the Guidelines

(a) The discharge shall not be permitted if there is a practicable alternative which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences.

The Alternatives Analysis in Section 4.0 of this FEIR establishes that the preferred alternative is the least environmentally damaging of the alternatives considered.

(b) No discharge shall be permitted if it contributes to the violation of a state water quality standard, violates any applicable toxic effluent standard or prohibition under Section 307 of the Act, jeopardizes the continued existence of endangered or threatened species, or violates any requirement to protect any federally-designated marine sanctuary.

The proposed discharge shall not violate any of these requirements, as discussed in Section 3-0 (Water Quality) and Section 4-0 (Endangered or Threatened Species). The proposed discharge

site is more than 60 miles, via sea, from the closest point of the nearest marine sanctuary, Stellwagen Bank, and will have no effect on it.

(c) No discharge shall be permitted which will cause or contribute to significant degradation of the waters of the United States. This discharge will not cause such degradation, as explained in discussions of the Subparts C through F.

(d) No discharge shall be permitted unless appropriate and practicable steps have been taken to minimize adverse impacts. Steps which will be taken to minimize these impacts are listed in the discussion of Subpart H.

6.2.1.2 Subpart C - Potential Impacts on Physical/Chemical Characteristics of the Aquatic Ecosystem

The discharge will not have a significant impact on physical and chemical characteristics of the ecosystem, as discussed in Section 4.0. Within this section, impacts on sediments are discussed in 4.1; impacts on suspended particulates/turbidity and water column impacts are in 5.0; and current patterns and water circulation in 3.0. The discharge will have no impact on normal water fluctuations, because the proposed disposal location is in an open area where discharges will not interfere with tidal circulation. Since these discharges will not affect circulation and such discharges are not near an area where fresh and salt water mix, it will therefore not affect salinity gradients.

6.2.1.3 Subpart D - Potential Impacts on Biological Characteristics of the Aquatic Ecosystem

The PIN CAD site will have no impact on threatened and endangered species, as discussed in Section 4-0. There are no benthic endangered species in the area which could be covered or otherwise directly killed, and no habitat for these species occurs in any area influenced by the disposal.

The PIN CAD disposal site will not permanently affect fish, crustaceans, mollusks, or other organisms in the aquatic food web. Any benthic organisms affected by disposal will be replaced by recolonizing organisms with aquatic larvae brought in by currents. The dredged material will be capped by clean sediments and therefore the recolonizing organisms will not be affected by toxins or heavy metals.

Other wildlife such as mammals, birds, reptiles, and amphibians will not be affected by the disposal sites. The subsurface open water disposal will not affect their habitat, and any turbidity during disposal will be temporary. Wildlife impacts were discussed in the DEIR (Maguire, 2002).

6.2.1.4 Subpart E - Potential Impacts on Special Aquatic Sites

Sanctuaries and refuges. The preferred alternative PIN CAD l site is not in the vicinity of any designated sanctuaries or refuges.

Wetlands. The preferred alternative PIN CAD site, being in open water removed from shore, will not affect any wetlands, as defined in these guidelines.

Mud flats. The preferred alternative PIN CAD site is all subtidal and will not affect any intertidal mud flats.

Vegetated shallows. Although eelgrass beds do exist in Upper Harbor, they are far enough away from the preferred alternative PIN CAD site so that they will not be affected.

The other two special aquatic sites, coral reefs and riffle and pool complexes, are found only in tropical and subtropical seas and in freshwater streams, respectively, and are not a factor in this project area.

6.2.1.5 Subpart F - Potential Effects on Human Use Characteristics

As a subaqueous disposal site, this project will have no effect on municipal and private water supplies. The preferred alternative PIN CAD site is not in an area of concentration or important migration or spawning areas for species important in recreational or commercial fisheries. Any impacts associated with CAD disposal to the water column or substrate will be temporary and will have no effect on fisheries. Fishery impacts are further discussed in Sections3-0 and 7-0.

Water-related recreation activities will not be affected by disposal. Even if disposal is conducted in the limited period of the year when recreational activities take place, turbidity from disposal, the most probable impact, will be temporary and limited in scope.

The disposal of UDM at the preferred alternative PIN CAD site will have no permanent aesthetic impacts because the subsurface disposal site will not be visible. Temporary changes in appearance of the water will last no longer than the actual disposal operation.

There are no parks, national and historical monuments, national seashores, wilderness areas, research sites, and similar preserves which could be affected by disposal at the preferred alternative PIN CAD sites.

6.2.1.6 Subpart G - Evaluation and Testing

Thorough testing of sediments proposed for dredging from New Bedford/Fairhaven Harbor has been initiated and will be completed in accordance with all regulatory requirements. This includes physical and bulk chemistry testing, bioaccumulation tests, and evaluation of sediment transport and circulation in the vicinity of disposal sites. These results of the chemical and physical testing performed for the FEIR are presented in Sections 3-0.

6.2.1.7 Subpart H - Actions to Minimize Adverse Effects

The following actions, among those listed in Subpart H of the Guidelines, will be taken to minimize averse effects from disposal:

- Confining the discharge to minimize smothering of organisms;
- Designing the discharge to avoid a disruption of periodic water inundation patterns;
- Disposal of dredged material in such a manner that physicochemical conditions are maintained and the potency and availability of pollutants are reduced;
- Selecting discharge methods and disposal sites where the potential for erosion, slumping, or leaching of materials into the surrounding aquatic ecosystem will be reduced;
- Capping in-place contaminated material with clean material or selectively discharging the most contaminated material first to be capped with the remaining material;
- Avoiding changes in water current or circulation patterns which would interfere with the movement of animals;
- Avoiding sites having unique habitat or other value, including habitat of threatened or endangered species;
- Timing discharge to avoid spawning or migration seasons and other biologically critical time periods;

6.2.2 Rivers and Harbors Act of 1899, Section 10

Section 10 of the Rivers and Harbors Act of 1899, authorizes the USACOE to regulate virtually all obstructions to navigation within navigable waters the United States. This section defines navigable waters as *"those waters of the United States that are subject to the ebb and flow of the tide shoreward to the mean high water mark and/or are presently used, or have been used in the past or may be susceptible to use to transport interstate or foreign commerce"*. Because all the dredging projects identified in New Bedford/Fairhaven Harbor are located in navigable waters, they will require a Section 10 permit from the USACE.

6.2.3 Marine Protection, Research and Sanctuaries Act (MPRSA)

The Marine Protection, Research and Sanctuaries Act (MPRSA) of 1972, also known as the Ocean Dumping Act, requires obtaining a permit for discharging some wastes (such as dredged material) and prohibits disposal of others (including radioactive wastes, chemical and biological warfare wastes). Three primary sections of the MPRSA apply to dredging projects:

(1) Section 102 - This section empowers the USEPA to establish the criteria for evaluating all dredged material for open ocean disposal. Section 102 also authorizes USEPA to designate ocean dredged material disposal sites such as CCDS and MBDS.

(2) Section 103 - USACOE has the authority issue Section 103 permits, with concurrence from the USEPA, to dispose of dredged material in the open ocean. The permitting process includes public notice, public hearings, compliance with USEPA criteria, and the use of designated disposal sites, when possible.

(3) Section 104 - The USEPA and the USACOE have the authority to place conditions upon any aspect of ocean disposal operations to minimize negative environmental impacts. Typical conditions are imposed on the type and volume of dredged material, timing and location of disposal, and surveillance and monitoring of disposal activities.

The preferred alternative PIN CAD cell site for New Bedford/Fairhaven Harbor will not require approval under the MPRSA. However, projects including the transportation and disposal of dredged material, CAD disposal options, to either CCDS or MBDS will require testing and approval under the MPRSA.

6.2.4 Endangered Species Act - Section 7

The Endangered Species Act of 1973, protects federally listed and proposed threatened and endangered species. Section 7 of the Act requires the consultation with USFWS and NMFs and an opinion statement. This project is being coordinated with NMFS and the USFWS to determine whether any endangered or threatened species under their jurisdiction may be affected by use of the preferred alternative PIN CAD site in New Bedford/Fairhaven Harbor. To date, staff of NMFS and USFWS have participated in the review of the preliminary upland, aquatic and dewatering site screening processes and have indicated their concurrence with the results of the screening. As the final preferred alternative is selected in this FEIR, CZM has continued to coordinate with both NMFS and USFWS staff in the Section 7 consultation process.

6.2.5 Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA)

The MSFCMA authorizes the NMFS to establish Essential Fish Habitat (EFH) areas. The general purpose of the act is to conserve productive fisheries that provide recreational and commercial benefit. EFH is defined as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity” and all of New Bedford/Fairhaven Harbor is classified as EFH.

Under section 305(b) of the Act, coordination between federal agencies is required for any work proposed within an EFH. The intent and procedures of the Act are very similar to the Endangered Species Act (ESA). CZM has been coordinating with NMFS and USFWS in accordance with Section 7 of the ESA as well as the MSFCMA.

6.2.6 Executive Orders 11988 and 11990

Executive Order 11988 directs federal agencies to avoid long and short term adverse impacts associated with the occupancy and modification of floodplains. Because their construction would not result in any reduction in flood storage, the preferred alternative PIN CAD site would be consistent with this policy.

Executive Order 11990 directs federal agencies to avoid the long- and short-term adverse impacts associated with the destruction or modification of wetlands and to avoid new construction in wetland areas wherever there is a practicable alternative. Where avoidance is not practicable, agencies must take actions to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agencies' responsibilities. Implementation of the preferred alternative PIN CAD will not involve the long term modification of wetlands.

SECTION 7.0 – MITIGATION MEASURES

7.0 MITIGATION MEASURES

In the DEIR, two preferred alternative CAD cell site areas were proposed, CI and PIN (Maguire, 2002). Avoidance, minimization, and mitigation relative to these preferred alternatives were discussed specifically with regard to shellfish, finfish (DEIR, Appendix F), operations and management. Limitation of impacts by implementation of physical, biological, chemical and management techniques is implicit in the approach used to select the preferred alternative in this FEIR. Additional avoidance and minimization measures implicit in the EIR are summarized.

MEPA requires that the EIR identify "…*specific measures to be taken by the Proponent or any other Agency or Person to avoid, minimize, and mitigate potential environmental impacts; an Agency or Person responsible for funding and implementing mitigation measures, if not the Proponent; and the anticipated implementation schedule that shall ensure that mitigation measures shall be implemented prior to or when appropriate in relation to environmental impacts.*" In this section of the FEIR both non-compensatory avoidance and minimization measures and compensatory mitigation measures will be discussed. Avoidance and minimization measures included to arrive at the selected preferred alternative are non-compensatory. Measures not included in the selection process but proposed as mitigation for unavoidable more long-term impacts that require a form of replacement are compensatory.

7.1 Non-Compensatory Avoidance and Minimization Measures

Avoidance and minimization measures incorporated in the selection of the preferred alternative are limiting harmful impacts to the environment. These measures are summarized below.

- Dredging operations will be performed to assure that mixing of the unsuitable material and the suitable material is minimized. UDM will be placed in secure scows to minimize exposure to humans and the environment until the CAD cell(s) are completely excavated at which point the UDM will be safely placed in the bottom of the CAD for perpetuity.

- Sequestering the UDM in the PIN CAD cell will remove it from contact with the overlying water column, and replace it with clean material.

- Specific CAD sites and locations within the area of the preferred alternative will be determined by the specific dredging program developed by New Bedford and Fairhaven. This approach allows flexibility to satisfy users near-term maintenance dredging needs identified in the New Bedford Harbor Port Characterizations, thus, moderate volumes of UDM have a better chance to be removed from contact with the water column in the near future than would otherwise be the case (Maguire, 2002).

- Monitoring of the water column chemistry during CAD cell construction and related dredging projects will measure impact to water quality against thresholds defined by regulators. Avoidance and minimization measures will be taken if threshold exceedences are identified by water quality monitoring.

- Installation of floating semi-permeable turbidity barriers, if determined necessary and feasible, will limit distribution of particulates and minimize turbidity exceedences.

- Information provided on tides, currents, and winds by the detailed CAD cell dredging disposal event modeling can be applied to operational schedules to minimize impacts to water quality. The SSFATE and BF MASS model showed that for any environmental condition the smallest sediment plume and instantaneous chemical release occurred during northwest winds. Northwest winds are prevalent in the fall and winter (ASA, 2003, and see section 5.0)

- Long-term disruption of benthic communities at PIN CAD cell site area will be avoided through site management. Once caps are placed there will be no further disruption of that area. Benthic infauna at the PIN CAD cell site was confirmed to be predominantly opportunistic and pioneering species. Species are expected to recolonize the PIN CAD cells after capping.

- An analysis of the finfish community within New Bedford Harbor shows that imposition of a biological time-of-year dredged material disposal window at the selected preferred alternative can avoid and minimize harmful impacts to finfish known to inhabit the vicinity of the Inner Harbor inclusive of the PIN CAD cell. A detailed discussion of finfish life stages in relation to time-of-year dredged material disposal recommendations are presented below.

7.1.1 Finfish Community Impacted by the Selected Preferred Alternative

An analysis of the finfish community within New Bedford Harbor was conducted to determine when an appropriate open dredging window should occur (i.e., when dredging and dredged material disposal should be allowed). A closed dredging window (i.e., a period when dredging is minimized or avoided) will be established during seasonal peak occurrences of important species, effectively minimizing negative impacts, such as excess turbidity, to these fisheries resources and the harbor ecosystem. An open dredging window (i.e., a period when dredging is maximized) occupies the time-of-year when important species are least present. Important species are those finfish managed by fisheries agencies and non-managed species, all of which are important to the Harbor marine ecosystem. Even though commercial and recreational fishing is closed due to excess contamination within the Inner Harbor, it is important to consider the valuable role of finfish in the Harbor ecosystem at various life stages.

The fisheries resources survey for New Bedford conducted by Normandeau Associates, Inc. (NAI, 1999) in association with the Dredged Material Management Plan was used as the primary reference to determine the seasonal occurrences of fisheries resources within New Bedford Harbor. Additional sources were referenced to augment the primary reference and included the following:

- The Ecology of Buzzards Bay: An Estuarine Profile (Howes and Goehringer, 1996). This source includes specific references to seasonal occurrences of anadromous fish runs within the Acushnet River and other major drainages of Buzzards Bay;

- The First Year in the Life of Estuarine Fishes in the Middle Atlantic Bight (Able and Fahay, 1998). Buzzards Bay is included within the study area of this reference;

- Fishes of the Gulf of Maine (Bigelow and Schroeder, 1953). This source includes numerous references to species occurrences within Buzzards Bay;

- Various EFH Source Documents: National Marine Fisheries Publications (1999) prepared by various authors for each EFH-designated (i.e., "managed") species. These documents include a review of the available literature of the region with numerous references to studies conducted in the northeast, New England, and many times specifically within Buzzards Bay waters and estuaries;

- Buzzards Bay Disposal Site Report; Competing Site Use Assessment (Colburn et al., 2002). This report summarizes recreational fishing in Buzzards Bay; and

- Buzzards Bay Disposal Site Fisheries Trawl Survey Report. March 2001 – March 2002 (Camisa and Wilbur, 2002).

The NAI study included sampling conducted twice per month in New Bedford Harbor from June through October 1998 and May 1999 and once per month in November 1998 through April 1999 at three seine and five trawl stations. The results of the NAI study revealed that the species of finfish identified within the finfish community of the New Bedford Harbor was similar in composition to other estuaries of the northeast. A total of twenty-two species were identified among the three seine sample stations (representing the near shore communities). This total included the following managed species: black sea bass (*Centropristus striata*), bluefish (*Pomatomus saltatrix*), hake sp. (*Urophycis* sp.), scup (*Stenotomus chrysops*), and winter flounder (*Pseudopleuronectes americanus*). Atlantic silverside (*Menidia menidia*), cunner (*Tautogolabrus adspersus*), mummichog (*Fundulus heteroclitus*), striped killifish (*Fundulus majalis*), and winter flounder dominated the seine catch for the three seine stations. Thirty-six fish species were captured in the trawl samples among all stations combined. This total included 8 managed species: Atlantic sea herring (*Clupea harengus*), black sea bass, butterfish (*Peprilus triacanthus*), red hake (*Urophycis chuss*), scup, summer flounder (*Paralichthys dentatus*), windowpane (*Scophthalmus aquosus*), and winter flounder. Black sea bass, cunner, northern pipefish (*Syngnathus fuscus*), scup, and winter flounder dominated the catch for the five trawl sample stations (representing the deeper water community).

The recruitment patterns of abundant fish species with economic and recreational value (scup, cunner, black sea bass, and winter flounder) in New Bedford Harbor were consistent with the published spawning and recruitment seasons for these species in the region. For instance, scup are known to spawn in early May through mid-July (Bigelow and Schroeder, 1953; Steimle et al 1999b) with young of year (YOY) recruiting to inshore waters in early summer, remaining there through September (Able and Fahay, 1998). While summering inshore, in water depths between 6 and 120 feet, scup stay close to shore in schools (Bigelow and Schroeder, 1953). They prefer smooth to rocky bottom (Bigelow and Schroeder, 1953). Scup were apparent in the NT5 trawl in September, while no particular size class was mentioned samples were expected to be the similar

larval stage in size class to those of the NT4 trawls. The NAI study found that cunners were recruited from July through November, which is indicative of an extended spawning season, and consistent with that reported by Wheatland (1956). Black sea bass are known to spawn in deeper waters offshore during summer months. They prefer depths of 18-45 m. When these bass reach 13-24 mm total length (TL) they become demersal and enter estuarine nursery grounds. This is consistent with the findings of the NAI study (NAI, 1999).

The finfish communities and habitat of the deeper-water (i.e., trawl) stations in New Bedford Harbor were very similar among all trawl stations except Station NT5, the station located farthest upriver within the Inner Harbor and proximal to the preferred alternative CAD cell site area at Pope's Island North (PIN). This station represents the finfish community expected to occur proximal to the PIN CAD cell site area. Station NT5 had a shallower depth (2-3 m) in comparison to the other trawl stations throughout the harbor, which ranged from 5 to 9m deep. The NAI study notes some presence of shells and gravel over sand and silt in their substrate description of sampling station NT5. There may have been patches of gravel and shell, but it is expected that the coarse material recognized in the trawl sample was not uniformly distributed at the trawl station (NAI, 1999). The surficial vibracores and grab sample programs for PIN showed predominant percentages of silt and clay in samples (Maguire, 2003; ENSR, 2003). The comparison of the percent contribution (by geometric mean catch-per-unit-effort) among the top five most abundant species and all remaining species captured at NT5 were as follows: winter flounder (52.5%) seaboard goby (*Gobiosoma ginsburgi*)(9.5%), Atlantic silverside (8.1%), bay anchovy (*Anchoa mitchilli*) (6.5%), windowpane (5.7%), and all other (eleven) species combined (17.8%) (NAI, 1999).

Due to their demersal egg, larvae, juvenile, and adult life stages, winter flounder are especially susceptible to dredging-induced, and dredged material disposal-induced turbidity. This managed species was present in trawl NT5 captures every month except July, with peak abundances occurring from October through December. Suitable spawning conditions occur when water temperatures drop below 10°C, which was determined to occur during the study as early as November. Larvae are reported to be abundant in Buzzards Bay waters from March through June. Young winter flounder are reported to remain within embayments their first year, move out into more open waters during summer months, then return to spawning areas in late fall (Howes and Goehringer, 1996). Recruitment of YOY (<100mm TL) was noted within the Inner Harbor in November. At this time, juveniles (100-200 mm TL) were more common at NT5 than at any other station, indicating that the Inner Harbor provides an important nursery for winter flounder. There was little evidence of YOY winter flounder recruitment during other months (NAI, 1999).

Diadromous fish were also collected within New Bedford Harbor during the NAI study. American eel (*Anguilla rostrata*), a catadromous species, was collected from one trawl sampling location in November. Anadromous fish run the Acushnet River in high abundance early in the year to spawn at upstream locations. Spring runs in the Acushnet River range between January and March with the peak of the run in February and March (Jim Turek, personal communication, 2003). Juveniles come down stream as early as August peaking in September and continuing to run to October (Jim Turek, personal communication, 2003) in the Acushnet. Alewife (*Alosa pseudoharengus*), rainbow smelt (*Osmerus mordax*), blueback herring (*Alosa aestivalis*), striped bass (*Morone saxatilis*) and white perch (*Morone americana*) are anadromous fish species that

were caught in trawl samples within New Bedford Harbor. Rainbow smelt are the first anadromous fish to migrate up tidal streams to brackish and freshwater systems for spawning. They begin their upstream spawning runs as early as February and continue into April. Alewives begin spawning migrations to freshwater ponds in late April to early May, depending on water temperature (Howes and Goehringer, 1996). The larvae stay within the spawning ponds only briefly, migrating out to the estuaries beginning in July and continuing through the fall. Likewise, blueback herring enter estuaries in mid-May to begin their spawning runs upriver. They are common throughout Buzzards Bay in later summer and fall. Although they are not managed species, they provide an important food source to bluefish and striped bass (Howes and Goehringer, 1996), and are the target of recent restoration efforts within the area (J. Turek, personal communication). Striped bass (*Morone saxatilis)* occurs within New Bedford Harbor from July through October. A summary of diadromous fish species, life stages, seasonal occurrence and presence confirmed within New Bedford Harbor is provided in Table 7-1.

Table 7-1. Diadromous fish species, life stages, seasonal occurrence and presence confirmed by the Normandeau trawl survey within New Bedford Harbor.

Species	Life Stages	Seasonal Occurrence	Presence Confirmed in New Bedford Harbor
American eel	A, J	November (NAI, 1999)	Lower Reach of Inner Harbor (NAI, 1999)
Alewife	A, J	Upstream: April - early May Downstream: Fall (Howes and Goehringer, 1996)	Captured in Outer Harbor in September (NAI, 1999)
Rainbow smelt	A, J	February through April.	Outer Harbor and Lower Reach of Inner Harbor (NAI, 1999)
Blueback herring	A, J	mid-May (Howes and Goehringer, 1996)	Reported in NAI (1999) comp. list of spp. captured in trawls, but does not appear within any station-specific lists
Striped bass	A	July, October (NAI, 1999)	Upper and Lower Reaches of Inner Harbor (NAI, 1999)
White perch	A, J	March (NAI, 1999)	Lower Reach of Inner Harbor (NAI, 1999)

A = Adults J= Juveniles

Highly migratory gamefish, such as blue fish and weakfish are expected to frequent the Harbor and Acushnet River estuary in pursuit of their favored prey during the summer. Favored prey includes herring, mackerel, butterfish, anchovies, scup, flatfishes, etc. (Bowman, 2000).

Natural sedimentation is expected to replicate existing seafloor habitat over constructed CAD cell caps (See ENSR, 2001 for Boston Harbor example); artificial habitat mitigation is therefore not proposed.

7.1.2 Biological Time-of-Year Dredged Material Disposal Windows for the Selected Preferred Alternative

The results of the NAI study identified the species and seasonal occurrences of both anadromous and EFH-designated (i.e., “managed”) finfish species within the harbor (Figures 7-1 and 7-2). Based on the results of the seasonal occurrences of these finfish resources, appropriate biological

time-of-year open dredging and dredged material disposal windows can be developed, in concert with a specific project proposal, based on the DMF recommendations.

7.2 Compensatory Mitigation Measures

Comments on the DEIR from the representative of the MA DMF indicated that compensatory mitigation through propagation should be provided for impacts on shellfish species at the disposal site on a project-by-project basis with assistance from a specific MA DMF shellfish biologist. Northern quahogs, *(Mercenaria mercenaria)* and soft-shell clams *(Mya arenaria)* are the two important sedentary shellfish species that will be negatively impacted by PIN CAD cell construction (MA DMF). A brief descriptive summary of these two indigenous shellfish populations and the proposed compensatory replacement mitigation is provided below.

7.2.1 Economically Important Sedentary Shellfish at the PIN CAD Cell Site Area

Research that supported preparation of the DEIR did not include benthic invertebrate sampling of the two economically important species of sedentary shellfish; northern quahogs and soft-shelled clams. However, previous DMF studies in the region contained some information on the abundance of these shellfish in the PIN CAD cell area of New Bedford Harbor (Whittaker, 1999). MA DMF sampled the New Bedford Harbor and Acushnet River estuary complex in order to identify important shellfish resource areas. In the same 1999 DMF report, sampling areas for shellfish that overlap the PIN CAD cell area showed a significant percentage (i.e., greater than 30%) of the cherrystone size class of the quahog, and a significant percentage (i.e., greater than 20%) of the littleneck size-class of the quahog The soft-shell clam was also found to be abundant at this location. The number of bushels of specific size-class quahogs per acre was calculated using an area-density method. The average number of cherrystones per acre for two sampling areas overlapping the PIN CAD cell area ranged from roughly 150 in the northern area west of Marsh Island to 450 south of Marsh Island in the direction of Popes Island (Whittaker, 1999). In the sampling area west of Marsh Island, nearly one bushel of soft-shell clams, evidently high-density, was retrieved on two sampling tows. However, all of New Bedford/Fairhaven Harbor waters north of the hurricane barrier are closed to shellfishing (DMF, 1999).

When interviewed for this section of the FEIR, DMF supported the finding of the 1999 study that the filter feeding sedentary bivalve mollusks, quahogs and clams, of the PIN CAD cell area were contaminated with PCBs to the extent that they were unfit to be purified for human consumption (Whittaker personal communication, 2003). The American oyster *(Crassostrea virginica),* also filter feeding sedentary bivalve mollusks, were collected for toxicity analysis from the area west of Marsh Island that overlapped the PIN CAD cell for the 1999 DMF survey. The 1999 American oyster sample was reported to have of 3.60 ppm. PCBs. This level of PCBs exceeded the 2.0 ppm. PCBs threshold for human consumption. MA DMF stated that any of the important northern quahogs or soft-shelled clams negatively impacted by PIN CAD cell construction dredging will be lost (Whittaker personal communication, 2003).

The DEIR noted that the quahogs and soft-shell clams that would be lost in construction of PIN CAD cell(s) are important to the estuarine harbor ecosystem through reproduction potential as

prey for other organisms and water filtering capacity. DMF will require compensatory replacement of the lost shellfish. The construction proponent(s) may be required to replace a specific quantity of quahogs and clams as a project permit condition. DMF will mathematically formulate the loss of these shellfish per acre of impact due to PIN CAD cell construction as a service for potential proponent(s) on a project-by-project basis in cooperation with local municipal shellfish constables.

New Bedford and Fairhaven operate shellfish management jurisdictions under the direction of municipal shellfish constables. Local municipal shellfish management will apply the best management practice for restocking mitigated quahogs and clams in their respective jurisdictions. The schedule for restocking will be determined by local shellfish constables. Restocking mitigated quahogs and clams will enhance the harbor shellfish populations and offset negative impacts to the established shellfish populations and surrounding estuarine harbor ecosystem.

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Figure 7-1. Diadromous Fish Species of New Bedford Harbor and Adjacent Buzzards Bay - Seasonal Occurrence of Life Stages Most Susceptible to Dredged Sediment Disposal Activities

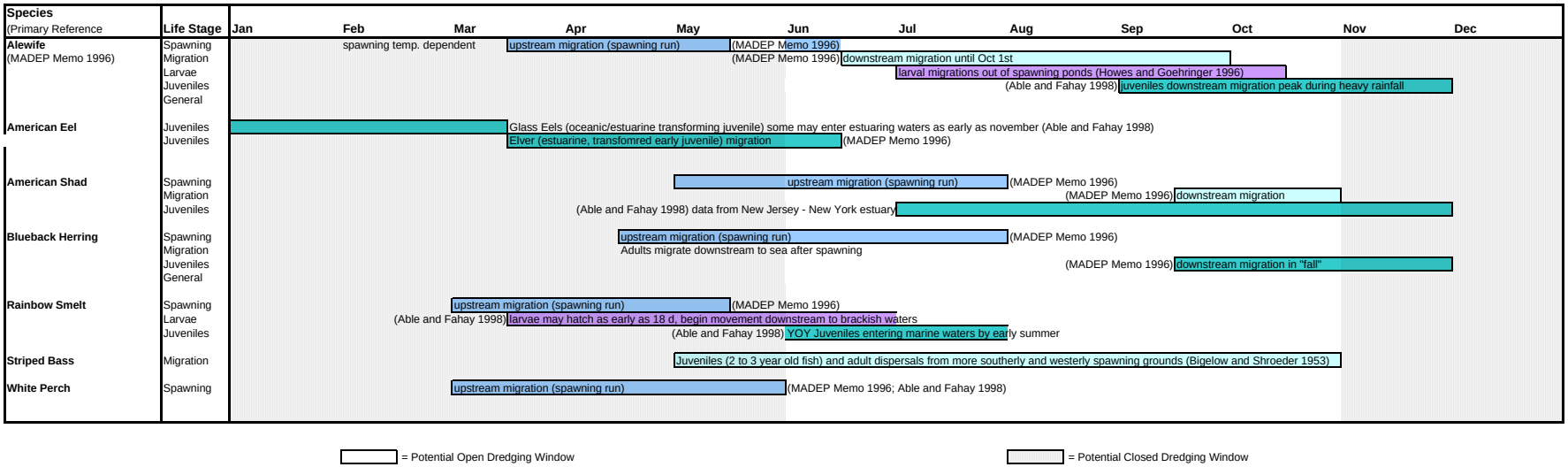
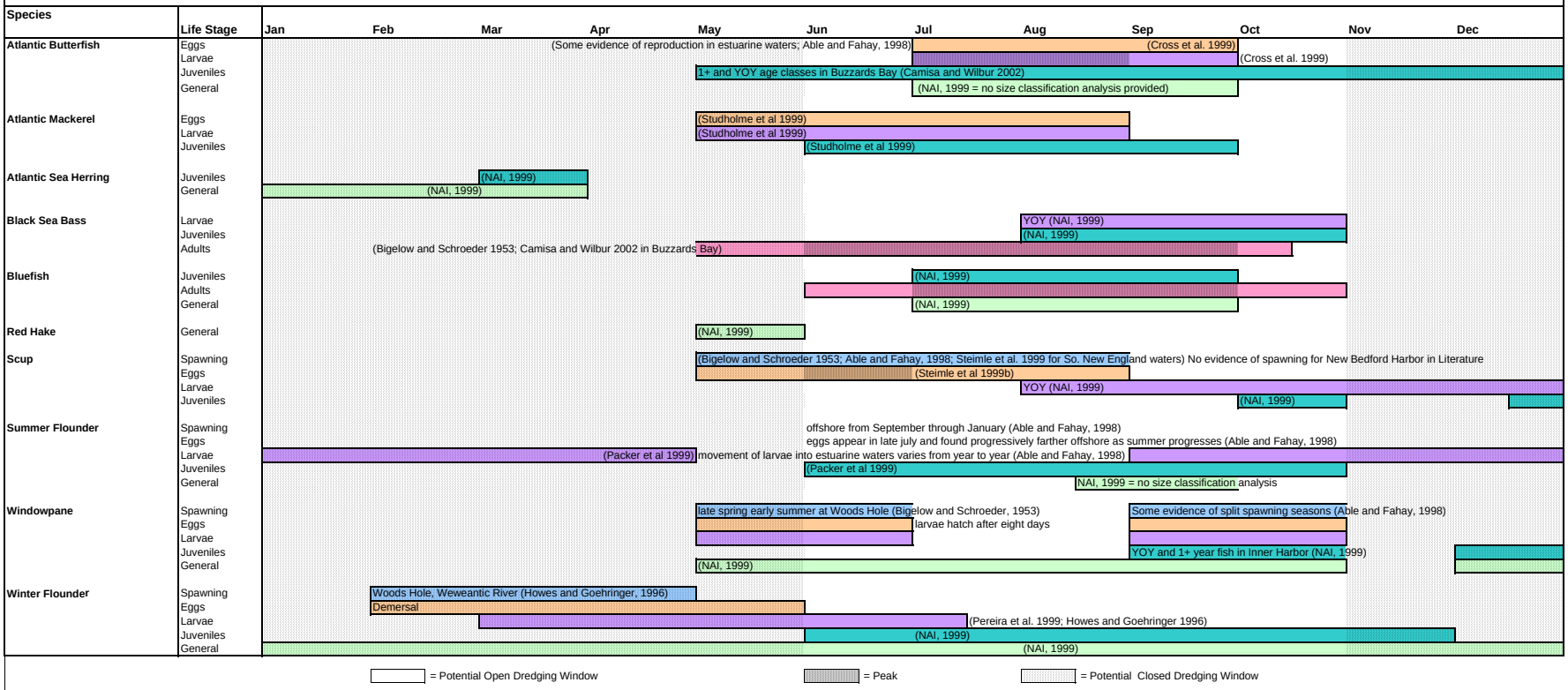


Figure7-2. Seasonal Occurrences of EFH Species Confirmed within the Vicinity of New Bedford Harbor (NAI, 1999) and Vicinity (Other References)



SECTION 8.0 – DREDGING MANAGEMENT PLAN

8.0 DREDGING MANAGEMENT PLAN

This FEIR identifies the Pope's Island North site as the preferred alternative, and recommends that the PIN area be designated by the Secretary of EOEA as an approved location for the construction of CAD cells. This section describes and provides the framework for the management tools that must be developed to support use of the designated CAD area by individual projects.

As is discussed above, this FEIR distributes capacity, based on the geotechnical characteristics of the PIN area, in a conceptual scheme that serves as the basis for long-term use of the CADs. The specific size and location of individual CADs located within the PIN area will be determined by the specific dredging program developed by New Bedford and Fairhaven. Local, state, and federal permitting requirements (or equivalent authorizations – see below) require detailed and site specific information regarding site engineering, chemistry, mitigation, and operations that will be developed by future project proponents. This section provides the framework for the following elements of the dredging management plan:

- Project management (design, permitting, operations, monitoring)
- Draft 401 Water Quality Certification Regulations (314 CMR 9.00)
- Approved sediment sampling and testing plan
- Project management plan (operations plan)
- Best management practices for CAD (planning, design, construction, disposal, capping, monitoring)
- Model Water Quality Certificate
- Independent Third Party Inspection

8.1 Project Management

The FEIR recommends a management structure under which New Bedford and Fairhaven manage CAD use under the terms of a Water Quality Certificate and Chapter 91 Waterways license of permit, or equivalent authorizations. (Under the terms of the Record of Decision for the New Bedford/Fairhaven Harbor PCB Superfund project, navigation dredging may be undertaken under the auspices of the state enhanced remedy. If so, the substantive requirements of the state regulatory programs must be met, but the certificate, license or permits themselves would not be issued.) The town and city will need to demonstrate that they and/or their consultant(s) have the professional capacity and experience to actively manage the dredging contractor. Local management will be augmented by the services of a Third Party Inspector, who will observe field operations in the context of project authorizations and report directly to the Department of Environmental Protection (DEP). As recommended by the DEIR, the FEIR recommends that a Technical Advisory Committee (TAC) be established to assist DEP. The TAC can be an ad hoc group of local, state and federal agency staff available to respond to questions, to review ongoing project monitoring information, and/or make recommendations to DEP as requested.

It is important to emphasize that CAD operations are not a routine marine construction process. State and federal agencies' experience with the Boston Harbor CADs amply demonstrated that

field operations do not always conform to expected conditions, and that their must be an established feed-back loop between the contractor, the manager, and regulators. In some instances it may be the Third Party Inspector who provides that function, but in other situations the perspective of the TAC members can be invaluable in providing DEP and/or the contractor with the guidance needed to make decisions regarding the interpretation of permit conditions. In addition, the presence of a TAC allows the Water Quality Certificate (or equivalent) to be written to give the give the contractor greater flexibility in operations, as opposed to being a restrictive permit that requires continual and time-consuming formal amendment as unexpected conditions are encountered in the field.

In summary, under this approach the city and town would manage the CADs subject to applicable local, state and federal authorizations; a Third Party Inspector will provide field oversight for DEP; and a Technical Advisory Committee to be determined will assist DEP in monitoring CAD operations. The FEIR anticipates that the management structure for use of the PIN CADs will be formally defined in the development of the Water Quality Certificate or Chapter 91 Waterways license or permit, or equivalent.

8.2 Draft 401 Water Quality Certification Regulations (314 CMR 9.00)

The DEP is currently finalizing revised regulations to govern state 401 Water Quality Certifications (314 CMR 9.00). The regulations, currently in draft, address dredging and aquatic and upland disposal and reuse through an integrated regulatory framework. The draft regulations also draw on DEP's experience with the Boston Harbor Navigation Improvement Project and include provisions that specifically address CAD disposal. The provisions of the draft regulations specific to CADs are summarized below.

General

- Confined aquatic disposal of material unsuitable for open ocean disposal shall include management techniques to isolate the material from the surrounding environment.
- Factors governing the evaluation of a site's suitability for confined disposal include fisheries, shellfish, wetland resources, fisheries habitat, recreational activities, hydrodynamic characteristics, geotechnical characteristics and unique site factors and conditions.

Placement

- Dredged material placement shall be designed to minimize release of sediment to the environment
- placement shall occur during specific periods of time to minimize dispersion and transport and maximize dilution
- Adequate consolidation time shall be provided prior to cap placement

Design standards

- Vessel traffic impacts to operational CADs shall be minimized
- A water quality model shall be employed to assess compliance with water quality standards and to determine if disposal management restrictions are necessary

- If possible, more contaminated material shall be placed in CADs first, to provide additional environmental protection
- CAD cell caps shall be placed to minimize the disturbance of material in the cell
- For cap placement, the amount, location, and track of the disposal vehicle over the cell shall be documented; surveys shall verify that required cap areal and vertical coverage is achieved; cap material shall be placed wet; tugs shall be used to propel deep draft placement vessels to minimize prop wash; the cap shall cover a minimum of 90% of the surface area of the cell; and the required thickness of the cap shall be comprised of at least 70% sand or other approved material.

Monitoring (in addition to chemical and physical monitoring of on-going project operations – see DEIR section 9.0)

- A disposal management plan shall be developed
- Bathymetric surveys shall be conducted prior to cell excavation, after cell is excavated, after the disposal of dredged material, and after the cap is placed
- Baseline water quality chemistry shall be established prior to any dredging or disposal
- Each disposal event shall document operation, navigation, and meteorological conditions
- CAD cell caps shall be monitored at one and five year intervals post closure to evaluate cap thickness and long-term cap integrity; benthic recolonization shall be monitored at one year post closure

8.3 Sediment Sampling and Testing Plan

Project-specific sediment testing of the surficial CAD sediments will be necessary to characterize the material for disposal or reuse alternatives. The extent and frequency of samples will be determined by the proposed disposal/reuse option. It is not possible to provide a formal and approved sampling plan until the volume to be dredged and the selected location of the CAD and its underlying geophysical characteristics have been determined, because the surficial footprint of the CAD will be determined by those factors. Alternatively, the entire PIN area could have been sampled and tested, but that would not have been cost effective, given the proposed sequential use of the area, and because sediment data and suitability determinations derived from there have a five-year shelf life.

To provide most of the necessary information, and allow project-specific sampling and testing to proceed expeditiously, this FIER has developed a formal sampling and testing plan for the entire PIN CAD area, submitted the plan for review by the Corps of Engineers and its sister federal agencies, and received formal plan approval. Thus, once specific projects are defined, the appropriate aspects of the approved sampling and testing plan can be identified and coordinated with DEP and the Corps in the context of the disposal/reuse options being considered. In addition to providing accurate cost figures for project planning, this should significantly expedite the sampling and testing schedule. The approved plan is presented in Appendix A of this Section.

8.4 Dredging Management Plan

This FIER provides the outline of a Dredging Management Plan (DMP) for CAD operations. The DMP outline was developed by the Corps of Engineers Project Manager for the Boston Harbor CAD project in association with the Independent Observer for the same project, and is based on their mutual, extensive experience with the design, permitting, and operations of the Boston project (ENSR, 2001). That experience is documented in *Summary Report of Independent Observations Phase 1 - Boston Harbor Navigation Improvement Project*, ENSR, October 1997; and *Boston Harbor Navigation Improvement Project Phase 2 Summary Report*, U.S. Army Corps of Engineers, New England District and Massachusetts Port Authority Maritime Department, May, 2002. A DMP will be a required element of the Water Quality Certificate or Chapter 91 Waterways license or permit, or equivalent authorization, in conjunction with all applicable information required pursuant to the draft regulations at 314 CMR 9.00.

The Model DMP presented below is based on the Boston Harbor CAD project (ENSR, 2001) and was developed for a fictitious harbor. The intent of the model is NOT to provide a template for a similar authorization for New Bedford/Fairhaven, but to provide an example of the kinds of information that should be incorporated in a formal DMP.The model DMP is presented in Appendix B of this Section.

8.5 Best Management Practices for CAD Operations

This FEIR provides Best Management Practices (BMPs) for CAD operations that should be considered in conjunction with the DEP draft regulations at 314 CMR 9.00 in the development of project-specific plans. The BMPS were developed by the authors described above (ENSR, 2001) based on their experience with the Boston Harbor CAD project. Not all aspects of the BMPs will be applicable, and, where they may conflict with the DEP regulations at 314 CMR 9.00, the DEP regulations control. The BMPs are provided as guidance only. The model BMPs document is presented in Appendix C of this Section.

8.6 Model Water Quality Certificate

The DEIR describes a tiered approach to water quality monitoring, based on experience with the Boston Harbor CAD project and other major projects. The specific elements of the Water Quality Certificate, or equivalent authorization, will be developed by DEP and based on the draft regulations at 314 CMR 9.00. The Model Water Quality Certificate presented below is based on the Boston Harbor CAD project (ENSR, 2001) and was developed for a fictitious harbor. The intent of the model is NOT to provide a template for a similar authorization for New Bedford/Fairhaven, but to provide an example of the kinds of monitoring in Boston Harbor that proved to be successful (i.e., provided meaningful data that could be used to make informed and timely decisions about project operations, potential impacts, and regulatory conditions imposed on the project) and, sometimes, not as successful. The model Water Quality Certificate is presented as Appendix D of this Section.

8.7 Third Party Inspector

The following is a description of the Third Party Inspection Program provided by DEP.

8.7.1 Introduction and Purpose

The Massachusetts Department of Environmental Protection ("DEP") requires that the permittee retain the services of an independent third-party inspector to participate in field decisions and to monitor compliance with the 401 Water Quality Certificate ("401 WQC") during dredging and related activities.

The objectives of the third party inspection program are:

1. to monitor all dredging and related activities to assure compliance with the 401 WQC; and
2. to provide interpretation of 401 WQC conditions and standards at the request of the permittee.

This document establishes the Independent Third Party Inspection Program ("3PIP") and outlines the responsibilities of permittee, DEP, and the Third Party Inspector ("3PI") under the 3PIP. Notwithstanding the duties of the 3PI stated herein, DEP reserves the right to inspect the Project at any time.

8.7.2 Selection of Independent Third-Party Inspector

8.7.2.1 Process

The selection of the 3PI shall be a collaborative effort of permittee and DEP. The permittee shall present the names of a qualified 3PI to DEP no later than 20 days prior to commencement of construction. If DEP does not make a selection within 10 days of receipt of the names, the permittee may invoke the dispute resolution mechanism set out in Section 7 below. In the event DEP rejects all candidates identified by the permittee, DEP shall state the reasons for such denial with particularity. The permittee may then either provide additional candidates or invoke the dispute resolution mechanism set out in Section 7 below.

8.7.2.2 Qualifications

The 3PI shall have the following minimum qualifications:

1. a degree in an environmental science or environmental engineering (or equivalent working experience) and a working knowledge of marine ecosystems;
2. the 3PI shall have dredging inspection experience;
3. the ability to clearly understand and articulate state and federal permits and conditions and effectively communicate with appropriate contractor and agency personnel;
4. the ability to clearly document activities being inspected;

5. qualified support staff with appropriate facilities to carry out the Duties and Responsibilities set forth in Section 3.0 of this document in a timely manner.

8.7.2.3 Approval

No 3PI shall be formally and finally engaged for service on the Project prior to DEP selection as referenced above.

8.7.2.4 Duties and Responsibilities

There shall be at least one 3PI per construction spread, whose duties shall consist of the following:

1. Prior to construction, become thoroughly familiar with pertinent Project documents, and relevant plans, etc.
2. Prior to construction, become thoroughly familiar with the terms and conditions of the Army Corps of Engineers permit, the 401 WQC, and the local Wetlands Protection Act ("WPA") Orders of Conditions for the Project.
3. Monitor dredging and related activities of the Project for compliance with the 401 WQC.
4. Maintain whatever records and photographs are necessary for the recording of observations, events, and possible non-compliance with 401 WQC conditions. Submit written reports to the DEP Project Manager, as required in Section 4.0 below.

It is expected that the 3PI will work with the permittee to identify and avoid permit compliance problems. If the 3PI observes a 401 WQC violation that poses an immediate threat to a protected resource, s/he may direct the contractor to cease the activity and/or take immediate corrective action. The 3PI may make informal recommendations to permittee as appropriate to ensure permit compliance. The 3PI shall have authority to submit compliance issue reports to DEP as set forth in Section 4.0 and may contact DEP at any time to communicate a violation. If the 3PI orally reports a violation to DEP, the 3PI shall provide immediate notice to the permittee and document the violation in writing.

8.7.3 Activity Documentation and Communication

8.7.3.1 Routine Reporting

The 3PIs will submit weekly written reports of their activities to designated contact(s) within DEP, with copies to the permittee. These reports shall include a summary of daily activities as they relate to permit conditions or permit condition interpretations and other notable or significant activities.

8.7.3.2 Required Action Report ("RAR")

RARs will be completed by the 3PI to record a matter requiring corrective action, including potential violation of the 401 WQC, and generally will follow failure to address problems identified.

An RAR will be completed only when the permittee has failed to take corrective action after having been notified of a problem. Before submitting an RAR, the 3PI will consult with the permittee concerning the circumstance potentially requiring the issuance of the report and provide an opportunity for the permittee to take corrective measures. If corrective action is not taken, the 3PI shall consult with the DEP, and if appropriate, complete the RAR and issue copies to the permittee and DEP. Final resolution of the RAR will be recorded by the 3PI and documented to DEP when the situation has been corrected.

8.7.4 Communication and Coordination

8.7.4.1 Communication with DEP

The 3PI shall report directly to DEP. The 3PI shall contact DEP staff to obtain clarifications, intent and interpretation of conditions, and to discuss issues of compliance. DEP's determination as to interpretations of the 401 WQC and conditions shall be binding on the 3PI. If a potential noncompliance issue is identified which requires some interpretation of the 401 WQC and conditions, the 3PI shall consult with DEP staff and determine whether, in fact, a non-compliance issue or permit violation is present. In turn, DEP staff will contact the 3PIs to solicit comments and input for site-specific issues, permit modifications, and other relevant permitting approvals. DEP will coordinate field inspections with the 3PI.

8.7.4.2 Coordination with Project Staff

Environmental Inspectors. Notwithstanding the 3PI's direct reporting obligation to DEP, it is expected that the 3PI will maximize communication and coordination with permittee as a means of avoiding permit compliance problems.

Contractor Personnel. In order to maintain the proper chain of command for information dispersal, the 3PIs shall not interact directly with contractor personnel unless they see a potential violation of the 401 WQC and conditions that poses an immediate threat to a protected resource. The 3PIs shall immediately notify the permittee's designee of any violations of the 401 WQC and conditions. The 3PIs shall not direct the activities of contractor personnel except when he observes a 401 WQC violation that poses an immediate threat to a protected resource, in which case he may direct the contractor to cease the activity and/or take immediate corrective action.

8.7.5 Program Implementation

This section provides a discussion of the specific activities undertaken by the 3PI in implementing the 3PIP.

8.7.5.1 Construction Activities

The 3PI shall review and become familiar with the project. An overview of the Project will be provided to the various agency, inspection, and contractor personnel and set the ground rules for the Project with regard to construction, safety, and environmental compliance.

The 3PI shall retain all log books, data forms, photos and other records in connection with the Project and shall make such records reasonably available for inspection by DEP and the permittee. It is expected that the 3PI will maintain detailed records such that a full post-dredging report can be generated, if requested.

8.7.6 Dispute Resolution

This section details how disputes in the selection of the 3PI or in the field shall be resolved.

Any dispute over the selection of the 3PI shall be decided by the Director of DEP's Wetlands and Waterway Program in Boston after an opportunity by both staff and the permittee to be heard. The Director's decision shall be final.

Disputes in the field over the 401 WQC and conditions shall be resolved as follows:

1. In the first instance, the parties (the 3PI, the permittee, and DEP Project Manager) shall engage in informal discussions within a period of 12 hours.

2. If the dispute persists, any party may appeal to the Director.

Disputes in the field over conflicts between the 401 WQC and conditions shall be resolved as in 7.2. However, any appeal by the parties must be made the Director or his/her designee.

8.7.7 Evidentiary Privilege

Neither the 3PI nor the permittee may claim any evidentiary privilege to prevent disclosure of communications, written or oral, between the 3PI and the permittee or the permittee's agents.

APPENDIX A

The Approved Sampling Plan

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RECEIVED
SEPT 15
2003

CENAE-R-PT (1145-2-303B) 9 September 2003

MEMORANDUM FOR: Brian Valiton, Project Manager, CENAE-R-PEA

SUBJECT: Sampling Plan for New Bedford Harbor CAD Site, New Bedford Harbor, New Bedford and Fairhaven, MA. Application Number 2003-01360.

1. In response to your request of 26 June 2003, I have developed a sampling plan for the above project. The applicant is proposing to mechanically dredge approximately 2,677,025 cu. yds. of material from an area of approximately 90 acres in New Bedford, MA and dispose of it at the Buzzards Bay Disposal Site (BBDS). This dredging project is composed of two sections. The first is the top four feet of the sediments which have been designated as sediments contaminated enough to require managed disposal. The upper layer of significant contamination has been identified by following metal contaminant profiles to a minimal concentration horizon, (Memorandum of 19 June 2003, to ACOE from Maguire Group, Inc, Henry Merrill, Senior Environmental Planner).

[Editor's note: The suitability determination process is designed to determine whether dredged material contains levels of contaminants that would render it unsafe for unconfined open-water disposal. The closest such site to New Bedford is the Buzzards Bay Disposal Site (BBDS).

This suitability determination is not an application to the Corps fro the use of the BBDS, but an application for the issuance of a sampling plan that may be used by private, municipal and/or federal dredging projects in the future.]

Below this layer of approximately 580,000 cu. yds. lies material that has the potential to be suitable for open water disposal. This is because the depth of this layer (-4' MLW to -14 MLW) places it below the horizon above which sedimentation rates over the last 150 years would have exposed it to contamination from historical anthropological inputs to the harbor. This layer (with an approximate volume of 2,677,025 cu. yds.} is the material the applicant is proposing to dredge and dispose of at the Buzzards Bay Disposal Site (BBDS).

2. SPILLS & OUTFALLS: New Bedford Harbor has a 150-year history of heavy industrial use. This history results in numerous spills and inputs of contaminants of concern. The most significant contaminant of concern in the Harbor are the polychlorinated biphenyls (PCB) which were deposited in the 1930's, 1940's and 1950's during the heyday of a local electrical transformer industry. These resulted in PCB concentrations of 5-50 ppm in the immediate vicinity of the Project location (see Figure 1).

3. Six cores (NB-1 through NB-6) should be taken from the area to be dredged according to the attached plan (see Figures 2 and 3). Core samples should be taken to the proposed dredge depth. All sediments being held for testing should be stored in accordance with the requirements of Table 8-2 in Evaluation of Dredged Material Proposed for Ocean Disposal, Testing Manual, 1991.

4. Cores should be subsampled and analyzed for grain size, PCBs and metals at two-foot intervals and the results from these analyses reported to me before any compositing is performed. I will review the data and determine if compositing is appropriate.

5. Bulk sediment chemistry analyses should be done on each composite sample according to the Guidance for Performing Tests on Dredged Material to be Disposed of in Open Waters, (draft, May 15, 1989). The test parameters should include all of the items on the attached sheet except for the metals and PCBs that were tested previously. These parameters are extracted from Table 1A and Table 1B of the Guidance for Performin~ Tests on Dredged Material to be Disposed of in Open Waters. The detection limits should be those indicated on the attached sheet. The listed analytical methods are recommended but can be replaced by other methods that will give the required detection limits. The Total Organic Carbon analysis (TOC) should be done in duplicate on each composited sample and a TOC Standard Reference Material (SRM} should be run with the sample batch.

5. Copies of this draft sampling plan were sent to the State DEP, US EPA and US NMFS. The EPA concurred with the sampling plan. The other agencies did not respond and their *concurrence* is assumed.

6. If you, the applicant or the testing laboratory have any questions, feel free to call me at (978) 318-8336.

CHARLES N. FARRiS
Project Manager
Marine Analysis Section

BULK SEDIMENT *TESTING* PARAMETERS

Parameter	Analytical Method	Detection Limit (ppm)
Metals		
Arsenic	7060, 7061	0.5
Cadmium	7130, 7131	0.1
Chromium	7190, 7191	1.0
Copper	7210	1.0
Lead	7420, 7421	1.0
Mercury	7471	0.02
Nickel	7520	1.0
Zinc	7950	1.0
PCBs (total by NOAA summation of congeners)	8082	0.001
Pesticides	8081A	0.02
Aldrin	Endrin	
Chlordane	Hexachlorobenzene	
DDT	gamma *Hexachlorocyclohexane* (Lindane)	
DDE	Heptachlor	
DDD	Heptachlor Epoxide	
Dieldrin	Methoxychlor	
Endosulfan I	Toxaphene	
Endosutfan II	Trans-nonachlor	
Endosulfan Sulfate		
Polyaromatic Hydrocarbons (PAH's)	8270	0.02
Acenaphthene	Chrysene	
Acenaphthylene	Dibenzo(a,h}anthracene	
Anthracene	Fluoranthene	
Benzo(a)anthracene	Fluorene	
Benzo(a)pyrene	Indeno(1, 2, 3-cd)pyrene	
Benzo(b)fluoranthene	Naphthalene	
Benzo(k)fluoranthene	Phenanthrene	
Benzo(g, h, i)perylene	Pyrene	
Dioxins/furans	8290	5 parts per trillion
Total Organic Carbon	9060	0.1%
Percent Water		1.0%
Grain Size	Wet Sieve (#4, 10, 40,200)	

CENAE-R-PT
SUBJECT: Draft Sampling Plan for New Bedford Harbor CAD Site, New Bedford Harbor, New Bedford and Fairhaven, MA. Application Number 2003-01360.

PCB CONGENERS

Analytical Method: EPA Method 8082 Target Detection Limit: 1 ppb Congeners

8*	2,4' diCB
18*	2,2',5 triCB
28*	2,4,4' triCB
44*	2,2',3,5' tetraCB
49	2,2',4',5 tetraCB
52*	2,2',5,5' tetraCB
66*	2,3',4,4' tetraCB
87	2,2',3,4,5' pentaCB
101 *	2,2',4,5,5' pentaCB
105"	2,3,3 ',4,4' pentaCB
118*	2,3 ',4,4',5 pentaCB
128"	2,3,3',4,4' hexaCB
138*	2,2',3,4,4',5' hexaCB
153"	2,2',4,4',5,5' hexaCB
170*	2,2',3,3 ',4,4',5 heptaCB
180*	2,2',3,4,4',5,5' heptaCB
183	2,2',3,4,4',5',6 heptaCB
184	2,2',3,4,4',6,6' heptaCB
187*	2,2',3,4',5,5',6 heptaCB
195*	2,2',3,3',4,4',5,6 octaCB
206*	2,2',3,3',4,4',5,5',6 nonaCB
209*	2,2',3,3',4,4',5,5',6,6' decaCB

The specified method is a recommendation only. Other acceptable methodologies capable of meeting the Target Detection Limits can be used. Sample preparation methodologies (e.g. extraction and cleanup) and sample size may need to be modified to achieve the required target detection limits.

• denotes a congener to be used in estimating Total PCB. To calculate Total PCB, sum the concentrations of all eighteen congeners marked with a "*" and multiply by 2.

Figure 1

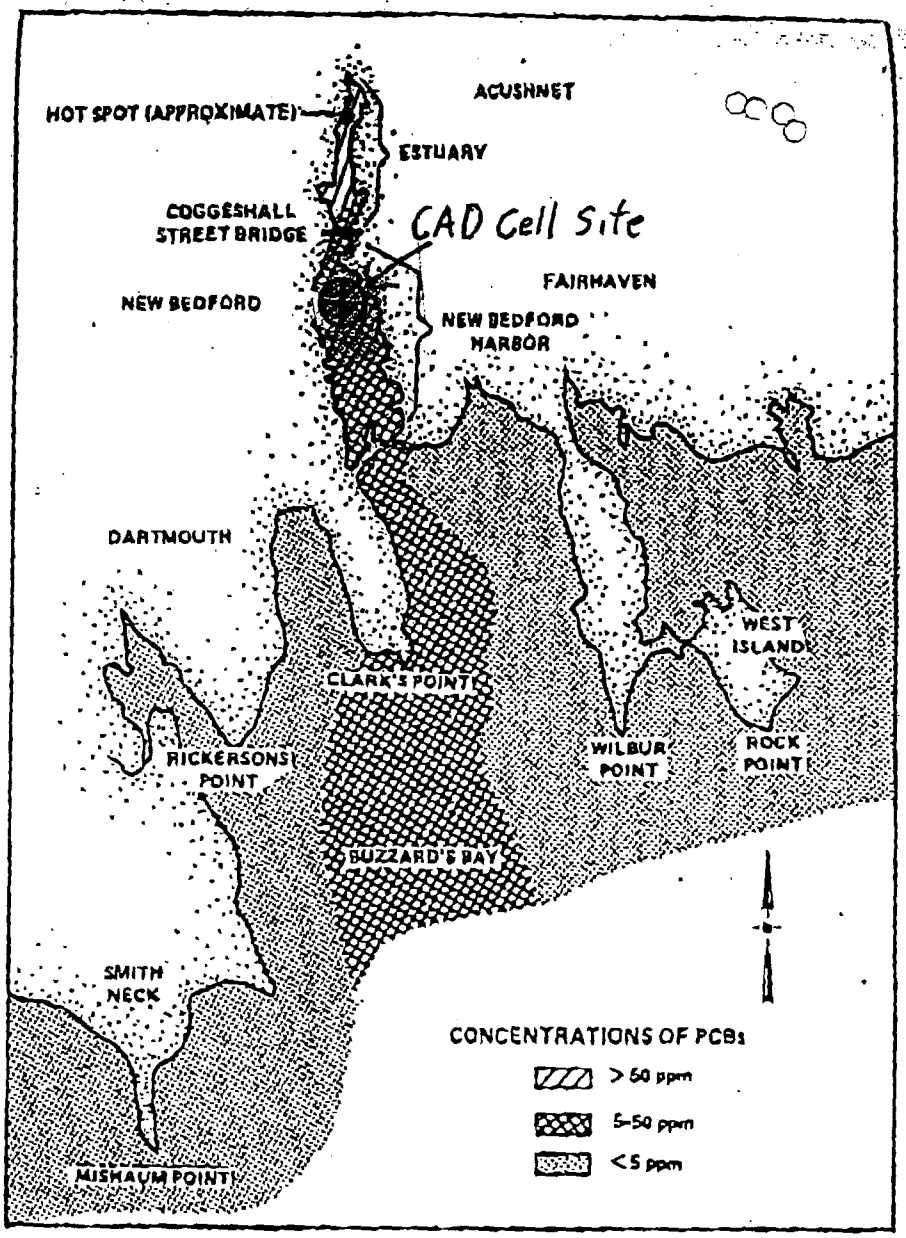

Figure 3. New Bedford Harbor PCB contamination (USEPA 1987)

b. Dredging contaminated sediments and disposing of them in a partially lined containment site in the northern part of the estuary along the eastern shore.

c. Same as option as b except that the containment site would be lined on the bottom, as well as on the sides.

d. Dredging contaminated sediments and disposing of them in an upland containment site.

e. Dredging contaminated sediments (which lay over clean sediments) and dredging clean sediments, temporarily storing both before returning the contaminated sediments to a specially constructed

005
REGULATORY

Figure 2

Send To Printer Back To TerraServer Change to 11x17 Print Size Show Grid Lines Change to Landscape

USGS New Bedford, Massachusetts, United States 01 Jul 1990

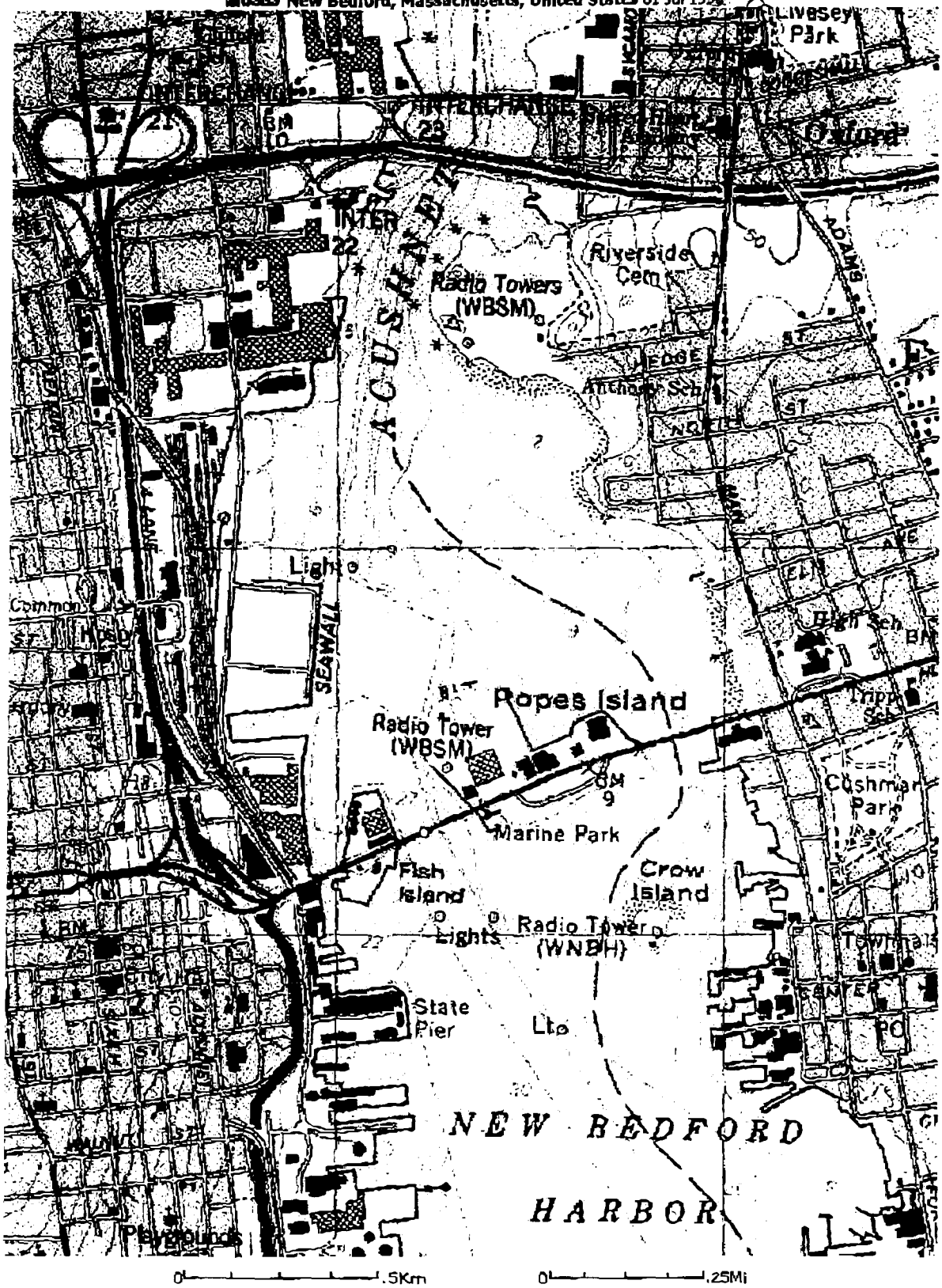

Image courtesy of the U.S. Geological Survey

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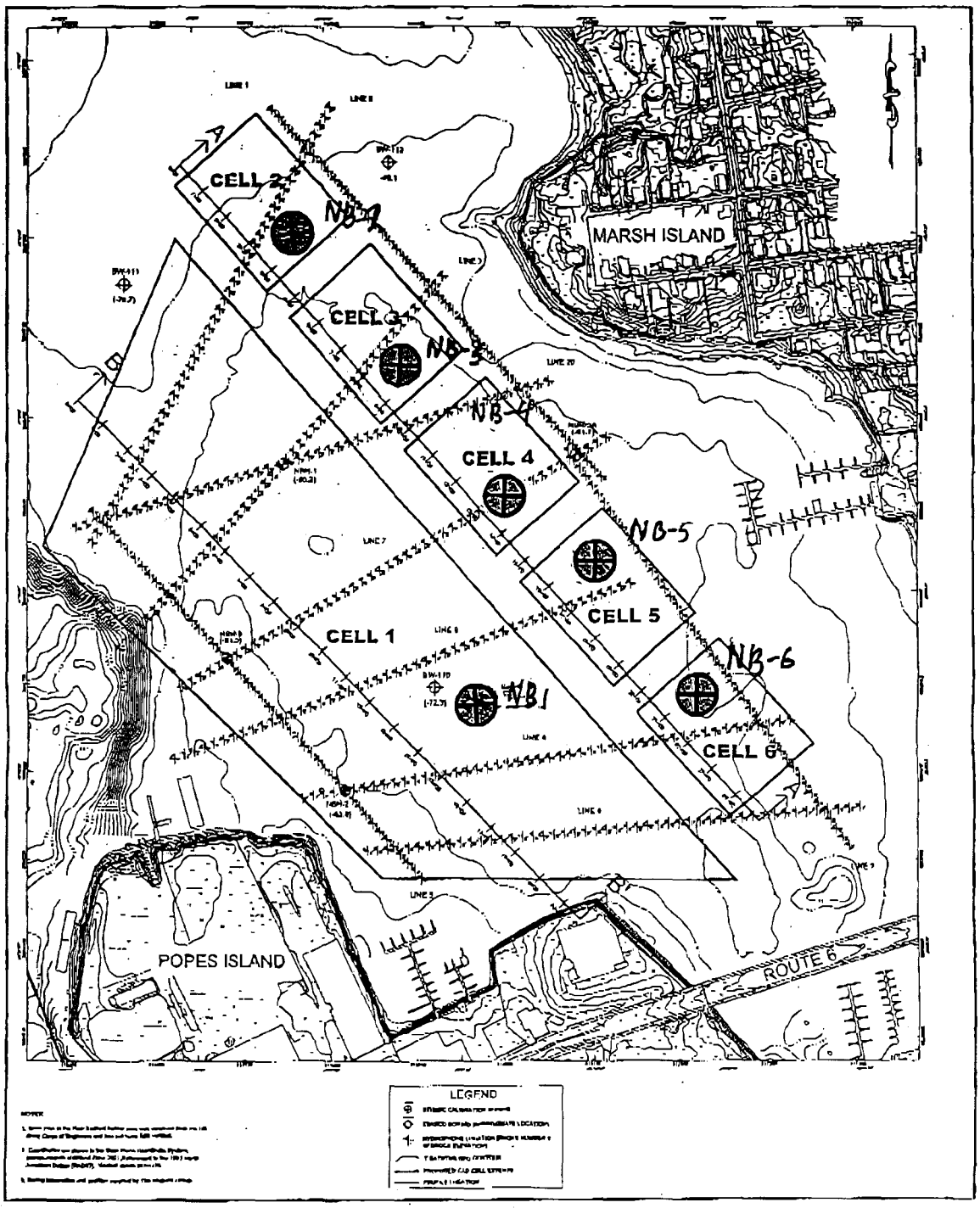
07/11 '03 SUN 09:35 FAX 9783188303 REGULATORY 006

Figure 3



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NEW BEDFORD HARBOR
NEW BEDFORD, MASSACHUSETTS

Popes Island North Site
Candidate CAD Cell Configuration

Maguire Group Inc.
Architects/Engineers/Planners
225 Foxborough Boulevard
Foxborough, Massachusetts 02035

CZM

APPENDIX B

The Model DMP

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Introduction

The Best Management Practices for confined aquatic disposal (CAD) of dredged material include a reference to development of a Dredging Management Plan (DMP). A DMP is nothing more than a detailed description of the dredging/disposal operation for a given project, i.e., the volume and quality of the material to be dredged, the equipment planned for use, and the overall schedule of operations. This document presents an example DMP for a fictitious project.

Specific guidelines for consideration in the development of the DMP are included in the text boxes.

Following the organization and content of the example will allow for the development of consistent DMPs. This is important for a CAD cell that may accept dredged material from multiple smaller projects.

The DMP should be included in the Environmental or Environmental Impact Statement for a given project, starting with the draft. It should be revised according to comments received during the review process. Following this approach will help assure that regulators have all the information needed to plan, approve, and manage the use of constructed CAD cell(s).

List of Abbreviations

BMP – Best Management Practices
CAD – Confined Aquatic Disposal
cy – Cubic Yard
DMP – Dredging Management Plan
MLW – Mean Low Water
WQC – Water Quality Certification

Dredging Management Plan
Harbor X Improvement Project
August 23, 2001

I. Project Description

A. Objective/Overview – The overall objective of the dredging project is maintenance dredging of the 25-foot approach channel into Harbor X and four berth areas as well as dredging of a new anchorage area. Some of the sediments to be removed have elevated levels of contaminants, and Confined Aquatic Disposal (CAD) has been selected as the disposal method. The project includes the following components which are shown on Figure 1:

- Maintenance dredging to remove shoals in approximately 2.5 miles of channel with a controlling depth of 25 feet (MLLW), removing approximately 100,000 cy.
- Maintenance dredging of four berth areas totaling 24,000 cy.
- Creation of a 25 ft (MLLW), 400 ft by 600 ft anchorage area, requiring removal of approximately 101,000 cy.

B. Location – Harbor X lies along a southern facing New England shoreline and is shown in Figure 1.

C. Factors that Can Impact Operations

1. Climate and Tide Conditions – Harbor X is protected from major weather impacts. Currents are generally 1 knot or less in the areas to be dredged and in the CAD cell area. Winds are generally from the west, perpendicular to the channel. The mean tide range is 8 ft, and the spring tide range is 9.2 ft.

Climate and tide conditions at the dredging and disposal sites should be indicated in sufficient detail for reviewers and field personnel to understand risks and to determine equipment needs based on the work environment.

2. Navigation Features

a) Navigation Traffic – The harbor contains a small port with limited commercial vessel traffic. Once every two weeks a container barge visits the port. The barge drafts 22 feet, arrives at high tide full and generally leaves empty. A bulk carrier carrying road salt visits seasonally and drafts 20 feet arriving at high tide. Visits are concentrated in the months from September through November averaging about two visits per week. During the winter season an oil barge calls on the port at least once every

two weeks with heating oil that supplies two storage tanks on the waterfront. One hundred commercial fishing vessels operate out of the harbor. Of these 60 are lobster vessels. Many of the lobstermen based in the harbor fish within the harbor that includes a part of the channel and the location of the CAD cell. There is also a large number of recreational vessels that transit the area with heaviest traffic during the summer season. Recreational traffic triples during special events such as the fourth of July and the annual yacht races held the first week of August.

Any special navigation traffic issues should be indicated such as seasonal vessel movements and recreational traffic patterns that could impact the project schedule or impact routes used for dredging and disposal operations. This allows reviewers and contractors to estimate the project schedule and to determine communication requirements to minimize project interference with normal traffic.

b) Navigation Obstructions or Hazards – There are no known navigation obstructions or hazards within the project area.

If there are bridge movements required during construction, coordination with the operators should determine if there are any time restrictions or recommended times to reduce impacts on surface traffic. Bridges also should be reviewed for openings to assure that construction equipment can safely pass through. All pertinent bridge dimensions should be listed.

c) USCG Restrictions – The USCG has special regulations that control traffic and use of the harbor. During the two special events (July 4th and the yacht races) there should not be any dredging traffic to or from the CAD or ocean disposal areas. More details of these and other harbor restrictions can be obtained by contacting the USCG.

Close coordination with the USCG is required to determine what restrictions may be in effect in the area of dredging and disposal or along the proposed routes.

3. Other Factors – All commercial berths that include dock facilities are subject to restrictions to prevent dock damage. The plans and specifications will provide details of restrictions for dredging at these facilities. Because a lobster fishing area is located in the project area there are seasonal restrictions to dredging and disposal operations. No dredging or disposal is permitted in this area during the months of March and April. During the period of June through September the contractor will follow the communications plan to notify lobstermen of planned activities in this area.

Other factors that should be noted include the presence of shoreline or submerged structures (such as old bulkheads or cable crossings) that may be vulnerable to dredging or construction activity. Any special conditions required to protect these structures should be noted.

D. Dredging Depths – Project depths vary and are listed in Table 1 for each project area.

E. Material Characterization/Volume – Table 1 shows the depths and volumes of material to be dredged from each area. This volume does not include an estimate of material to be removed to create the CAD (see Section IIC). Physical/chemical characterization of the unsuitable material is presented in Table 2.

Table 1

Project Area	Project Depth	VOLUME			
		Suitable	Unsuitable	Rock	TOTAL
	Ft (MLLW)	(cy)	(cy)	(cy)	(cy)
Channel	25	-	100,000	-	100,000
Berth 1	25	-	2,500	-	2,500
Berth 2	20	-	4,000	-	4,000
Berth 3	15	-	6,000	-	6,000
Berth 4	12	-	12,000	-	12,000
Anchorage	25	60,000	40,000	600	100,600
TOTALS		**60,000**	**164,500**	**600**	**225,100**

NOTES:
1. Volumes include overdepth allowances: 2 feet for suitable and unsuitable material and 3 feet for rock.
2. Estimates are based on in-situ conditions and do not include allowances for bulking after dredging and handling.
3. Suitable material will be disposed at the ocean site. All unsuitable material will be disposed at the CAD site.
4. Rock will be used by ACE construction company for use in road construction.

Table 2
Characterization of Material Classified as Unsuitable for Open-Water Disposal

		Characterization of Unsuitable Material Mean Concentration mg/kg (dry wt.)				
Project Area	**Physical**	**Copper**	**Lead**	**Mercury**	**PAH**	**PCB**
Channel	Silt	142	204	0.51	3.6	1.8
Berth 1	Silt	166	228	0.48	7.2	2.1
Berth 2	Silt	147	214	0.43	4.8	1.4
Berth 3	Silt w/debris	230	332	1.1	38	122
Berth 4	Silt	138	197	0.62	3.1	1.8
Anchorage	Silt	109	127	0.38	1.7	0.8

In addition to dredged material it is estimated that 1 ton of debris will be removed. This material will be disposed in accordance with an approved debris management plan. In most cases large debris will be disposed at an approved upland site.

Unsuitable material is fine silty material with high water content. Suitable material is primarily consolidated clay with small isolated pockets of sand and gravel. There is one area of glacial till located in the northeast corner of the CAD located about –40 MLLW.

The dredged material characterization and estimated volumes should be shown in tabular form for each area dredged. The material volumes should be broken down by the following main categori es:

Material suitable for open-water disposal – Material within this category should be further broken down to include estimates on rock, gravel, sand, silt, and clay.

Material unsuitable for open-water disposal – Material within this category should include both a physical and chemical characterization.

Debris – Any significant quantities of debris should be noted and described in such detail that operational plans can be developed for removal and disposal

F. Disposal Volumes – The volumes listed in Table 1 are based in bathymetric surveys of in-situ conditions in each project area. Final volumes will be computed using pre- and after-dredge surveys. In order to assure adequate capacity at the CAD, the volumes listed in Table 1 are increased by 30% to account for bulking or fluffing which occurs during handling of the material. This bulking factor is less than typically used for silty material but experience has shown that rapid consolidation in the CAD during and after disposal significantly reduces the impact. Based on these assumptions the CAD must have capacity for 214,000 cy of dredged material. The sizing of the CAD is further described in Sec. IIC.

The are no limitations on the volume of suitable material at the ocean site. The rock volumes meet the need for beneficial use.

II. Selection of Dredging/Disposal Methodologies

A. Alternative Methods Considered – Dredging operations will be performed to assure that mixing of the unsuitable material and the suitable material is at a minimum level. In order to conserve space in the CAD cell for unsuitable material, the equipment used must have a dredge tolerance of less than 0.5 feet to avoid excessive overdredging into underlying suitable material. The equipment must be sized to dredge safely in and around the limited spaces in the berth areas. Due to the vessel traffic in the channel and berth areas, floating equipment must minimally impact normal vessel operations (being easily moved when required). The rock found in Berth 1 does not require blasting if a mechanical dredge with suitable bucket is used. Trash and debris expected will be removed by the on-site dredge. Turbidity control is required for dredging and disposal activities. Control of turbidity depends on the equipment used and the rate of dredging. Turbidity can be minimized in hydraulic dredges by minimizing swing speed and cutter

rotation speeds. Mechanical dredges can be fitted with closed buckets. Three types of dredges are readily available: mechanical; hydraulic; and hopper.

1. Mechanical – Mechanical dredging uses equipment such as clamshell dredges, dipper dredges, draglines, grab buckets as well as barge mounted excavators. The material removed by mechanical dredges is typically high in solids content. Material is usually placed in a scow or barge for transport to the disposal site. Mechanical dredges can leave an irregular bottom and typically generates high turbidity unless special closed buckets are used. Mechanical dredges are rugged and highly reliable and are capable of removing a wide range of materials including unconsolidated silts, consolidated clays, sand, gravel, trash, debris and certain kinds of bedrock. Mechanical dredges are able to operate in confined areas such as berths. Their production is low compared to hydraulic dredges.

2. Hydraulic – Hydraulic dredges operate using a solids handling pump to transport dredges sediments, as a slurry, through a pipeline to the disposal site. The slurry can also be pumped to a scow for transport to the disposal site. There are several variations in the design which include the very efficient cutter head dredge. Hydraulic dredges are capable of excavating a wide range of material but can not remove rock or certain debris. Turbidity is typically limited to the immediate vicinity of the cutter head. The pipeline from the dredge to the disposal site, if used, can be a navigation obstruction. There is also a limit to the length of the pipeline before it is necessary to include a booster pump. The slurry resulting from hydraulic dredging entrains large amounts of water resulting in water contents 3 to 5 times the in-situ levels. Management of this water may include treatment.

3. Hopper – Hopper dredges are self propelled floating vessels which include an integral suction pipe or several suction pipes which are dragged along the channel bottom. The dredged material is drawn through a suction head in the drag arms and passed through the suction pipe and centrifugal pump and deposited, as a slurry, in a large onboard hopper. After loading, the hopper dredged can sail to the disposal site and open bottom doors and discharge the dredged material. Some hoppers have the capability to off-load the dredged material by pumping. Hopper dredges are able to operate in sea conditions which would severely restrict the safe operation of other types of dredges. In addition, hopper dredges present a minimum interference to other vessel operations when working in busy channels and are able to efficiently transport dredged material over short haul distances. However, disposal requires that the dredging process be temporarily suspended as the dredge travels to the disposal site. Hopper dredges are typically more effective when dredging in deep channel projects and are not effective in restricted areas such as berths and docking facilities. They have high production characteristics when dredging loose alluvial soils and unconsolidated sands, but are severely restricted by stiff clays and similar bottom materials. Very fine silts are easily dredged by hopper vessels, but such materials do no readily settle in

onboard hoppers. This requires the dredge to carry only partial loads, with relatively high water content.

4. Rock Excavation Equipment – The project will include the removal of about 600 cubic yards of rock from the anchorage area. Specifications will allow the rock to be removed by mechanical means. There is a possibility that some rock will require drilling and blasting prior to removal. Prior to removal or drilling and blasting all overburden material will be removed by dredging. Drilling is typically performed by a series of barge mounted drilling rigs, which will drill bore holes of a specific diameter and pattern in the rock formation. The barge will require a small tug or push boat for maneuvering. The drill holes will be packed with precise quantities of explosive, which will be detonated in order to fracture the rock and facilitate removal. In order to remove the fractured rock or to remove rock that has not required blasting, a mechanical dredge equipped with a special rock handling bucket will be used. Because the blasted rock has planned beneficial use, it will be loaded into barges and transported to a shoreline off-loading site. If beneficial uses are not available at the time of construction, the rock will be disposed at the ocean site.

B. Recommended Dredging Method – Dredging will be performed by barge mounted mechanical equipment. This equipment will provide continuous and reliable service for the duration of the project. The mechanical dredge can be fitted with different types of buckets to optimize dredge production in the various materials which will be encountered. This plant will be capable of operating in both the open channel sites as well as within the restricted berth areas. Dump scows will be used for hauling and placement of dredged material. Scows will also be used for temporary storage of silts during initial phases of construction, while the CAD is under construction. Hydraulic or hopper dredges are not recommended for a number of reasons. The hydraulic dredge was not recommended because it would require a long pipeline system which would be a potential navigation obstruction. There is no readily available area for construction of a facility to dewater maintenance material and manage the high volumes of entrained water. Hopper dredges are not recommended because of the restricted operating areas in the berths and the anticipated difficulty of dredging consolidated improvement material including the rock.

1. Equipment :

(a) Dredge – Due to the size of the project it is anticipated that only one dredge will be used. The barge mounted mechanical dredge will require between 1,500 and 2,000 horsepower.

(b) Dredge Buckets – Optimal production will require the use of as large a bucket as possible. Bucket size and type depend upon the available power on the dredge and the type of material being dredged. Unsuitable silty material will be dredged using a sealed "environmental" bucket with a capacity of 15 to 22 cubic yards. The bucket will have no teeth that could easily penetrate into the improvement material, will be designed to reduce sediment loss during

closure, and seals to minimize loss of fines as the bucket is drawn up through the water column. Suitable improvement material will be dredged using a standard open bucket. Heavy duty open rock buckets will be used to dredge rock or to remove rock after blasting. Daily production rates using these buckets are estimated to be: 4,000 cy for unsuitable maintenance material; 8,000 cy for suitable improvement material; and 500 cy for rock (fractured or blasted).

(c) Scows and Barges – Scows (bottom-dump or slit hull) and barges will vary in size depending upon availability and location of the dredging operation. Scows typically range from 500 cy to 4,000 cy. It is likely that the smaller scows will be used in the berths and larger ones for channel work. It is anticipated that a minimum of two scows will be used. It is likely that additional scows will be mobilized as needed for temporary storage of maintenance material during CAD construction and as backup in case repairs are needed. The scows will be moved by tugs with on-board power of around 1,500 hp for disposal in the CAD site. Tugs for use in ocean disposal would require about 3,000 hp.

(d) Other Equipment – Typical equipment needed to support the operations may include a fuel barge, maintenance barge, a small work tug to assist in moving the dredge and scows. Also, if blasting is required a drill rig and associated equipment described above will be used.

(e) Operational Controls – The dredging operations, including the required drilling and blasting, can be managed sufficiently to minimize associated environmental impacts, The primary objective of defining and implementing operational controls is to minimize sediment resuspension throughout the dredging and disposal process while maintaining operational efficiency. Drilling and blasting, if needed, present an additional control challenge. Resuspension of sediments could impact the shellfish beds and the lobster fishing areas. Control of dredging operations is covered in detail in Section III.

The selected alternative should be described in detail including the following:

- *Specific equipment to be used;*
- *Number of dredges expected;*
- *Expected production rates; and*
- *Equipment proposed to reduce environmental impacts.*

C. Recommended Disposal Method – Based on environmental studies and financial considerations, disposal of unsuitable material will be in the designated CAD site located in the channel and shown on Figure 1. Disposal into the CAD will be from bottom dump

scows. Suitable improvement material and rock, if no beneficial use is found, will be disposed at the designated ocean site using bottom dump scows.

The CAD cell will be sized to accommodate all unsuitable material from the project (214,000 cy, see Sec. IE), space for a three foot thick cap and additional headroom space to prevent spill over during disposal. The total space above the disposed material could be up to five feet (including the three-foot cap). The total volume of material that must be excavated to create the required CAD is estimated to be 260,000 cy. The footprint dimensions of the cell will be determined by the scows that will be used, and the allowed depth and side slopes based on geotechnical studies.

The contractor will have the option of changing the dimensions of the CAD and will be encouraged to increase the depth if equipment capacity and geotechnical conditions allow it. The only restrictions in dimensions is that the width may not exceed channel width of 250 feet and the southern limit can not be extended into the lobster fishing area. Design studies indicate that the material to be excavated from the cell is primarily clay with sand and gravel pockets and one area of glacial till. This material could support excavated side slopes of 1V on 2H. All material to be excavated from the cell is suitable for disposal at the ocean site or available for beneficial use. There is no bedrock within the expected depth of the cell. However, the northern third of the cell may have glacial till about 20 feet below the bottom of the channel. The CAD footprint that would accommodate this criteria would be 250 X 1,000 feet. The depth below the authorized channel bottom would be about 50 feet. The contractor will perform subsurface explorations, geotechnical analysis and submit a cell design for approval.

In some cases, where there are structures close to the cell location, the cell geometry may be governed by stability requirements. The results may limit the depth of the CAD or its location.

D. Drilling and Blasting (if required)- It is anticipated that the project rock can be removed by the mechanical dredge.

E. Capping (if required) – Based on state requirements, the disposal cell will be capped with a minimum 3 feet of medium to coarse sand. The contractor will be required to submit a capping plan which will identify the source and physical properties of the capping material to assure compliance with all technical and environmental requirements.

III. **Dredging/Disposal Operations** – The dredging operations require close coordination with the proponent, all berth owners, harbormaster, Coast Guard, the contractor, environmental resource agencies, fishermen and lobstermen. It is anticipated that the dredging and disposal operations will take about 8 months to complete. Dredging can be performed any time of year and will be a 24-hour, 7 day per week operation except for restricted periods for lobster fishing and two special events as described in IC. A general schedule of operations is shown on Figure 2.

A. Mobilization – Prior to initiation of dredging, a number of preparatory tasks must be completed. In addition to equipment movement into the area, there are contract requirements for submittals which require approval before work may commence. Included in these required submittals is the inspection of equipment to assure it is safe and fully functional and meets all environmental protection requirements. The completion of these tasks will set the foundation for the efficient execution of the contract work.

It is important to include any unusual requirements beyond the normal mobilization process.

1. Upland Support Requirements – Dredging operations require upland support area(s) with direct access to the harbor. Berth 2 has sufficient area to provide parking for the workers, project trailer space, an equipment storage area and docking facilities for marine transport for workers, survey boats, tugs and other craft.

2. Structural Evaluation – Prior to dredging or blasting operations, a detailed survey of existing infrastructure will be performed. This survey will include a review and documentation of the harbor structures that may be impacted by the proposed activities. The location of critical structures will be determined and recorded. Structure condition will be described and a photographic record made. Pre-project conditions will be clearly identified. A condition report of each structure will be prepared by the blasting contractor and provided to each facility owner prior to any construction activities. A survey of the channel and berth areas included within the project bounds will be performed to identify and locate all submarine utilities. The survey will encompass a review of record drawings maintained by utility companies. The survey will identify the location of all utility elements and will identify specific means for protection or relocation during dredging and/or blasting operations.

3. Regulatory Constraints – All construction activities will be performed under the conditions established in permits issued for the work. These conditions may identify specific environmental performance criteria which must be satisfied.

4. Seasonal Limitations – The only known seasonal constraint is associated with the lobster fishing area. No dredging or disposal is permitted during the months of March and April or July through October 15. During the period of May and June the contractor will follow the communications plan to notify lobstermen of planned activities. Disposal is allowed during these periods after following communication protocols.

B. Dredged Material Handling – The proper handling of dredged material will assure that potential impacts to the environment are minimized.

1. Monitoring Requirements – During dredging and disposal operations, activities of the contractor will be observed by a CZM inspector and construction management team. In addition to monitoring and verifying the dredge position, surveys and quality control, the team will also assure compliance with required permit conditions. Because of the sensitivity of the surrounding environmental resources to both dredging and disposal operations, this project will include the required independent observer. The independent observer will coordinate closely with the construction team and contractor to assure that permit conditions are met. The independent observer may facilitate meetings to resolve unexpected issues that may require amendments to permits. However, the observer may not direct contractor operations.

2. Environmental Bucket – Dredging of unsuitable soft material will be performed with a closed "environmental bucket as described in IIB.

3. Standard Bucket – Dredging of suitable material, including removal of fractured rock, will be performed with standard open buckets.

4. Scows – Standard bottom-dump or split hull scows with be used to transport dredged material form the dredging site to the disposal locations. All scows will be inspected prior to use to assure that no leakage will occur. During filling operations, no overflow of water will be allowed. Periodic inspections during the construction period will assure that water tightness of the scows is maintained. During the initial construction of the disposal cell, the unsuitable material removed to expose the CAD will be stored temporarily on a scow until the cell has been completed. Extra precautions for assuring the scow remains tight and docked securely will assure that this one-time storage does not cause release of the sediments prior to disposal.

C. Dredging/Disposal Sequencing –The first operation is a complete pre-dredge survey required for payment purposes and also to track dredged volumes of each type of material. The next phase will be any baseline or pre-dredge monitoring required. Construction will begin at the disposal cell to remove unsuitable material down to suitable material. Unsuitable material will be temporarily stored as described above. Once the disposal cell footprint is exposed and a bathymetric survey is taken the cell will be excavated to its full dimensions. Progress surveys of the cell will be taken to assure that capacity requirements will be met. With only one disposal cell available for the project, cell capacity is critical. After the final survey indicates that the cell has sufficient capacity, the stored material will be disposed. From this point until all dredging is completed the sequence of dredging and disposal of unsuitable material directly into the cell will be maintained. In some cases the dredge bucket can be changed to dredge suitable material once the overlying unsuitable material is removed. Periodic bathymetric surveys will be performed for progress payments but at least at the end of each category of dredging.

1. Site Prioritization – After completion of the disposal cell, dredging will follow the following sequence listed in order of priority. This sequence may temporarily change in order to avoid conflicts with vessel passage or berthing traffic.

a) **Unsuitable Material** – One of the environmental objectives is to sequence the disposal of unsuitable material into the disposal cell in order of most contaminated first and least contaminated last. The following sequence meets that objective:
   (i) Berth 1 – The unsuitable material in this berth has the highest level of contamination and will be first in the cell.
   (ii) Berth 2 – This berth has the next highest contamination level and will second into the cell
   (iii) The channel downstream of the cell has moderate levels of contaminants and will be placed next in the cell.
   (iv) Berths 3 and 4, the anchorage, and the channel upstream of the cell have the lowest levels of contamination and will be placed last.

b) **Suitable Material** – The anchorage area is the only location of suitable material.

D. Capping – The CAD for this project requires capping. The 3-foot thick cap will fully contain the disposed material and protect the site from propwash from vessels transiting the site.

1. Materials – The medium to coarse sand required by the state is compatible with the unsuitable material once the dredged material has consolidated to an acceptable level.

2. Potential Sources – While no specific source for the capping material has been selected, there are several potential sites that the contractor has available. There are two upland quarries that could supply river run sand. The preferred source would be from a water site such as a dredging project. Experience has shown that wet marine sand works better than dry sand during handling. The contractor will search for potential dredge material sources for capping material before seeking upland sources.

3. Consolidation of Dredged Material – A minimum consolidation time of two months will be used. Time will begin with the last disposal event into the CAD. Monitoring of the material may indicate that more or less consolidation time is needed. At this time there are no standard methods to determine readiness to cap, but simple field observations and bathymetric surveys provide indications when the initial rapid consolidation is complete.

4. Placement Methods and Controls – There are several methods of placing capping material. In all cases the equipment used must place the material gradually while in motion. Possible methods are: split hulled scow, hopper dredge, and pipeline. Monitoring during placement will be required to assure that minimum cap thickness is attained and that excessive cap thickness is avoided. Caps will be placed in complete layers until the required thickness is met

E. Communication – All communications will be copied to the project team. Communication protocol will be described in an approved Communication Plan. The following parties require specific communications on a routine basis or for specific reasons. These requirements are may be modified to accommodate permit requirements:

US Coast Guard
Harbormaster
Morin Lobstermen's Association
Fishermen's Association
Recreational Boat Club

F. Operational Controls – During construction and monitoring the project construction team and other personnel will assure that the project meets safety and environmental requirements. Contract documents will clearly define levels of responsibility and lines of authority for the CZM, the contracting officer and the contractor. The contracting officer will be responsible for implementing all terms of the contract and for assuring that all conditions of all project permits are met. The contracting officer may designate various experts to assist with contract administration. This assistance may include licensed surveyors, on-board inspectors and specialists in environmental services. The contracting officer is the only person with authority to modify the contractor's work. The independent observer will have full access to the site and will be responsible to the resources agencies for status reporting and permit compliance.

G. Operations to Reduce Impacts – In addition to using the environmental bucket to reduce suspended solids during dredging, disposal will be limited to high slack tide (plus 2 hours) to reduce the turbidity plume concentration to meet state requirements. If monitoring shows that disposal during other tidal ranges can meet the water quality criteria, then a change may be requested. If suspended solids reach exceed limits at the disposal cell, dredging will be shifted from unsuitable to suitable material until turbidity at the cell area returns to acceptable levels. If there are reasons to move out of one area to avoid environmental or vessel traffic problems, the contracting officer will coordinate changes with the contractor.

H. Monitoring – Monitoring is planned as specified in the Water Quality Certification.

I. Mitigation Measures – No mitigation measures have been identified for this project. If permits require mitigation, then this plan will be amended.

J. Volume Calculation - Final volumes of dredged material will be computed using the pre-and after-dredge surveys for payment purposes. In order to meet the permit requirement for an estimate of volume actually placed in the disposal cell, additional surveys will be performed during cell filling. Because bulking of the material is expected from handling and rapid consolidation of the material is expected within the cell, these estimates will be based on several assumptions. To assist in this effort, the contracting officer will record all scow movements and estimate volumes based on scow drafts before departing for disposal.

IV. **Contingency Plans** - Due to the complex nature of dredging and disposal operations, equipment reliability, vessel traffic, weather and other factors unique to construction on the water, it is necessary to be prepared for potential unforseen impacts on schedules and costs.

Having contingency plans prepared and approved before construction is in the best interest of the proponent and the regulators and should avoid unnecessary delays during construction. While it is impossible to predict all the possible situations that would require contingency plans and how to deal with them, there are situations common to dredging projects that can be predicted.

Contingency plans will be prepared for the following:

A. Project Delays – Prior to project construction, the contractor will be required to submit a detailed schedule of operations for the entire project. This schedule will accommodate all known weather, seasonal environmental restrictions and vessel traffic situations. This schedule will be approved by the contracting officer with input by others.

The contracting officer will monitor the progress of the schedule. Any prolonged delays which could impact critical milestones will activate a contingency plan. The cause of the delay will be critically reviewed and procedures implemented to reduce delays. To assure that contractor delays will not be extended and potentially threaten completion of the project, the contracting officer will have the authority to require the mobilization of additional equipment and personnel as required. The contractor will be obligated to provide the necessary resources at its cost within the established time table. If the delay is caused by unforeseen weather phenomena, impact from a non-project condition or other uncontrollable condition, the contractor will be required to add resources but at no additional cost to the contractor.

B. Operations Issues – If changes to the sequence of dredging and/or disposal are required, there should be a plan that will continue to meet all requirements. There should be measures in place if unexpected types or volumes of dredged material are encountered.

1. Operator Qualifications – It is essential that the dredge operator understand the unique requirements of the project. Experience in operating closed buckets, regulating bucket impact and haul speed to minimize turbidity is critical. The contracting officer will contractually require the contractor to employ dredge operators with demonstrated exemplary skills. The contracting officer will reserve the right to replace any operator that does not meet minimum skills or does not demonstrate an ability to satisfy the performance requirements of the project.

2. Disposal Operations – Due to the uncertainty of disposal cell construction, operations and capping only a modest change in any of the factors governing cell capacity could require alternative disposal plans. Because any anticipated contingency needs would be small, upland disposal at a local landfill is feasible. For the situation where turbidity limits are exceeded at the cell area, operations

could be shifted to suitable material or other operations not requiring use of the cell. Also, permission may be requested to dispose during other tidal conditions with appropriate monitoring.

There may be weather or permit related reasons for delaying or halting disposal operations at all sites or specific sites. The contingency plan should describe what temporary operations may take place if this were to occur. In some cases the project may shut down entirely. Reviewers should understand the consequences of changes to disposal operations.

C. Permit Conditions Exceeded – As described previously, project operations may be shifted in location or rescheduled in order to meet permit conditions. As the project progresses the options for moving the location or schedule becomes more limited.

The plan should identify possible measures to be taken if permit conditions are temporarily exceeded. Changes in timing and location of operations should be considered.

D. Equipment Failure – As described previously, the contracting officer may require the contractor to mobilize the equipment necessary to maintain the approved project schedule. In some cases the contractor may be able to shift from one type of operation to another to allow for repairs. However, if the dredge itself requires shutdown for repairs, all dredging stops. The contracting officer may require mobilization of another dredge if dredge shutdown is prolonged. The contractor's contingency plan should identify availability of other equipment or subcontracting options. Any use of substitute equipment must be approved by the contracting officer.

E. Environmental Conditions – There may be changes in environmental conditions which may require changes in operations. These may be seasonal such as unforeseen movements of fish or lobsters into impacted areas. The contingency plan will include options for changing project operations including contracting of fish observers or other environmental specialists who are qualified to monitor environmental problems and recommend solutions that meet permit requirements or fishermen's needs

APPENDIX C

The Model BMPs

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Introduction

This document presents Best Management Practices (BMP) for confined aquatic disposal of dredged material that is unsuitable for unconfined open water disposal. For the purposes of this document, confined aquatic disposal (commonly referred to as CAD) involves disposing the dredged material entirely within the aquatic environment, and sequestering it by placement within constructed cells or natural depressions on the bottom of harbors, bays, or other coastal environments. The specifics of CAD management may vary significantly from project to project, depending on the following factors:

- Will the CAD area be sited or constructed for a single project or will it be used by multiple projects over more than one dredging season?
- What type of equipment will be used, how much material will be dredged/disposed and at what rate?
- Is capping of the CAD cell or area required after disposal is completed?

This set of BMP has been developed to cover constructed CAD cells and is based on experience from the Boston Harbor Navigation Improvement Project (BHNIP) and review of other related projects. Relevant aspects of the BHNIP are included in the text boxes throughout the BMP. This BMP covers the following project phases related to constructed CAD:

- Planning
- Design
- Construction
- Disposal into CAD Cell
- Capping
- Monitoring (included in multiple phases)

A key companion to the successful implementation of BMP for constructed CAD is the development of a Dredging Management Plan for each project that will use a given CAD cell. The Dredging Management Plan will supply the necessary detail to allow proper interpretation and application of practices related to CAD.

List of Abbreviations

BHNIP – Boston Harbor Navigation Improvement Project
BMP – Best Management Practices
CAD – Confined Aquatic Disposal
DMP – Dredge Management Plan
MLW – Mean Low Water
WQC – Water Quality Certificate

I. Planning

The planning step allows for a general assessment of the feasibility of CAD within a given area. This step also supplies the information required for a preliminary cost estimate for CAD as well as the input for the actual design of CAD cell(s) for a given project.

A. Determine the Required Capacity of CAD(s)

1. Estimate the volume of dredged material to be placed into the CAD cell(s). The uncertainty associated with the projection method (bathymetry, geophysical methods, coring, etc.) should be considered in providing for a capacity contingency factor.

2. Estimate the potential bulking and consolidation of material to be placed. For a large project, this may include collection of samples and performance of laboratory tests. For a smaller project, literature values can potentially be used. Knowledge of the material handling methods (dredging and disposal) is critical to an accurate bulking estimate. A projection of the potential filling schedule is as important as the post-disposal consolidation phase in estimating overall consolidation.

3. Estimate accumulation from sediment transport into the cell over the time it is open if it is located in a depositional zone (could potentially result in capacity reduction).

4. Estimate an overall contingency factor for cell capacity. This includes the estimates from numbers 1-3 above as well as other project-specific factors. Is there only one CAD cell to be open at a given time? If so, can the project schedule accept potential delays if the cell is shut down because of temporarily reduced capacity associated with short-term bulking of disposed material or for other reasons? Will the cell be nearing capacity at a time of year with increased frequency of storms that may limit the height to which material is filled within the cell?

B. Select Potential CAD Area

1. Potential areas for locating CAD cells should be shown on a map or chart in relation to the proposed dredging locations with a goal of minimizing the transport distance. If possible, the information should be shown in GIS so that the other relevant information can be presented as individual data layers.

2. Determine any seasonal or environmental restrictions on cell construction, disposal events, or cell capping. Consider restrictions that may be placed on vessels transiting away from the site during construction (potentially transiting to

an offshore disposal site) or on vessels transiting from the dredging area to the CAD site.

3. Locate all environmentally sensitive areas or areas with special protection relative to the CAD site and within any potential routes between the dredging sites and the CAD. These areas should include known fisheries and lobster areas.

4. Determine if any hydraulic issues, i.e., currents, propwash, nearby intakes or outfalls, exist in the area. Locate the CAD site in as low an energy area as possible.

5. Evaluate potential impacts on nearby structures.

6. Determine if any navigational restrictions exist in the area or within potential routes between the dredging sites and the CAD. If sites are to be considered within the navigational channel, additional assessment of hydraulics (prop wash) and restrictions (no spud zone, future depth limits) must be included.

7. Locate CAD sites away from areas that require bridge openings if possible.

C. Perform Preliminary Layout of Specific CAD Sites Within the Designated Area

1. Determine if there will be multiple CAD cells within the designated area. If so, assess the benefits of keeping them close together (ease of management/monitoring) vs. operational constraints if nearby cells are in use concurrently. Multiple cells offer the advantage of flexibility. If one cell is not available (because of a water quality exceedence or excessive bulking, for example), the other cell can be used. Note that if multiple cells are too close together, a constraint on one cell could affect operation of the adjacent cell.

2. Consider the potential long-term habitat changes resulting from the cell(s) in the designated area.

a) Final disposed material or cap may be different substrate than the surrounding area.

b) Planned incomplete filling of a cell (to avoid loss of disposed material) coupled with consolidation over time may result in the cell being depressed below the surrounding area with potential deposition and water quality issues.

D. Assess Capping Requirement

1. Assess the regulatory requirements associated with capping. Specific requirements may focus the physical/chemical assessment in number 2 below.

a) Is the requirement for a cap absolute and, if so, what are the thickness requirements?

b) Are there time requirements associated with how long a cell can remain open or in the consolidation phase? Note that an extended consolidation phase increases the likelihood of a successful cap. Is an interim cap required if a cell is open more than one dredging season?

2. Perform a qualitative assessment of the potential impacts to human health and the environment associated with the CAD cell that focuses on the potential for exposure to contaminants.

a) Define the physical-chemical characteristics of the contaminants of concern associated with the dredged material destined for disposal.

b) Compare the characteristics of the contaminants in the disposed material with that in the surrounding vicinity of the proposed CAD cell(s). The comparison should include both concentration and aerial extent and note if concentrations are expected to remain constant over time.

c) Determine the potential for groundwater transport through the cell(s) (distance from shore, type of native material, relief along shoreline, aquifer structure). For coastal New England, this is generally not a major concern.

d) Assess the potential loss from the cell(s) due to vessel passage and storm events. This can range from a general overview based on cell location to performance of hydrodynamic modeling.

e) Determine the natural deposition rate expected over the cell after completion.

3. Perform a quantitative risk assessment if required.

4. Cap Specifics

a) Determine the physical characteristics and amount of cap material that would be required (grain size, thickness, bulking/consolidation factors, overall volume).

b) Assess the feasibility of cap placement (source of cap material, accessibility of equipment during cap placement)

E. Prepare Guidelines for Use – Setting guidelines for use of the CAD cell(s) will help to focus the specifics of design.

1. Set limits on the type material to be disposed, including both chemical and physical properties. The limits may vary over the life of the cell, such as disposing more contaminated material deeper within the cell.

2. Set limits on equipment to be used for dredging. The physical properties of the dredged material are impacted by the method used to dredge them. Mechanical or clamshell equipment would be the most likely used for smaller scale harbor projects and is also the method least likely to cause adverse changes in the physical properties of the material. Other methods such as hydraulic dredging entrain more water and increase bulking, lengthening consolidation time and potentially reducing cap performance.

Within the mechanical methods are the specific bucket designs and capacities. The objective is to reduce water entrainment by using buckets that are not oversized. Usually contractors size their buckets for fill efficiency based on depth or face expected. Fortunately, this also results in minimal water entrainment. The adverse impact of using closed or environmental buckets, which capture more water, have to be balanced by the positive reduction in turbidity at the dredging sites.

Preliminary results from the Boston Harbor Navigation Improvement Project indicate that closed buckets do not have a significant positive reduction in the turbidity at the dredge site compared to conventional open buckets. Some researchers believe that use of closed buckets increases water content which increases consolidation times in the cell and may compromise cap integrity.

The equipment needed to dredge the cell may be different that that used to dredge the unsuitable material. Larger and heavier buckets will likely be used. If side slope stability requires a slope then stair stepping will be needed. This requires a well-planned construction sequence particularly if deep cells are used. Safety becomes an important issue when spuds are used near the slopes. Boom reach and swing angles are factors. These issues may determine the shape and final size of the cell opening.

3. Set limits on the equipment used for disposal. With mechanical dredging, split-hulled or bottom-dump scows will likely be used for disposal. The size and general condition of the scows can vary widely. Water quality issues may necessitate requiring a watertight scow. Alternate methods exist for direct placement of material into the cell. These may result in reduced impact to the upper water column, but will significantly extend the length of the disposal operation and may result in additional bulking of the disposed material if pumping is used.

4. Set limits on schedule of disposal. This includes the specific timing, such as tidal (slack tide) or weekly (non-weekend) or seasonal (non-migratory) components. It also includes consideration on the overall rate of disposal.

5. Define the general monitoring requirements during disposal.

II. Design

The design tasks below assume that an area has been selected for construction of one or more CAD cells. The most important effort in cell design is to determine the geometry required to meet disposal capacity requirements. It is recommended that the plans and specifications for cell construction leave as much room as possible for contractor design and layout. This allows for optimization of cell design, layout, and operations considering the equipment and other resources available to the selected contractor.

A. List the Relevant Design Criteria – A list of the relevant design criteria should be developed prior to the start of any fieldwork. This list should include:

1. Maximum Depth - The maximum practical cell depth is a function of cell material as well as the equipment that will be used to dig the cell. Most mechanical dredging barges that work off spuds can dig up to about 100 feet below MLW. Safety of the equipment at these depths has to be considered. In order to construct the deeper cells, dredges have to set up, dig, and then back up for the next reach, always moving backward rather than forward. This means that once the spud limit is reached no further dredging can be done in that area unless it is safely within arm's reach from the edge of the cell.

2. Side Slope Stability – Side slopes may also affect the maximum practical cell depth since the side slopes may converge before a desired depth is reached. This in turn may require a larger cell footprint to reach needed capacity.

3. Distance from Structures – If the cell is planned to be near existing or future docks, piers, navigational aids, etc., a formal geotechnical analysis may be required to determine an adequate safety factor on the slopes and distances adjacent to structures. The potential for impacting underwater or buried utility crossings should also be evaluated.

4. Subsurface Investigations – Subsurface investigations should include a boring program at a minimum. Geophysical methods (acoustic and seismic profiling, radar, sidescan sonar, etc.) can be used to extend the boring program. The sub-bottom profiling is a requirement if hard digging or rock is expected anywhere in the cell area. Sufficient coverage around the proposed cell site should be accomplished to allow for realignment or other changes that may be needed to accommodate the capacity requirements.

B. Assess Other Factors that Affect CAD Capacity

1. Natural Sediment Transport - Another factor that may reduce capacity is accumulation of material from tide currents, propwash etc. that may occur while the CAD cell is open. The open cell will trap any material that normally moves

along the bottom. This potential accumulation should be estimated from existing data and may not be a major factor for cells open a relatively short time.

2. Overflow Concerns – If there is a desire to end up with a completed cell flush with the surrounding area, some loss of material from the cell during the latter stages of disposal may occur (as the cell is nearly full). Alternatively, cap thickness could be increased to "fill" the cell to the top.

3. Single Cell - If only one CAD cell is available for each dredging project, a significant contingency factor must be included in setting the cell capacity. There will be no alternative disposal sites in case there are any restrictions or delays in disposing in the open cell because of excessive bulking of the previously disposed material. Underestimating capacity could result in major delays and limitations on dredging.

BHNIP – During the final disposal rounds into one of the first cells in the BHNIP (a relatively small cell), the contractor discovered material outside of the cell following disposal (based on pre- and post-disposal bathymetry). As all of the disposal events were determined to have taken place over the cell (no "misses"), it was assumed that the material overtopped the cell in the form of an internal wave during disposal. The contractor subsequently set a limit to the fill depth within the cell of approximately 8 feet below the top of the cell.

C. Assess Material to Be Removed from CAD Cell During Construction

1. Unsuitable for Open-Water Disposal – If construction of the cell requires removal of material that cannot be reused or disposed at an open water site, provisions need to be made for the safe storage of that material until the cell is completed or for disposal via alternative (upland) methods. Note that if the material is stored aboard a scow, that scow should be inspected prior to use to ensure an adequate seal.

2. Suitable for Open-Water Disposal – If the material removed from the cell during construction is suitable for offshore disposal, beneficial reuse should be explored. Reuse of the material as an interim or final cap should be considered.

D. CAD Cell Design Specifics

1. Optimize Number of CAD Cell(s) – Fewer, deeper cells are generally more efficient than larger number of shallower cells in terms of construction and in management of the cells after closure.

2. Cell Spacing – If multiple cells are considered, side slope stability will dictate a minimum distance between cells. This separation distance should also be evaluated in terms of the equipment that may need to access a cell from its boundary (sufficient space for anchors/spuds).

3. Optimize Cell(s) Open Area – The surface area of a cell that is open should be optimized based on several factors. The type and size of the equipment used for constructing the cell, the equipment used for disposal, and the equipment used for cap placement should be considered. In general the long axis of the cell should be in line with currents to aid in navigation over the cell and to help limit transport of suspended solids from the cell. If possible, the size should be such that the capping equipment can place one layer of material over the entire cell during each cap placement.

4. Future Use - If any cell is proposed to be located within an area that is anticipated to require dredging in the future such as a navigation channel or anchorage, several major restrictions will limit its navigation uses. The top of the cell cap will limit future deepening. The top of cap must be set below future dredge depths plus a reasonable overdepth of at least two feet. Cells should also be clearly shown on navigation charts as no spud zones and no anchor areas.

E. Cap Design

1. Material - The cap material must be compatible with the disposed material, i.e., not of a form or density that results in the cap material displacing the disposed material. The cap material must also withstand erosion from currents, wave action, and propwash expected for the area.

2. Thickness - Cap thickness must be sufficient to meet the overall capping objectives: preventing erosion, biological penetration, and/or chemical migration. If sediment accumulation over the cell (self-capping) is projected to be rapid enough, consideration may be given to a thinner cap.

3. Configuration – The final configuration of the capped cell must be clearly identified. If the capped cell is required to be at a specified elevation (flush with surrounding area or within a specified depth), multiple capping sequences may be required.

4. Consolidation Time - The maximum allowed consolidation time prior to capping must be determined as this can impact the sequence of capping events and the amount of capping material required (assuming some mixing with initial capping layers).

BHNIP – The required cap thickness was set at three feet (one foot potentially mixed with disposed material and two feet clean cap). This thickness met the biological and chemical criteria and was also a practical thickness to construct and monitor underwater.

III. Operations

A. Construction Phase

1. Once cell construction begins there must be close quality control to assure that cell capacity is maximized and safety is maintained. This requires multiple bathymetric surveys with sufficient resolution to determine the interior dimensions of the cell for capacity calculations and slope stability confirmation. High-resolution multi-beam surveys are recommended. Periodic surveys will also detect sloughing of material off side slopes and material moving into and trapped in the cell. The final survey immediately before disposal will be used to compute the total capacity and remaining capacities during the filling process.

2. Monitoring may be required during cell construction dredging to assure that any overlying contaminated sediments (which may be held for disposal into the completed cell or disposed elsewhere) are adequately removed prior to dredging of underlying clean material. Storage of any contaminated material removed during construction may also require monitoring.

B. Disposal Phase

1. Prior to filling, a water quality model can be used to determine if restrictions on volume/timing of disposal events are required. Such restrictions could include tidal stage, tidal current, disposal volume, multiple disposal event timing, and proximity in time to expected vessel passage.

2. If project sequencing allows, disposal of the most contaminated material first (deepest in the cell) will allow for the greatest level of sequestering. At a minimum, the more contaminated sediments should not be disposed in the final stages of cell filling.

3. Bathymetric surveys should be performed after each disposal to track remaining capacity and consolidation and to detect uneven accumulation.

4. Documentation of each disposal event should include the date, time and source of material dredged; the time and location of disposal (including high accuracy location coupled with orientation of the disposal vessel); the equipment used to dredge and dispose of the material; the weather and sea conditions; and personnel on duty. It is also helpful to have an estimate of the volume of material disposed even if based on scow loads using drafts and depths and reduced by estimates of water in the scow.

5. Detailed, step-by-step requirements for filling should be included in the DMP.

BHNIP - Some of the key constraints that were placed on disposal included:

- Disposal only during a three-hour period around high water slack tide (1 hour prior to 2 hours after the predicted high tide). This requirement was based on water quality modeling results that showed maximum dilution (into the high-tide water column) and reduced transport (with limited tidal current). Because no significant water column impacts were detected during the monitoring, this requirement was relaxed near the end of the project to allow for disposal around low water slack.
- Disposal during expected fish migration periods required the presence of a fisheries observer, fish-detecting sonar, and a fish-startle system. Although disposal was performed during migration periods, significant fish schools were never detected in the vicinity of disposal.
- No disposal while other tugs/vessels are within 1000 feet of the disposal cell
- Disposal of the most contaminated material in the lower half of the cell

C. Consolidation Phase

After disposal is completed, adequate time is needed for the material to consolidate prior to capping. Premature capping may result in mixing of cap and underlying material and possibly major shifts of material resulting in a submerged cap. The optimal time depends on the material, the depth of the cell, and the history of disposal events. During consolidation, bathymetric surveys should be performed to track changes. Surface grab samples should be collected periodically from different areas of the cell to observe physical characteristics of material and check consistency across the cell. These samples are easily collected and can be performed in conjunction with the bathymetry. Capping should be delayed at least until consolidation begins to level out and the surface material is not fluid. A more detailed evaluation would require corings and lab evaluations and/or use of a cone penetrometer. At this time there are no clear criteria available to evaluate the readiness to cap. Current research is underway at WES and MIT on this topic.

BHNIP

- For the type of material disposed in the BHNIP coupled with the cell design, a minimum of 2 months was required for successful capping. The best capping results were obtained after a 5 month consolidation period.
- As a simple means of assessing the relative water content of the surficial sediments in the disposal cell, grab samples were dropped onto the center of a flat board with measured concentric circles. The spread of the material on the board over a fixed time was photographed and recorded as a semi-quantitative method of tracking consolidation. While there is no scientific criteria to correlate these observations with readiness to cap, this technique did demonstrate when the upper material stopped its rapid consolidation and may also have been an indication that deeper underlying material has also reached a more stable phase.

D. Capping Phase

1. Equipment – A variety of equipment can be used for placement of cap material including split-hulled hopper dredges or scows (only if opening of the hull can be accurately controlled), washing off flat-deck barges, and piping down with a broadcaster. The method selected should be one that has been used successfully at a similar location and/or one the contractor is familiar with.

2. Placement - Cap material should be placed wet. Vessel movement should be perpendicular with the long axis of the vessel opening. Tugs should be used to move the deeper draft, self-propelled vessels to minimize prop wash effects. Overcapping should not be allowed as this may create more mixing with disposed material. Capping should be performed without the use of spuds or anchors within the cell. Once in place, the cap material should not be reworked, such as with a bucket or drag bar.

3. Tracking - During each capping event the volume dumped and the track of the disposal vehicle should be computed to determine where the following load should be placed (if multiple loads are required) to keep the cap thickness as even as possible until the required thickness is achieved. Bathymetric surveys may help in evaluating cap status but the results can be misleading since consolidation increases with the cap weight. It is likely that the surface will be very flat due to the very soft conditions on the top of the dredged material. Any unevenness on the cap surface is a positive result indicating that the underlying material has enough structure to hold a shape under the weight of the cap.

4. Immediately after capping is completed a bathymetric survey should be completed which will serve as the base for future monitoring. This survey will assist in tracking post-cap consolidation and possibly material accumulation over the cap. Alternative methods for determining cap thickness as capping progresses should be explored.

BHNIP

- Capping of the first BHNIP cell involved placement of dry sand from a stationary split-hulled scow, relying on ambient current to distribute the sand. This method proved ineffective at evenly distributing sand over the cell.
- Subsequent capping events utilized a hopper dredge discharging wet sand. The most even distribution was achieved using a tug in a "T" configuration pushing the dredge sideways with minimal maneuvering by the dredges' own propulsion.

IV. Monitoring

A. Baseline Monitoring – Baseline conditions of general water quality (dissolved oxygen, suspended solids, turbidity) as well as specific contaminants of concern (those determined to be in the dredged material to be disposed) need to be assessed prior to the start of any project work. Adequate data may exist from past water quality studies for a given area. It is important that the baseline data include a range of conditions, as the water quality parameters and contaminant concentrations may vary significantly over short time scales, dependent on weather conditions and vessel passage. It is important to determine if water quality criteria and standards are already being exceeded under "normal" (non-project) conditions.

B. Monitoring Placement of Material During Disposal – Monitoring the placement of the dredged material within the cell includes tracking the position and orientation of the disposal operation to verify that the material was discharged at the intended location and performance of pre- and post-disposal bathymetry over the cell and the surrounding area to ensure that disposed material was contained within the cell.

BHNIP – The contractor performing the work tracked disposal location and performed the pre- and post-disposal bathymetry. A Corps-certified inspector (and often Corps personnel) was onboard the scow/attending tug for each disposal event. The Corps survey team performed periodic bathymetry checks over the open cells and surrounding area.

C. Water Quality Monitoring During Operations

1. General Scope – As dredged material is disposed into a CAD cell, some sediment and associated contaminants are released to the water column. The overall goal of the water quality monitoring is to ensure that this release is minimized and that it does not result in unacceptable impacts to the water column.

The balance between an effective monitoring program and program costs is a difficult one. This balance can be better achieved with a program that has frequent field efforts performing real-time measurements of turbidity and collecting samples for analysis of total suspended solids and less-frequent monitoring that involves analysis of contaminants. Given the nature of the disposal and potential release to the water column, the turbidity and total suspended solids measurements can be good, cost-effective indicator of potential water column impacts. The more expensive contaminant analyses should be reserved for project startup of an operation that has a greater potential for contaminant release or as a contingency when the routine monitoring indicates a potential issue.

Some detail can be written into the overall monitoring plan, such as the size of the mixing zone that is granted (detailing as what distance from the disposal operation monitoring should take place). However, given the intrinsic variability of

currents in the coastal marine environment, specific sampling locations should be determined in the field based on real-time measurements of supporting information such as turbidity, drogue tracks, and profiling of currents and suspended solids.

2. Contingencies – Prior to the start of the project, contingencies should be established that set target water quality criteria, detail when more intensive monitoring should be performed, and outline what monitoring results require modification to project operations.

3. Who Should Perform the Monitoring – For a project involving a single dredging contractor, having the contractor responsible for the monitoring simplifies many of the logistical issues associated with integration of the monitoring into the overall construction operation. However, this practice generally results in the monitoring contract awarded to the lowest bidder. Hence, performance standards for the environmental contractor must be clearly stated.

4. Quality Assurance – Accurate monitoring data is critical to making informed decisions regarding project operations. A set of quality assurance objectives and practices should be developed as part of the Water Quality Certification process. This set should include reference to standard field practices, instrument calibration standards, and laboratory methodologies. This quality assurance framework would then be included as background to any environmental contractors bidding on performing the monitoring. The selected contractor would be required to submit a Quality Assurance Project Plan detailing how they would meet the objectives.

BHNIP – Because this was the first use of constructed CAD cells in Massachusetts waters and because of concerns over mobilizing contaminated Boston Harbor sediments, an intensive monitoring program was required that focused on monitoring of disposal events. The program included a significant amount of laboratory analysis. The field monitoring revealed limited transport of material away from the cells following a disposal event, and there were no reported exceedences of target water quality criteria over the entire project.

D. Verification of Cap Placement

1. General Scope – The monitoring of cap placement includes verification of cap thickness, cap composition, and aerial coverage over the cell. The monitoring should provide some physical sampling to ground truth the placement of the cap as well as remote monitoring that can provide greater coverage across the cell. The monitoring should be designed to give broad coverage across the cell as well as focus on potential problem areas identified during tracking of cap placement.

It is believed that problems with a given cap, such as mixing with or displacement of the underlying disposed material occur during or immediately after the capping

operation. Hence, monitoring to verify cap placement can take place relatively soon after capping operations are completed. For cells that are depressed below the surrounding area and in areas where existing bottom sediments are frequently mobilized (by vessel traffic or by waver/current events), the monitoring should be scheduled for soon after cap completion to avoid the complicating issue of new deposition over the cap.

2. Contingencies – Prior to the start of the project, triggers should be established that detail when additional cap data should be collected.

3. Quality Assurance – Accurate monitoring data are critical to making informed decisions regarding cap coverage. Similar to the water quality monitoring, a set of quality assurance objectives and practices should be developed as part of the Water Quality Certification process. This set should include target recovery for cores and density of tracklines for geophysical surveys.

BHNIP – Verification of cap placement was accomplished with a combination of coring and sub-bottom profiling. A high level of coring expertise was required to achieve good core recoveries in the coarse sand overlying soft silts from maintenance dredging. Core locations were targeted at the intersections of the sub-bottom profiling tracklines to provide greater correlation between the two methods. Grain size analyses were performed on a subset of core sections. These proved very beneficial, as a limited amount of the disposed sediments (predominantly black silt) mixed with the light-colored capping sand could result in a misleading visual interpretation.

E. Post-Closure Monitoring – A long-term monitoring plan should be developed that will verify continued cap coverage for those cells requiring a cap and verify disposed material placement in those cells without a cap. The monitoring should also be designed to track recovery of the benthic community over the cell. This monitoring should be patterned after the Disposal Area Monitoring System (DAMOS) currently performed by the U.S. Army Corps of Engineers at open water disposal sites. It is important to maintain all as-built documentation for comparison to future monitoring results. Responsibility for who will perform the monitoring, who will review the results, and who will perform any corrective measures (if required) must be established as part of the initial project.

F. Technical Advisory Committee – Permitting of the overall CAD project draws upon input from regulatory agencies, project proponents, and environmental and business groups. This group should be formalized into a Technical Advisory Committee (TAC) that should be maintained at least through the start up of the overall project. If permitting agencies agree to the TAC concept, the TAC can have the following goals:

- Determine what permit modifications may be required as execution of the project necessitates operational changes or when unexpected issues arise.
- Determine when and if contingencies need to be put in place based on review of monitoring data.

- Disseminate information about the progress of the project to a wider circle.

If the TAC model is followed, a mechanism for making recommendations and communicating those recommendations to the permitting agencies should be established at the outset of the project.

BHNIP – The TAC met approximately every two weeks during project startup and monthly during the heaviest phase of dredging/monitoring. There was regular attendance by representatives from the following:

Massachusetts Department of Environmental Protection
U.S. Environmental Protection Agency
Massachusetts Coastal Zone Management
U.S. Army Corps of Engineers
Massachusetts Port Authority
Dredging Contractor (Weeks Marine – Phase 1, Great Lakes Dredge & Dock – Phase 2)
Seaport Advisory Council
MIT Sea Grant
The Boston Harbor Association
Save the Harbor/Save the Bay
Clean Water Action
Independent Observer

Other agencies/groups that attended meetings less frequently, but remained in the communication network and provided input throughout the project included:

Massachusetts Division of Marine Fisheries
National Marine Fisheries Service
Massachusetts Lobsterman Association

The TAC made numerous recommendations on changes to project operations and modifications to the Water Quality Certification.

G. Independent Observer – If the overall project is large enough to support an independent observer, incorporation of the roll can provide the following:

- Interpretation of issues arising on the project and monitoring results.
- Communicate project progress and issues to TAC.
- Facilitate TAC meetings.

BHNIP – The independent observer position was defined and administered by Massachusetts Coastal Zone Management. Funding for the position was provided by one of the project proponents (Massport). The observer was present on site frequently at the outset of the project and during startup of new phases of construction. The observer facilitated TAC meetings for the duration of the project. The on-site presence diminished as the project progressed, but the communication role continued throughout the project.

APPENDIX D

The Model Water Quality Certificate

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Introduction

This document provides a series of consideration points in developing a Water Quality Certification (WQC) for projects involving dredging and confined aquatic disposal of dredged material that is unsuitable for unconfined open water disposal. For the purposes of this document, confined aquatic disposal (commonly referred to as CAD) involves disposing the dredged material entirely within the aquatic environment, and sequestering it by placement within constructed cells or natural depressions on the bottom of harbors, bays, or other coastal environments.

The consideration points presented here are based on experience from the Boston Harbor Navigation Improvement Project (BHNIP) and review of other related projects. The organization of an actual WQC has been followed. A fictitious project (referred to as "Harbor X") is described in order to provide specific examples. Relevant aspects of the BHNIP are also included.

Examples from the fictitious project **Harbor X** and the **BHNIP** are included in the text boxes throughout the document.

The discussion and examples are focused on projects that involve complexity in the operations, are performed over an extended time frame, and/or are controversial in nature. The document is presented in outline format, and subject headings that are not relevant to a particular project could be included and noted as not applicable. This will maintain consistency in WQC for dredging/disposal projects, and allow for easier review and use.

Reference is made to a Dredging Management Plan (DMP) within the discussion (see ENSR 2001b for DMP example). It is assumed that such a plan is submitted along with the application for WQC.

List of Abbreviations

BMP – Best Management Practices
CAD – Confined Aquatic Disposal
cy – Cubic Yards
DMP – Dredging Management Plan
EIR – Environmental Impact Report
GIS – Geographic Information System
MLW – Mean Low Water
WQC – Water Quality Certification

Water Quality Certification
Dredging Projects Including CAD Cell Disposal

I. Project Description

*A. **Overview*** – A short (1-2 paragraph) description of the project should be provided. This section could be extracted directly from the DMP for the project.

> **Example Harbor X** - Harbor X lies along a southern facing New England shoreline as shown in Figure 1. The overall objective of the Harbor X Improvement Project is maintenance dredging of the 25-foot approach channel into the harbor and four berth areas as well as dredging of a new anchorage area. Some of the sediments to be removed have elevated levels of contaminants, and Confined Aquatic Disposal (CAD) has been selected as the disposal method. The dredging project includes removal of an estimated 225,100 cy of sediments (not including construction of the cell), of which 60,600 cy are suitable for open water disposal and 164,500 cy are unsuitable for open water disposal.

B. Proposed Project – This section should detail the proposed project and include the components listed below. This section could be extracted directly from the DMP for the project, and should be presented in tabular or list format. A figure is critical.

- Location, proposed depth, material type, and amount to be removed.
- Location and type of disposal of dredged material.
- Expected time frame of the project.

C. Existing Conditions and Environmental Concerns - A detailed description of the existing conditions for the project should be available in the EIR. Data in the EIR should be presented in GIS format, with an electronic deliverable to the DEP. This will allow for clear presentation within the Water Quality Certification related to potential environmental concerns

1. Physical Conditions – Basic information on tides, currents, prevailing winds, water depths, and bottom types should be presented.

2. Benthic Habitat – A summary of the benthic habitats in the vicinity of the project should be presented. This is best presented by figure in GIS format, with a listing of specific areas of concern and the reasons why.

> **Example Harbor X** – A summary of the benthic habitats in the vicinity of Harbor Improvement Project can be found in Figure 1. The following are specific concerns related to this project:
> - Direct disturbance of oyster and clam bed habitats during dredging of Berth 4 and the anchorage.
> - Indirect impacts to oyster and clam beds and other surrounding benthic habitat due to deposition of sediment suspended during dredging and support activities.

3. Fish – A summary of the important pelagic and demersal fish species for the area should be presented. This should include the relevant location(s), seasonality, and specific environmental concerns.

4. Commercial Fisheries – A summary of all relevant commercial fisheries should be presented. This should include stocks that are fished in the affected area, stocks that are fished elsewhere but may be impacted by the project, and project activities that may affect fishermen transiting to other areas. Specific dates of importance for each fishery should also be presented.

BHNIP – Several issues regarding lobster arose during performance of the BHNIP. Scheduling of dredging in specific areas became an issue as lobster catches began to increase in the spring 1999. Although the lobster resource had been addressed in the EIR, seasonality was not specifically noted in the WQC. Even if there will not be specific conditions placed on the project regarding a given fishery, this should be noted in the WQC along with the rationale or EIR reference.

Another issue arose on the BHNIP outside of the specific dredging area. Improvement material that was dredged within the harbor was transported offshore for disposal at the Massachusetts Bay Disposal Site. Transiting the inner harbor, dump scows were maneuvered with a tug alongside or on a short tow. The transition to a longer tow for the trip offshore was made in the outer harbor, away from the project, but in an area heavily fished for lobster during some seasons. In lengthening or shortening the towline, slack would sometime develop, causing the heavy wire towline to drag the bottom. Although this generally occurred for a short distance, lines of traps on the bottom were occasionally dragged or damaged.

5. Sediment Quality – Sediment quality data and physical characteristics should be presented in tabular rather than narrative format. Presented data should include mean and maximum sediment concentrations for specific areas affected by the project. A reference should be included for the presented data.

6. Water Quality – In addition to the water quality designation for the affected waters, reference should be included to any ongoing or recent water quality monitoring studies. Specific concerns should be presented such as increased turbidity/suspended solids blocking light penetration over sensitive areas, transport of contaminants bound to particulate, release of dissolved contaminants, or impacts to dissolved oxygen.

II. Regulatory History

A. Permitting Background – Preparation of a draft and final EIR for the project should be noted as well as applicable State regulations such as affected wetlands or designated port area.

B. Comments Received

C. Section 61 Findings

III. Conditions

A. General Conditions

1. Standard Conditions – Conditions related to antidegradation, notification period, length of performance, and contact information that are generally similar between projects.

2. Monitoring Criteria – Listing of the specific criteria that the project will be evaluated against and the location of compliance. In addition to any specific contaminants of concern, performance standards should be set for both total suspended solids (lab measured) and turbidity (field measured).

3. QA/QC and Lab Requirements – Listing of specific lab methodologies, detection limits, and QA/QC requirements.

4. Reporting – Listing of reporting format, deliverable type, and required schedule.

B. Dredging

1. Equipment – The requirement for a sealed environmental bucket for maintenance (contaminated) material removal should be evaluated for each project. When used for production dredging, recent investigations by the Waterways Experiment Station have shown that the difference in performance (in terms of material loss to the water column) between conventional open and closed environmental buckets may not be all that great (Welp et al., 2001). In addition, the closed buckets tested tended to increase the water content of the dredged material to a greater degree than the open bucket. This can be problematic depending on the type of disposal that is planned.

If an environmental bucket is required for use on a project, its use should be governed by the performance standards set for the project, rather than performance specifications reported by a particular brand bucket. The conditions under which a particular bucket's performance was measured may have included a very controlled remediation application atypical for navigation dredging projects. Other closed environmental buckets fabricated by contractors from standard open buckets have been found to perform adequately under typical conditions but have no performance measurements. Initial monitoring should be used to determine the suitability of a bucket.

2. Operational Requirements – The manner in which the dredge is operated can have a greater impact on release of material to the water column than the type of bucket used. A push to increase production and decrease the cycle time (time to remove one bucket, empty into a scow, and return to the water) can significantly increase suspension of sediments as the bucket impacts the bottom, as it leaves the bottom, and as it exits the water. Rather than specifying the operation itself,

periodic monitoring should be performed to ensure that turbidity/total suspended solids performance goals are being met at the compliance point.

3. Monitoring Specifics – Because of the variable nature of the dredging process and the associated variable release of suspended material, water column effects from dredging can be very transient. Monitoring should incorporate real-time measurements to identify the presence of a suspended solids plume with conditional sampling. Specific components include the following:

- Equipment – Measurements of turbidity, light transmittance, and particle backscatter can all be used to provide real-time assessment of the presence of a plume. The key is that the equipment be able to provide a snapshot view of suspended material in real time over a spatial/depth scale relevant to the particular project and resources of interest.
- Location – Although the monitoring will focus on the compliance point at a particular distance down current of the operation, it should also include measurements as near to the dredging operation as safe and practical as well as detailed background measurements. The goal is to be able to infer suspended solids source strength at the dredge and attenuation down current without the influence of non-project sources.
- Timing - Monitoring of dredging should be performed periodically throughout the project, focusing on changes of equipment, operators, or conditions of dredging (such as a move to a higher current or debris area). If the dredging is located adjacent to a sensitive area, continuous monitoring can be performed with a moored sensor. Data can be physically downloaded on a regular basis or collected via telemetry.
- Supplemental Sampling – Collection of water samples for laboratory analysis of total suspended solids should be performed at a limited number of locations to supplement the real-time measurements. Analysis for other parameters should only be performed if the real-time measurements identify a significant plume or if there is a particular concern about dissolved constituents being released during the dredging (potentially causing a water quality issue without a related suspended solids plume).

BHNIP – Monitoring of dredging-related impacts to water quality was required at the beginning of Phase 1 of the project, and limited monitoring was required with the start up of a new contractor at the beginning of Phase 2. However, no additional monitoring of dredging operations was required during the remainder of Phase 2 (nearly two years in length), a period that included multiple changes in dredge plant, buckets, location, operating conditions, and operators. Limited real-time monitoring at periodic intervals or for specified location/operation changes could have been tied to other required monitoring events to provide a cost-effective check on the dredging operation.

In general, the WQC should include a provision for reducing the scope of the overall monitoring effort if the scope of the initial monitoring reveals impacts far reduced from those identified through predictive modeling that may have been part of the Environmental Impact Report.

Example Harbor X – Monitoring during dredging will include

- One monitoring event during the first week of dredging, with dredging being performed at what is considered a typical pace for the project. Monitoring will be performed during periods of peak ebb and flood tidal currents. Monitoring will include point measurements of turbidity as well as water column current structure and particle backscatter. Monitoring coverage should be sufficient to map suspended solids plume emanating from the dredge and to track the plume down current until it is no longer detectable. Samples will be collected at a background location, immediately down current of the operation, and down current at the compliance location. Samples will be collected in the axis of any identified plume and at the depth in the water column with maximum turbidity signal. Samples will be analyzed for total suspended solids. Analysis of the project list of contaminants of concern will only be required if the turbidity performance standard has been exceeded at the compliance location.
- Additional monitoring events identical in scope to that described above will be performed when dredging is initiated at berth areas 1-2, 3, 4; at the anchorage area; and with each major change in dredge bucket size or type.

4. Exceedences of Water Quality Criteria – An exceedence of a water quality criterion typically triggers a resampling effort to verify the results. However, as the analytical results are received 1-2 days following the original effort and scheduling the resampling takes another 1-2 days, the activity generating the exceedence may have already been completed. Setting performance standards for the real-time measurements such as turbidity allows for real-time feedback on the operation. Sampling and follow up laboratory analysis can be conditional, triggered only by an exceedence of performance standards for the real-time measurements.

C. Disposal

1. Equipment – Disposal scows require initial and periodic inspection to assure workability for a given project. In general, it is impractical for a dump scow to be 100% watertight. Monitoring for turbidity and total suspended solids in the vicinity of the scow may be required if the transit to the disposal cell or area is lengthy and/or passes nearby to more sensitive areas.

The navigational system used to position the scow over a cell or disposal area must have an accuracy adequate for the scale of the scow relative to the cell. The positioning system should include a real-time display that depicts the dump scow relative to the cell boundary.

2. Operational Requirements – Some of the operational requirements listed below are discussed in greater detail in the Best Management Practices for confined aquatic disposal (ENSR, 2001b).

- Timing/Volume Restrictions – Restrictions could include tidal stage, tidal current, disposal volume, multiple disposal event timing, and proximity in time to expected vessel passage. Tugs or support vessels should be required to limit maneuvering over the cell following the disposal event.

- Sequencing – If project operations allow, disposal of the most contaminated material should occur early in the project to allow the greatest level of sequestering (deepest in the cell). At a minimum, the more contaminated material should not be disposed in the final stages of cell filling.
- Tracking Cell Capacity - Bathymetric surveys should be performed after each disposal to track remaining capacity and consolidation and to detect uneven accumulation.
- Documentation - Documentation of each disposal event should include the date, time and source of material dredged; the time and location of disposal (including high accuracy location coupled with orientation of the disposal vessel); the equipment used to dredge and dispose of the material; the weather and sea conditions; and personnel on duty. It is also helpful to have an estimate of the volume of material disposed even if based on scow loads using drafts and depths and reduced by estimates of water in the scow.

BHNIP - Some of the key constraints that were placed on disposal included:

- Disposal only during a three-hour period around high water slack tide (1 hour prior to 2 hours after the predicted high tide). This requirement was based on water quality modeling results that showed maximum dilution (into the high-tide water column) and reduced transport during the monitoring. The WQC was amended near the end of the project to allow for disposal around low water slack following monitoring of a trial.
- Disposal during expected fish migration periods required the presence of a fisheries observer, fish-detecting sonar, and a fish-startle system. Although disposal was performed during migration periods, significant fish schools were never detected in the vicinity of disposal.
- No disposal while other tugs/vessels are within 1000 feet of the disposal cell. The high tide disposal requirement often made this an issue as vessels often schedule arrival to/departure from the harbor around the high tide. The dredging contractor sometimes hurried to get a disposal event in prior to the departure of a nearby vessel. This resulted in vessels passing nearby or over a cell a short time after a disposal event occurred.
- Disposal of the most contaminated material in the lower half of the cell.

3. Monitoring Specifics – Monitoring requirements following disposal are very similar to those associated with dredging described above. Because the disposal is a short-term event with potential generation of a pulse-type plume, real-time measurements are key to identifying any water column impacts. Specific components of the monitoring could include the following:

- Equipment – Measurements of turbidity, light transmittance, and particle backscatter can all be used to provide real-time assessment of the presence of a plume. The key is that the equipment be able to provide a snapshot view of suspended material in real time over a spatial/depth scale relevant to the disposal cell and down current areas of interest.
- Location – Although the monitoring will focus on the compliance point at a particular distance down current of the operation, it should also include measurements directly over the disposal cell prior to and following the disposal event to aid in identifying if the event actually produced a plume.

- Timing – For an individual event, monitoring should begin immediately following disposal into the cell. If the real-time monitoring identifies a plume moving away from the cell, monitoring/sampling at the compliance point should be timed to intercept the plume. Overall, the disposal monitoring should be performed periodically throughout the project, with emphasis on initial disposal, disposal of the material with highest contamination, and disposal as the cell nears capacity. If the cell is located adjacent to a sensitive area, continuous monitoring can also be performed with a moored sensor. Data can be physically downloaded on a regular basis or collected via telemetry.
- Supplemental Sampling – Collection of water samples for laboratory analysis of total suspended solids should be performed at a limited number of locations to supplement the real-time measurements. Analysis for other parameters should only be performed if the real-time measurements identify a significant plume or if there is a particular concern about dissolved constituents being released during the dredging (potentially causing a water quality issue without a related suspended solids plume).

BHNIP – Although a very intensive monitoring program was specified for the BHNIP, much of the monitoring occurred early in the project and/or was grouped into a series of sequential events. There were significant time periods (2-5 months) with no monitoring required, and very little monitoring was performed as cells neared capacity. Sampling and analysis were hardwired into the monitoring regardless of the results of real-time monitoring, significantly increasing the cost of each event.

4. Exceedences of Water Quality Criteria – Similar to the requirements for dredging, setting performance standards for disposal operations for real-time measurements such as turbidity allows for real-time feedback on the operation. Sampling and follow up laboratory analysis can be conditional, triggered only by an exceedence of performance standards for the real-time measurements. The frequency of monitoring can be increased with the savings gained from the reduced analytical costs.

D. Capping - As the WQC will contain the specific performance standards for the cap, it is important to include a mechanism for assessing the "success" of a capping effort. A metric could be developed to score the performance of a given cap, with points specified for coverage, thickness, mixing of capping/capped material, and material on top of the cap. The "goal" for the number of points that would establish the effort as successful, i.e., not needing additional capping, could be based on factors such as the level of contamination of the material within the cell, similarity of the material within the cell to the surrounding harbor bottom, movement of water over the cell, and the proximity of the cell to specific habitats of concern.

Prior to the start of capping, a plan should be submitted to the DEP for approval. The plan should address the following components:

- Determination of the readiness of the cell contents for capping.
- Methodology for placement of the cap.
- Monitoring performed during cap placement to assess coverage.
- Post-capping monitoring to verify coverage and thickness.

A detailed description of cap placement and monitoring can be found in Best Management Practices – Confined Aquatic Disposal (ENSR 2001a).

E. Post-Project – Post-project monitoring should be patterned after the U.S. Army Corps' Disposal Area Monitoring System (DAMOS) and should include the following considerations:

- Seasonality - Monitoring performed to assess biological recovery over a cell should be scheduled to occur in mid summer to capture peak biological activity.
- Sediment Profile Imaging – Sediment profile imaging is a good tool to assess biological activity as well as sediment type of the upper surface of the cell.
- Deposition – Assessment of deposition occurring over the cell relative to adjacent bottom areas.
- Bathymetry – Used to assess general cell condition and consolidation when combined with deposition.

Sub-bottom profiling could be performed on a less than annual basis to assess overall cell/contents structure or if the more frequent monitoring reveals questions or issues. Coring is not recommended except to address specific concerns raised by the monitoring.

F. Protection of Fisheries – In addition to the standard information on environmental windows and fisheries observers, the following requirements would be beneficial for some projects:

- Notification prior to dredge relocation – For projects that cover a large area or multiple area and are performed over an extended period of time, a notification system should be set up through the Division of Marine Fisheries to ensure that fisherman have sufficient time to relocate fishing gear prior to movement of a dredge into a particular area.
- Impacting bottom gear – Towing and maneuvering scows should be performed in such a way that the tow line does not impact the bottom.

G. Communication – With a larger project, issues often arise that require consultation with regulators, particularly at the outset. A summary table of contacts would be very helpful.

Contact Person/Area of Responsibility	**Contact Information**
Report Submittals	Name/Address/Fax/Email
DEP primary contact	Phone/email
DEP backup contact #1	Phone/email
DEP backup contact #2	Phone/email
Fisheries primary contact	Phone/email
Fisheries backup contact	Phone/email
Marine mammal primary contact	Phone/email
Marine mammal backup contact	Phone/email
Other relevant contacts	Phone/email
24-hour emergency contact	Phone

H. Technical Advisory Committee – If a Technical Advisory Committee is expected to actively participate during the execution of the project, its role should be clearly defined in the WQC. In particular, the preferred mechanism for communicating recommendations to the DEP should be defined.

I. Independent Observer – If the overall project is large enough to support an independent observer, the WQC can detail specific responsibilities for the role, potentially including the following:

- Direct observation of specific components of the project.
- Interpretation of issues arising on the project and monitoring results.
- Tracking of project milestones and required monitoring.
- Communication of project progress and issues to the Technical Advisory Committee.
- Facilitation of Technical Advisory Committee meetings.

BHNIP – The independent observer position was defined and administered by Massachusetts Coastal Zone Management. Funding for the position was provided by one of the project proponents (Massport). From the outset, it was clear that the Corps' inspectors provided an adequate level of oversight for the logistical components of the project such as dredging location, disposal amounts, and disposal location. The observer was present on site frequently at the beginning of the project and during startup of new phases of construction with the goal of documenting the activity (video, photos, and notes) and distributing the information to the Technical Advisory Committee. The observer tracked project activities versus those restricted or requiring monitoring in the WQC and provided summaries and interpretation of results. The observer also facilitated Technical Advisory Committee meetings for the duration of the project. The on-site presence diminished as the project progressed, but the communication role with the contractor, project proponents, and Technical Advisory Committee continued throughout the project.

A project-specific web site is now relatively easy to establish and maintain. This could be an effective means to disseminate information and reduce the number of meetings for larger projects. The web site could be set up with password access for members of the Technical Advisory Committee and could contain a complete record of project activities, observations (including photos and video clips), monitoring data, and comment/discussion areas.

IV. <u>Summaries</u> – Tables summarizing some of the requirements of the WQC would be beneficial for a more complex project or for one carried out over an extended time frame. The following are provided as examples for the "Harbor X" project.

A. Summary of Operational Restrictions

Time Period	Operational Restriction
Entire Project	Disposal into cells only during two-hour period (+1/-1 hour) around the predicted time of high or low tide.
Entire Project	Minimal maneuvering over cell following disposal.
Entire Project	No disposal into cell when vessel (ship) passage over the cell is anticipated to occur within ½ hour following disposal.
15 Feb – 15 Jun	No blasting.
15 Feb – 15 Jun	Fisheries observer and sonar system required to ensure cell area if clear of migratory schools of fish prior to disposal into cell.
1 Apr – 30 Nov	Distribution of weekly schedule of dredging locations and minimum 4 day advance notification of relocation of dredge to new area within harbor.

B. Summary of Monitoring Requirements

Monitoring Type	Timing Requirements	Sampling Requirements
Dredging of maintenance material	1 ebb/flood period during first week of dredging	Turbidity (real-time), TSS, metals
	1 ebb/flood period during first 2 days of dredging of berth 1-2	Turbidity (real-time), TSS
	1 ebb/flood period during first 2 days of dredging of berth 3	Turbidity (real-time), TSS, metals, PAH
	1 ebb/flood period during first 2 days of dredging of berth 4	Turbidity (real-time), TSS
	1 ebb/flood period during first 2 days of dredging of anchorage area	Turbidity (real-time), TSS
	Unspecified number – 1 ebb/flood period for each change to a new bucket size/type	Turbidity (real-time), TSS
Dredging of improvement material	1 ebb/flood period during first week of dredging	Turbidity (real-time), TSS
	1 ebb/flood period during first two days of dredging of anchorage area	Turbidity (real-time), TSS
	Unspecified number – 1 ebb/flood period for each change to a new bucket size/type	Turbidity (real-time), TSS
Disposal	1 event during first week of disposal	Turbidity (real-time), TSS, metals
	1 event during first time two or more scows are disposed during a single tidal window (monitoring following both disposal)	Turbidity (real-time), TSS
	1 event during disposal of berth 3 material	Turbidity (real-time), TSS, metals, PAH
	1 event when the cell is approximately 90% filled	Turbidity (real-time), TSS
	1 event after the cell is approximately 95% filled	Turbidity (real-time), TSS
	Minimum 1 event every month	Turbidity (real-time), TSS

Note: Sampling requirements will include metals (and PAH for berth 3 related material) whenever real-time monitoring reveals exceedence of turbidity performance standard.

References

ENSR, 2001a. Best Management Practices – Confined Aquatic Disposal. Submitted to the Maguire Group/MA Coastal Zone Management. March 2001.

ENSR, 2001b. Best Management Practices – Example Dredging Management Plan. Submitted to the Maguire Group/MA Coastal Zone Management. August 2001.

Welp, T., D. Hayes, M. Tubman, S. McDowell, T. Fredette, J. Clausner, C. Albro. 2001. Dredge Bucket Comparison Demonstration at Boston Harbor. U.S. Army Corps of Engineers ERDC/CHL, CHETN-VI-35, March 2001.

SECTION 9.0 – SECTION 61 FINDINGS

9.0 SECTION 61 FINDINGS

This section of the FEIR presents the Section 61 Findings for the New Bedford/Fairhaven Harbor DMMP, as required under the Massachusetts Environmental Policy Act (MEPA) regulations at 301 CMR 11.12. Section 11.07 of the MEPA regulations requires Section 61 Findings in the EIR for a project. As a state agency, CZM is bound by the statutory requirement under MEPA to take all feasible measures to avoid or minimize damage to the environment. This section presents Section 61 Findings for the preferred alternative PIN CAD for Harbor.

9.1 Preferred Alternative - Popes Island North CAD Cell Area

Potential environmental impacts associated with selection of the preferred alternative CAD site in the Harbor, PIN, include those associated with sediments and water quality, benthos, finfish, wetlands, wildlife, endangered species, navigation and shipping, land use, air quality and noise, historic and archaeological resources and recreation areas.

9.1.1 Sediments and Water Quality

Construction of preferred alternative CAD cell(s) including placement of UDM in the cell(s) will lead to temporary impacts to the existing sedimentary environment at the site, including mortality of existing benthic organisms and the alteration of existing sediment composition. The results from the sediment grain-size analysis conducted as part of this latest survey for the FEIR showed that fine-grained silt and clay were the predominant sediment type found at the PIN and total organic carbon was high. These results agree with those found by the SPI survey in the DEIR conducted in 1999 by CZM. The overwhelmingly dominant species found at the field sites sampled for the FEIR were opportunistic polychaetes (*Mediomastus ambiseta* and *Streblospio benedicti*). These two polychaetes are considered successional Stage I species.

The SPI survey (1999) and the benthic infaunal analysis (2002) are remarkably consistent with one another. This provides strong evidence to support the fact that the communities in the Lower New Bedford/Fairhaven Harbor, in the area of the two proposed CAD cell sites, are dominated by opportunistic species that can tolerate disturbed conditions. Similar opportunistic communities were observed at the Boston Harbor Navigational Improvement Project (BHNIP) CAD cell sites in 1999 (ENSR, 2001). The investigation at the BHNIP CAD cell site showed that, within a year of filling and capping, the opportunistic benthic infauna had re-colonized the sediment surfaces. It is highly likely that construction, filling, and capping events at the proposed New Bedford/Fairhaven Harbor CAD cell sites will temporarily impact the benthic communities. However, similar to BHNIP cells the PIN cell capped surfaces will be recolonized rapidly by similar opportunistic species. Eventually, the benthic community will return to a pre-dredging composition. Adults and larvae from adjacent areas, which were not dredged, will provide recruits to the disturbed sites.

Water quality impacts from development of the PIN CAD cell site(s) in New Bedford/ Fairhaven Harbor are predicted through ground-truthed water quality testing and hydrodynamic modeling of this FEIR, to be temporary and minor in nature. The location of the proposed disposal sites within the Inner Harbor, above the Hurricane Barrier, above Popes Island minimizes potential

storm-induced wave action impacts, minimizing the impacts to water quality from the resuspension of cap sediments. Hydrodynamic data collected during the field study required for the FEIR showed the PIN CAD area to be depositional where depth-averaged currents had a mean speed of 2.3 cm/s (0.5 kt./hr.) to the southeast, with a maximum value 15.0 cm/s (0.29 kt./hr.) during this period. Currents at PIN are therefore not erosional. According to toxicity tests using sediments from the NBH-202 station, the combination of multiple pollutants was the cause of the observed acute toxicity effects. For example, half the toxicity to mysids was due to PCBs and the other half was due to a combination of copper and ammonia. From analysis of these results it was concluded that a dilution to less than 2.2% of the elutriate concentration would be protective. Detailed dredged material transport analysis for this FEIR showed that for any environmental condition, area coverage for a concentration of 2.2% of the elutriate level was always smaller than the PIN-CAD area (1.67×10^5 m^2 [41 ac]). The largest area coverage (1.2×10^5 m^2 [30 ac]) of the 2.2% elutriate concentration occurred for a release during calm conditions while the smallest coverage (1.0×10^4 m^2 [2.5 ac]) occurred for a release during northwesterly winds. Other sediments with lower elutriate concentrations, and presumably lower toxicity, will affect smaller areas. The placement of four-feet of coarse-grained sand as a final cap will also minimize sediment resuspension at the preferred alternative site.

9.1.2 Benthos

Benthic resources include marine epifauna and infaunal invertebrates, and submerged aquatic vegetation. As described above, the community structure of benthic organisms is typically a function of sediment characteristics and water quality (Day, et. al., 1989). Dredging and disposal of sediment may impact benthic marine organisms outside the project area, by altering preferred microhabitat (i.e., sediment composition) or via interference with the organism's feeding type. Therefore, impacts to benthic epifauna and infaunal sessile invertebrates such as various bivalve mollusks and echinoderms are expected. However CAD cell construction involves dredging to create sub-aqueous pit(s). To create the pit(s) the benthic community of the CAD cell design footprint will be removed. Two species important species of shellfish, Northern quahogs (Mercenaria mercenaria) and soft-shell clams (Mya arenaria) occupy the footprint.. Since the shellfish of PIN Cad cell site area are known to be contaminated above limits allowable for human consumption they will be lost in the process. According to DMF, mitigation for the shellfish loss will be replacement based on DMF calculations on a project-by-project basis. The area of the disposal sites are closed to shellfishing. Additionally, there were no eelgrass beds identified in the area of the proposed disposal site. The closest eelgrass areas are located outside of the Hurricane Barrier.

9.1.3 Finfish

Construction and disposal activities at the preferred alternative sites will have little impact on existing fisheries resources. Commercial and recreational fishing within New Bedford/ Fairhaven Harbor is prohibited. Highly migratory sport fish species, including striped bass and bluefish will not be impacted by cell construction at the PIN CAD cell area. Diadromous species such as catadramous species; American eels and anadromous species; rainbow smelt and blueback herring will likewise not be impacted by cell construction. All the above-mentioned finfish species are fully capable of avoiding CAD cell construction activities. However, winter

flounder, an important recreational species in the area that frequents neritic waters, are bottom spawners. Larvae are known to swim off bottom and drift back down to rest (Bigelow and Shroeder, 1953). Winter flounder eggs doe not carry oil globules, therefore they have negative buoyancy and they incubate on bottom. Timing of cell construction and dredged material disposal activities at the preferred PIN CAD cell site area should be set to avoid the spawning and egg development cycle of demersal fish to avoid impacts to these resources.

9.1.4 Wetlands

There would be no impacts to coastal wetlands or salt marsh. The entire area of the preferred alternative PIN CAD cell area is sub-tidal, therefore, no coastal wetlands exist there. The site is, however, classified as Land Under the Ocean within a DPA under the Massachusetts Wetlands Regulations at 310 CMR 10.26. Under the regulations, a project impacting Land Under the Ocean in a DPA must minimize adverse impacts to water circulation and water quality, including fluctuations in dissolved oxygen, temperature or turbidity, or the addition of pollutants. As discussed in the preceding section on water quality impacts, no adverse long-term impacts to water quality are expected from construction and dredged material disposal activities at the sites. Likewise, the impacts to water circulation are described in the preceding section. No adverse impacts are expected.

9.1.5 Wildlife

Wildlife impacts were adequately assessed in the DEIR and included those to avifauna, marine mammals, and marine reptiles. No shorebird breeding or foraging habitat is located within the confines of the preferred alternative PIN CAD site area, since these areas are generally intertidal or supratidal areas. Shorebird habitat in New Bedford/Fairhaven Harbor lies outside of the UDM disposal zone of influence. The nature of the disturbance (sub-tidal) dictates that impacts to nesting habitat would not occur. Since finfish will leave the area to avoid dredging and disposal impacts, piscivorous waterfowl will also avoid the impact areas as they follow departing finfish concentrations. Molluscivorous waterfowl tend to congregate in areas with high mollusk density such as the vicinity of shellfish beds and reefs. Since shellfish beds lie within the vicinity of the disposal areas or within the zones of UDM disposal influence, minimal, temporary impacts to molluscivorous waterfowl is expected.

The various species of whales and other cetaceans found in the region, occur far offshore of New Bedford/Fairhaven, rarely, if ever, entering harbor waters. Therefore, the only marine mammal species commonly found in New Bedford/Fairhaven Harbor is the harbor seal, which frequent shorefront areas, not the deep water and muddy bottom conditions of the disposal site. The harbor seal is also highly mobile, and quite able to avoid cell construction and dredged material disposal events. Therefore, no impacts to marine mammals are expected.

Marine reptiles in the region are represented by sea turtles. Two species of marine turtles that occur in the North Atlantic are not commonly found in New Bedford/Fairhaven Harbor. They occur in the much deeper open ocean waters off-shore and the north Atlantic Ocean and rarely, if ever, enter New Bedford/Fairhaven Harbor. The distance from the PIN CAD cell area to the sea

turtle habitat will preclude any impact to these species or their habitat from either cell construction or dredged material disposal activities.

9.1.6 Endangered Species

Although five whale and two sea turtle species listed by the USFWS occur in the ocean waters outside New Bedford/Fairhaven Harbor, there is no indication that these species occur at the preferred alternative PIN CAD cell area within the harbor. Therefore, no impacts to endangered species habitat from CAD cell construction and dredged material disposal activities will occur.

9.1.7 Navigation and Shipping

New Bedford/Fairhaven Harbor has maintained status as one of the leading fishing ports of the nation. The harvesting, processing and supporting industry to the local fishing industry is directly linked to the ability of vessels to navigate safely within New Bedford/Fairhaven Harbor. Continued access to shore-side locations is an integral component of the Harbor Plan's vision to maintain and expand existing maritime, industrial and recreational visitor harbor uses, to continue New Bedford/Fairhaven Harbor as a working, productive port and economic asset for the City, Town and Commonwealth. PIN CAD cell area construction activities will be situated north of most harbor traffic outside navigable channels. Seasonal recreation boating in and about New Bedford/Fairhaven Harbor is enjoyed by residents and visitors. Any dredged material disposal activities off the PIN CAD cell area in New Bedford/Fairhaven Harbor channels will be scheduled to avoid conflicts with commercial and recreational vessel movements, avoiding temporary impacts to existing navigation and shipping. Therefore, there will be no permanent impacts to existing commercial or recreational navigation and shipping in New Bedford/Fairhaven Harbor.

9.1.8 Land Use and Consistency with the Harbor Plan

The proposed CAD disposal sites are entirely within sub-tidal waters, therefore there would be no direct negative impacts to existing shore front land use patterns surrounding New Bedford/Fairhaven Harbor. The PIN CAD cell area is submerged and therefore it will not interrupt view-sheds from land. Positive indirect impacts will result from the development of the PIN CAD cell area. The development of PIN CAD cell area will allow for environmentally sound, cost effective disposal of UDM from New Bedford/Fairhaven Harbor dredging projects, maintaining the economic viability of existing marine facilities and existing land use patterns along the New Bedford/Fairhaven Harbor shoreline.

CAD cell development is consistent with the stated goals of the Harbor Plan. The Harbor Plan also encourages the coordination with the DMMP to develop a suitable alternative for disposal of UDM. As noted on the preceding paragraph, CAD cell development will encourage the completion of the anticipated public and private dredging projects in New Bedford/Fairhaven Harbor and provide a local disposal option for the UDM from those dredging projects.

9.1.9 Air Quality and Noise

Air quality and noise impacts from development of the PIN CAD cell site(s) in New Bedford/Fairhaven Harbor are expected to be temporary and minor. Air quality impacts from the disposal of dredged materials at the candidate disposal sites in Buzzards Bay are expected to be minor and temporary. Impacts will result from the operation of tugboat engines, and from the potential escape of odors from temporary storage of dredged material on barges (e.g., nitrogen oxide, NO_x).

Under the Enhanced Emissions and Safety Test (310 CMR 60.02), tug boats and dredge scows used in dredging are not required to undergo an emissions inspection because the boats are not defined as motor vehicles under 310 CMR 60.02. Emissions from disposal activities are managed through the use of proper emission controls on diesel engines under the guidance of the Massachusetts Diesel Retrofit Program. All towing equipment is strongly encouraged to be equipped with proper air pollution control equipment and mufflers.

The Massachusetts Diesel Retrofit Program (MDRP) is the primary component of the DEP Mobile Source Emissions Control Program that responds to the need to control diesel emissions generated on-site by heavy-duty construction vehicles. The goal of the MDRP is to help reduce adverse health impacts relating to emissions from diesel engines.

The DEP believes that retrofitting heavy-duty construction equipment is a very cost effective and efficient way to significantly reduce emissions of fine particulates and toxics into the ambient air, to mitigate adverse localized impacts, and improve the air quality for construction workers, while not adversely affecting the construction phase of major construction and development projects.

Air quality impacts will be minimized through the use of equipment that complies with emission standards applicable to equipment, use of proper emission controls, and the temporary nature of the activity. Temporary stockpiling on or near land of dredged material may result in minor air quality and odor impacts to adjacent properties due to anaerobic decomposition of organic materials in the dredged sediment. These odors will be minimized with the use of lime as necessary. Volatilization of organic compounds in the stockpiled dredged material is not expected to occur because the short duration of stockpiling activities will not allow for complete drying of the dredged material.

9.1.10 Historic and Archaeological Resources

The location of the preferred alternative PIN CAD cell area within the sub-tidal area of New Bedford/Fairhaven Harbor avoids direct and indirect impacts to nearby land-based local-, state- and federal-listed historic sites and districts.

Detailed underwater archeological surveys of the PIN CAD cell area were conducted for this FEIR (See Section 3-0). Numerous targets of interest, which do not represent hazards to the future dredging or PIN CAD cell construction operations were identified on the summary maps. None of the remote sensing targets appears to contain submerged cultural resources. No

additional underwater archeological investigation is recommended. Therefore, no impacts to underwater archaeological resources are expected at the PIN CAD cell area.

9.1.11 Recreation Areas

The PIN CAD cell area will not pose direct impacts to existing recreation areas from the construction or use of the proposed disposal sites. The Inner Harbor is closed to fishing an swimming, minimizing the potential for recreational conflict associated with PIN CAD area cell sites. CAD development will not have long-term impact movement of small draft recreational boats that may use this area currently. Any recreational boat moorings permitted by the Town of Fairhaven currently set in areas of the PIN CAD cell area would need to be moved temporarily during construction; however, they would be replaced following final capping. Potential recreational boating conflicts associated with the construction of the CAD disposal sites will be mitigated by clearly delineating the work area and issuing boating advisories. This temporary impact is minimized by the presence of other recreational boating opportunities areas in the Outer Harbor area and beyond.

9.2 Implementation of Mitigation Measures and Proposed Mitigation Implementation Schedule

Prior to the commencement of dredging projects, the PIN CAD disposal cells need to be dredged open. Dredging of the disposal cells will be completed during an environmentally favorable window to reduce the disturbance to marine life. Dredge limits and locations will be located by Geodetic Positioning System (GPS), which is a satellite positioning system, accurate to within a foot of the intended horizontal design limits. The dredge machinery will most likely be a large barge mounted crane with a clamshell bucket. The environmental bucket used for the UDM dredging portion of the project is expected to minimize resuspension of UDM in the water column. Floating semi-permeable turbidity barriers may be installed to minimize impacts from resuspended dredged sediment. The material will be removed to the final design depth and side slopes. The dredging contractor will also be compensated for an allowable over-dredge limit to ensure that the intended depths are achieved. The UDM CAD cell footprint material will be held in secure scows. Material underlying the UDM will be classified as suitable for unconfined disposal through DEP testing protocol. Suitable dredged materials (SDM) will be loaded into scows and shipped to the Buzzards Bay Disposal Site approximately 15 nautical miles from the Harbor and safely deposited. A predetermined volume of SDM will be retained in scows at the Harbor to be used as capping material for the specific PIN CAD cell.

Following the opening dredging of each disposal cell, maintenance UDM from the harbor will be dredged by mechanical means. After being dredged, the UDM will be placed on a dump scow and transported to the disposal cell, where the material will be deposited. After the completion of all UDM disposal the CAD cell will be capped, ultimately, long-term water quality protection and benthic recolonization will occur.

Potential mitigation for direct impacts will be determined during the permitting process through consultation with the appropriate agencies. The party responsible for the implementation of the required mitigation measures has not been identified to date. Potential entities include the

Massachusetts Department of Environmental Management, the US Army Corps of Engineers, or the City of New Bedford/Fairhaven operating through an existing or created public authority.

9.3 Draft Section 61 Finding

With the selection of the preferred alternative PIN CAD cell area for UDM disposal from New Bedford/Fairhaven Harbor, CZM finds that, with implementation of the mitigation measures listed above, all feasible means have been taken to avoid or minimize damage to the environment.

SECTION 10.0 – RESPONSE TO COMMENTS

10.0 RESPONSE TO COMMENTS

This section of the FEIR provides individual responses to the public and agency comments received on the Draft Environmental Impact Report (DEIR) for the New Bedford/Fairhaven Harbor DMMP.

Two letters of response to the DEIR were received by MEPA. Agency letters are addressed in the order in which they are listed in the MEPA DEIR Certificate of June 14, 2002. The first response letter received by MEPA was from Massachusetts Department of Environmental Protection. The second response letter received by MEPA was from Massachusetts Department of Marine Fisheries.

Copies of the MEPA DEIR Certificate and these two agency letters are presented in this section of the FEIR with annotated comments. Responses to the annotated comments follow each letter in the annotated order. Where appropriate, the response may direct readers to the specific sections of the FEIR where the comments are implicitly answered.

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COASTAL ZONE MANAGEMENT
Exec. Office of Environmental Affairs

June 14, 2002

CERTIFICATE OF THE SECRETARY OF ENVIRONMENTAL AFFAIRS
ON THE
DRAFT ENVIRONMENTAL IMPACT REPORT

PROJECT NAME	: Dredged Material Management Plan
PROJECT MUNICIPALITY	: New Bedford and Fairhaven
PROJECT WATERSHED	: Buzzards Bay
EOEA NUMBER	: 11669
PROJECT PROPONENT	: Massachusetts Coastal Zone Management
DATE NOTICED IN MONITOR	: May 8, 2002

As Secretary of Environmental Affairs, I hereby determine that the Draft Environmental Impact Report submitted on the above project **adequately and properly complies** with the Massachusetts Environmental Policy Act (G. L. c. 30, ss. 61-62H) and with its implementing regulations (301 CMR 11.00).

This project is part of a state-wide Dredged Material Management Plan (DMMP) to address the issue of finding environmentally sound disposal sites for dredged material from the Commonwealth's eight Designated Port Areas (DPA) that is unsuitable for unconfined ocean disposal. This Draft EIR is being filed specifically for the DPA of New Bedford/Fairhaven Harbor. The DEIR deals with the disposal of dredged material and not with dredging itself. Individual dredging projects within the harbor must undergo their own environmental review.

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Studies reported in the baseline demand analysis have estimated that up to 960,000 cubic yards (cy) of contaminated and otherwise unsuitable material from both public and private dredging projects will require management and disposal over the next 10 years to maintain the DPA as a viable working port.

The DEIR has provided a detailed and thorough analysis of a large variety of alternative disposal and de-watering sites and has presented a preferred alternative. The preferred alternative involves construction of two Confined Aquatic Disposal (CAD) sites within New Bedford/Fairhaven Harbor, one just north of Popes Island and the other in the Inner Channel. These CADs have the capacity to accommodate the estimated volume of dredged material and are in close proximity to the dredging areas. Based on the level of detail of information provided in the DEIR, the selection of this method of disposal and these CAD sites is reasonable on both environmental and economic grounds.

A. As the DEIR indicates, before a final decision is made on a management plan, there will need to be some additional site specific information provided in the Final EIR. That site specific information is identified in the DEIR and includes:

1. • Additional geotechnical borings
2. • Macrobenthic sampling and identification
3. • Current measurements and water column chemistry
4. • Dredging and disposal event modeling and hydrodynamic analyses
5. • Underwater archaeological surveys
6. • Physical and chemical analyses of surgical sediments

7. I expect that this information will be provided in the FEIR. Should this site-specific information indicate that the preferred alternative, in whole or part, is not suitable, the FEIR should provide the same level of information on any alternative site or methodology that might be chosen.

The DEIR has provided sufficient information to allow the dismissal of upland disposal and upland reuse of the dredged materials, and those options need not be carried forward in the FEIR. Nevertheless, while the DEIR has also shown that Alternative Technologies are not practicable or cost-effective at

this time, these technologies are being continuously advanced. Therefore, I expect that their use will be re-evaluated periodically by the proponent and the permitting agencies to determine whether all or some of the dredged material can be managed in the future using an improved Alternative Technology.

B. The DEIR has presented a Monitoring and Management Plan that uses a tiered monitoring strategy. Under this strategy, if lower level monitoring uncovers adverse effects, a higher level of monitoring would be implemented and, if necessary, management actions such as restricting or curtailing disposal operations might be implemented. The DEIR also identifies a number of Best Management Practices for the CADs that have been used in other disposal operations with considerable success.

The DEIR also indicates that the proponent intends to establish a Technical Advisory Committee that will include representatives of local, state and federal agencies. This group will establish what specific actions will be taken in response to monitored problems, and will determine who is responsible for
C. taking any necessary actions. This group should also consult with the Division of Marine Fisheries (DMF) to develop a schedule for CAD use, and to develop appropriate plans for shellfish propogation and other mitigation measures, as indicated in the DMF comment.

I am pleased with the progress made to date on this important project and I look forward to reviewing the more detailed information in the FEIR.

June 14, 2002
Date

Bob Durand

Comments received :

Department of Environmental Protection
Division of Marine Fisheries

BD/rf

10.1 Certificate of the Secretary of Environmental Affairs on the DEIR

Comment: A. *Need for additional site-specific information provided in the FEIR*

Response: Additional site-specific information is presented in section 3.0 for the preferred alternatives and 5.0 for the selected preferred alternative.

Comment: A 1. – *(need for) Additional geotechnical borings*

Response: A discussion of the additional information gained from the Phase II geotechnical borings program performed for the FEIR is presented in Section 3.1.

Comment: A 2. *– (need for) Macrobenthic sampling and identification*

Response: A discussion of the additional information gained from the macrobenthic sampling and identification program performed for the proposed preferred alternative CI and PIN CAD site areas is presented in Section 3.6.

Comment: A 3. *– (need for) Current measurements and water column chemistry*

Response: A discussion of the additional information gained from the current measurements program performed for the proposed preferred alternative CI and PIN CAD site areas is presented in Section 3.9. A discussion of the additional information gained from the water column chemistry program performed for the proposed preferred alternative CI and PIN CAD site areas is presented in Section 3.8.

Comment: A 4.- *(need for)Dredging and disposal event modeling and hydrodynamic analyses*

Response: A discussion of the additional information gained from the dredging and disposal event modeling program performed for the selected preferred alternative PIN CAD site area is presented in Section 5.0. A discussion of the additional information gained from the hydrodynamic analyses program performed for the proposed preferred alternative CI and PIN CAD site areas is presented in Section 3.8.

Comment: A 5.- *(need for) Underwater archaeological surveys*

Response: A discussion of the additional information gained from the underwater archaeological surveys program performed for the proposed preferred alternative CI and PIN CAD site areas is presented in Section 3.4.

Comment: A 6.-*(need for) Physical and chemical analyses of surficial sediments*

Response: A discussion of the additional information gained from the physical and chemical analyses of surficial sediments program performed for the proposed preferred alternative CI and PIN CAD site areas is presented in Section 3.5.

Comment: A 7.*-If the preferred alternative, in whole or in part, is not suitable, the FEIR should provide the same level of information on any alternative site…*

Response: The selection of the preferred alternative CAD cell site, Section 4.0, presents the objective analysis of both proposed preferred alternatives, CI and PIN, brought forward from the DEIR. The selected preferred alternative is PIN and it is considered suitable. The PIN site is recommended for designation.

Comment: B.*- The DEIR presented a Monitoring and Management Plan…*

Response: The FEIR includes a dredging management plan that is presented in Section 8.0. This section describes and provides the framework for the management tools that must be developed to support use of the designated CAD area by individual projects.

Comment: C.*- This group (Technical Advisory Committee) should also consult with the Division of Marine Fisheries(DMF) to Develop a schedule for CAD use and to develop appropriate plans for shellfish propagation and other mitigation measures…*

Response: The formation and importance of a Technical Advisory Committee (TEC) is discussed in Section 9.0 Dredging management Plan. In Section 7.0 Mitigation Measures the TEC will find helpful information regarding avoidance, minimization and mitigation measures. Biological time-of -year dredging windows recommendations are presented to assist regulatory agencies in the determination of dredging project time frames with the least environmental impact. The DMF has been consulted by CZM in the preparation of the shellfish mitigation recommended for development of the preferred alternative.

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL PROTECTION
ONE WINTER STREET, BOSTON, MA 02108 617-292-5500

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JANE M. SWIFT
Governor

BOB DURAND
Secretary

LAUREN A. LISS
Commissioner

June 7, 2002

Jay Wickersham, Director
MEPA Unit
Executive Office of Environmental Affairs
251 Causeway Street – 9th Floor
Boston, MA 02114-2150

Re: EOEA # 11669
DEIR, Dredged Material Management Plan
New Bedford and Fairhaven Harbor

Attention: Richard Foster

Dear Mr. Wickersham:

The Department of Environmental Protection (DEP) has reviewed the Draft Environmental Impact Report (DEIR) for the Dredged Material Management Plan (DMMP) for New Bedford and Fairhaven Harbor (EOEA # 11669) and this correspondence includes DEP's consolidated comments.

Introductory and Background Comments

Initially, DEP would like to indicate its full support for development of a Dredged Material Management Plan to identify and permit dredged material management alternatives with sufficient capacity to safely and cost-effectively manage the 960,000 cubic yards of sediment that are deemed unsuitable for unconfined ocean disposal (UDM) from both public and private dredging projects over the next 10 years from the Harbor serving both New Bedford and Fairhaven . As you are aware, DEP has been working closely with the Office of Coastal Zone Management (CZM) and other stakeholders the past few years to move forward with DMMPs for the Commonwealth's Designated Port Areas, New Bedford/Fairhaven being just one of them.

Disposal site identification and designation is being integrated with, and relies on, the New Bedford/Fairhaven Harbor Plan and as part of the plan, the communities will identify specific landside development activities that will require dredging. The DMMP is working simultaneously to identify reuse and disposal sites for the dredged sediments so that potential sites can be reviewed by the community in the context of the Harbor Plan. By supporting the two programs in tandem, it will be able to efficiently provide the technical information for the ports to develop community consensus on the most appropriate development and dredging disposal site scenario.

This information is available in alternate format by calling our ADA Coordinator at (617) 574-6872.

DEP on the World Wide Web: http://www.mass.gov/dep
Printed on Recycled Paper

General Comments

(1) The DMMP has fully assessed the entire spectrum of alternatives, including; upland reuse/disposal, alternative treatment technologies, and aquatic disposal and performed analyses of the resources present at the potential sites to assess the potential impacts associated with the use of each site.

(2) DEP is of the opinion that CZM has performed an excellent and thorough assessment of options and sites and that the proposal to carry two Inner-Harbor CAD sites (Popes Island North and Channel Inner) into the Final EIR to allow for public/agency review and comment on both sites is reasonable and logical and is supported by the current level of documentation.

A. (3) As clearly articulated in the DEIR, additional site-specific information will need to be obtained before final site selection and permitting determinations can be made. This information will be critical to allow for final decision-making on whether either CAD is permittable and if both are, which one is preferable. According to the DEIR, this information will include at least the following:

1. • Additional geotechnical borings to confirm depth to bedrock and determine side slope stability

2. • Macrobenthic sampling and identification

3. • Current-meter measurements and basic water column chemistry

4. • Dredging and disposal event modeling and hydrodynamic analysis

5. • Underwater archaeological surveys

6. • Physical and chemical analysis of surficial sediment

7. In addition, the Final EIR will need to include more detailed discussion of Long-Term Management Strategies.

A review of DEIR Table 1-2 (page 1-26), titled; "Summary of Attributes of Proposed Preferred Alternative Sites" indicates that each of the CAD sites has its own particular pluses and minuses. As previously indicated, additional information is necessary to allow for final decision-making, but at first blush, it appears that Popes Island North has a number of environmental attributes (e.g., Benthos-Habitat Complexity, Shellfish & Fisheries) that would point to this site as the "better location" for a CAD.

Technology Assessment

(1) DEP agrees with the DEIR determination that upland reuse/disposal of UDM is neither feasible nor cost-effective and we concur with the DEIR recommendation that this option no longer needs to be considered.

(2) DEP also agrees with the DEIR conclusion that at this time Alternative Technologies to manage the volume and nature of the UDM are currently not realistic nor cost-effective, but that this category of technologies should be carried forward as potential future options and periodically reassessed to determine whether new information has been developed that might result in the use of an alternative technology for all, or portions of, UDM during one or more of the 5-year disposal phases.

Monitoring and Management Plans

(1) A tiered approach to monitoring dredged material disposal impacts has been proposed, and is summarized in the DEIR, using a series of "decision tree" flow charts. The decision trees are structured such that indications of adverse effects at lower levels will trigger management actions involving more thorough examination of the impacts. If Tier I monitoring (Tier I would represent the minimum or "routine" level of monitoring) indicates potential impacts, the proponent would implement the next higher monitoring tier. If the monitoring at this level indicates an absence of adverse environmental impacts, then there typically would be no need to implement additional monitoring and/or take management action (such as reduce/restrict disposal operations).

(2) MCZM has developed draft Best Management Practices (BMPs) for the CADs based in part on the experiences and data from the Boston Harbor Navigation Improvement and Dredging Project (BHNIP). The DEIR states that BMPs have been developed to meet state and federal water quality criteria and standards. As occurred during the BHNIP, DEP staff will work closely with CZM and other stakeholders to review and refine the BMPs.

(3) DEP concurs with the DEIR proposal that a disposal site management and monitoring plan be developed by a Technical Advisory Committee (TAC) composed of local, state, and federal interests (as was done during the BHNIP), the purpose being to determine the specific actions and responsibilities necessary to ensure that disposal site use protects human and environmental health and resources. It will address where, when, and how a disposal site can be used, what kind of short and long-term monitoring will be required, and who should be responsible for every aspect of site use, management, and monitoring. The management plan will also determine what kind of material can be safely disposed of, and what testing may be necessary to determine the nature of the material proposed for disposal. As with the BMP Plan, DEP staff will actively participate in the development and implementation of this plan.

B. **Compliance With Water Quality Standards**

1. (1) The DEIR states that additional detailed site-specific information is required to fully assess the fate of UDM placed at the proposed locations, in that at present, understanding of the magnitude and seasonal/spatial components of these physical forces is insufficient to quantify the long-term

stability of UDM at the preferred disposal sites. Detailed, *in-situ* measurements of tides, circulation, and patterns of sediment resuspension will be evaluated at the preferred disposal site. DEP concurs with this proposal.

2. (2) From prior projects, evidence suggests the impact to water quality from UDM disposal is short-term and typically includes a localized decrease in DO, pH, light penetration, and increase in TSS with a related slight increase in certain contaminant concentrations. Conditions historically have returned to ambient conditions within hours to days, depending on the amount and composition of the disposed material.

3. (3) DEP staff have reviewed Section 9.1.3, Water Quality Standards of the DEIR and have the following comments:

   a) The authors state, "The development of water quality standards prior to dredging and disposal activities will provide target baseline conditions, which are not to be exceeded during operations." DEP wishes to clarify this statement in that we do not anticipate that project or site-specific "standards" will be developed, but that "thresholds" would be developed which could be used as either/both not-to-exceed criteria or caution/warning criteria which if exceeded would require the implementation of a specific action(s); and

   b) The report refers to use of a 300-foot down-current mixing zone to determine water quality compliance for both acute and chronic criteria. It is true that 300 feet was utilized for the BHNIP (and for other dredging projects) but a final determination on the size and shape of the regulatory mixing zone would be made during the permitting process, in cooperation with the deliberations of the TAC.

   This same comment applies to the other proposals included in this section of the DEIR; but in general, DEP can indicate that these proposals are certainly in-line with prior DEP WQC determinations.

4. (4) The results from the BHNIP, which utilized CAD disposal, showed that the project consistently met the Water Quality Certification compliance standards during the operation, and no long-term impacts have been observed.

C. **Site Permittability**

1. (1) Table 1-5 (pages 1-32) correctly delineates DEP's statutory, regulatory and permitting procedures for the project, the only exception being if a Wetlands Protection Act Superseding Order of Conditions is found to be necessary, which would be issued by DEP.

2. (2) DEP would like to indicate that the Water Quality Certification is the key DEP permitting action for dredging projects, particularly one which includes aquatic disposal. DEP therefore anticipates that, as occurred with the BHNIP, the WQC for this Project will be an extensive and detailed document which will require extensive activities by the project proponent and its contractor(s). As MEPA is aware, as part of the BHNIP, the state regulatory agencies required that

the project proponents retain the services of an "Independent Observer" to monitor and oversee for the regulating agencies daily operations. This procedure was found to be critically important during the BHNIP. DEP respectfully requests that MEPA consider whether a similar activity should be incorporated into this Project.

3. (3) Project Permittability is directly related to the avoidance, minimization and mitigation of impacts associated with the site(s) and operations proposed to be performed. In short, proposals that avoid sensitive biological resources are more permittable than those which directly affect these resources. If impacts to biological resources are unavoidable, then means to minimize these impacts would need to be employed. Finally, if an impact is anticipated to occur, even after minimization measures will be employed, then mitigation is required.

Feel free to contact at (617) 292-5698 if you have any questions regarding this correspondence.

Very truly yours,

Steve G. Lipman, P.E.
Special Projects Coordinator

SGL/wp
6B: 1169DEIR
cc: Deerin Babb-Brott, CZM
New Bedford/Fairhaven Dredged Material Management Committee
Army Corps of Engineers
Massachusetts Division of Marine Fisheries
Massachusetts Department of Environmental Management
USEPA
National Marine Fisheries Service
U.S. Fish and Wildlife Service

10.2 Department of Environmental Protection

Comment: A.- *Need for additional site-specific information provided in the FEIR at a minimum…*

Response: Additional site-specific information is presented in section 3.0 for the preferred alternatives and 5.0 for the selected preferred alternative.

Comment: A 1. –*(need for) Additional geotechnical borings*

Response: A discussion of the additional information gained from the Phase II geotechnical borings program performed for the FEIR is presented in Section 3.1.

Comment: A 2. *(need for) Macrobenthic sampling and identification*

Response: A discussion of the additional information gained from the macrobenthic sampling and identification program performed for the proposed preferred alternative CI and PIN CAD site areas is presented in Section 3.6.

Comment: A 3. *– (need for) Current measurements and water column chemistry*

Response: A discussion of the additional information gained from the current measurements program performed for the proposed preferred alternative CI and PIN CAD site areas is presented in Section 3.9. A discussion of the additional information gained from the water column chemistry program performed for the proposed preferred alternative CI and PIN CAD site areas is presented in Section 3.8.

Comment: A 4. *– (need for)Dredging and disposal event modeling and hydrodynamic analyses*

Response: A discussion of the additional information gained from the dredging and disposal event modeling program performed for the selected preferred alternative PIN CAD site area is presented in Section 5.0. A discussion of the additional information gained from the hydrodynamic analyses program performed for the proposed preferred alternative CI and PIN CAD site areas is presented in Section 3.8.

Comment: A 5. –.- *(need for) Underwater archaeological surveys*

Response: A discussion of the additional information gained from the underwater archaeological surveys program performed for the proposed preferred alternative CI and PIN CAD site areas is presented in Section 3.4.

Comment: A 6. –.-*(need for) Physical and chemical analyses of surficial sediments*

Response: A discussion of the additional information gained from the physical and chemical analyses of surficial sediments program performed for the proposed preferred alternative CI and PIN CAD site areas is presented in Section 3.5.

Comment: A 7. *– the Final EIR will need to include more detailed discussion of Long-Term Management Strategies.*

Response: The FEIR includes a dredging management plan that is presented in Section 8.0. This section describes and provides the framework for the management tools that must be developed to support long-term use of the designated CAD area by individual projects.

Comment: B 1. *–Detailed in-situ measurements of tides, circulation and patterns of sediment resuspension will be evaluated at the preferred disposal site*

Response: Detailed in-situ measurements of tides, circulation and patterns of sediment resuspension were performed as part of the hydrodynamics field program for the FEIR and reported in Section 3.9.

Comment: B 2. *–From prior projects, evidence suggests the impact to water quality from UDM disposal is short-term…*

Response: Detailed CAD cell dredging disposal event modeling and hydrodynamic analyses presented in Section 5.0 presents predictive modeling that further suggests the impact to water quality from UDM disposal is short-term.

Comment: B 3 a. *–…DEP wishes to clarify this statement in that we do not anticipate that project or site-specific "standards" will be developed…*

Response: In the FEIR site-specific information supportive of establishing Water Quality thresholds for dredging and disposal activities of the preferred alternative PIN CAD is presented in Section 3.8.

Comment: B 3 b. *–…a final determination on the size and shape of the regulatory mixing zone would be made during the permitting process, in cooperation with the deliberations of the TAC.*

Response: In the FEIR, information pertaining to the establishment of site-specific mixing zones at the preferred alternative PIN CAD site area has been developed and is presented in Section 3.8. Spatial modeling of disposal events at the preferred alternative PIN CAD have incorporated the water quality WER, presented in Section 3.8 in predictive modeling in Section 5.0. This water quality WER information and modeling will be very helpful to the TYAC and regulatory agencies in the establishment of project specific mixing zones.

Comment: B 4. *– The results from the BHNIP, which utilized CAD disposal , showed that the project consistently met the Water Quality Certification compliance standards during the operation, and no long term impacts have been observed.*

Response: The macrobenthic program presented in Section 3.6, suggests that the benthic community of the preferred alternative is occupied by opportunistic species similar to the BHNIP example. It is expected that no long-term impacts will be observed from dredging and disposal activities at the preferred alternative PIN CAD. The macrobenthic program results presented in Section 3.8 can be used as baseline information for long-term monitoring.

Comment: C 1. *–if Wetlands Protection Act Superseding Order of Conditions is found to be necessary, which would be issued by DE.*

Response: The Dredging Management Plan Section 8.0 presents information that Under the terms of the Record of Decision for the New Bedford Fairhaven Harbor PCB Superfund project, navigation dredging may be undertaken under the state enhanced remedy. If so, the substantive requirements of the state regulatory programs must be met, but the certificate, license or permits themselves would not be issued.

Comment: C 2. *–…the Water Quality Certification is the key DEP permitting action for dredging projects … the WQC for this project will be an extensive and detailed document..*

Response: The FEIR provides a detailed water quality thresholds study in section 3.8, and detailed modeling of disposal events for the preferred alternative PIN CAD site. This information should be very helpful to the TAC, regulators, future project proponents and contractors in developing the WQC.

Comment: C 3. *–In short, proposals that avoid sensitive biological resources are more permittable…*

Response: The FEIR presents information in Section 3.6 that suggests no long-term impacts to benthic infauna from dredging and disposal events at the PIN CAD cell area. Section 7.0 discusses avoidance and minimization of impacts to finfish species and mitigation of impacts to shellfish from dredging and disposal events at the PIN CAD cell area.

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Foster, Dick (ENV)

From: Malkoski, Vincent (FWE)
Sent: Friday, June 14, 2002 8:31 AM
To: Foster, Dick (ENV)
Cc: Babb-Brott, Deerin (ENV)
Subject: EOEA #11669, New Bedford DMMP DEIR

Hi Dick

Thank you for your patience. We agree conceptually with the location of the preferred alternatives - north of Pope's Island and the inner harbor area from the south terminal pier to the vicinity of Coal Packet Pier. Although there will be a loss of shellfish no matter where the material goes, these sites represent the least damaging alternative. Replacement of the lost shellfish through mitigation (propagation) can be dealt with project by project. One of our Shellfish biologists, Dave Whittaker, already works very closely with the City's Shellfish Officer and can assist with development of a good propagation plan.

A.

The remaining issues that need to be worked out are more of an operational nature. As these cells are designed for multiple disposal events, we need to define the schedule for their use to minimize impacts from resuspension of dredged material. Best management practices for dredging and confinement of dredging to traditional time-of-year windows should help to address these issues.

B.

Vin

Vin Malkoski
Senior Marine Fisheries Biologist / Diving Safety Officer
MA Division of Marine Fisheries
Southeast Marine Fisheries Station
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10.3 Department of Marine Fisheries

Comment: ***A.-*** *…there will be a loss of shellfish no matter where the material goes. Replacement of the lost shellfish can be dealt with through mitigation.*

Response: The DMF shellfish biologist assigned to New Bedford/Fairhaven Harbor has suggested mitigation for shellfish as a condition of future dredging and disposal events at the PIN CAD cell area. A discussion of shellfish mitigation measures for dredging and disposal events at the PIN CAD cell area is presented in Section 7.0.

Comment: ***B.*** *–We need to define the schedule for their use(PIN CAD)…*

Response: Biological time-of-year dredging windows are presented as information and recommendation in Section 7.0 of the FEIR. These dredging windows are protective of fish species in various life stages. The dredging windows information presented in the FEIR is intended to provide a tool for regulators to consider for specific dredging projects. This dredging windows tool is adjustable.

SECTION 11- REFERENCES

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Dredged Material Management Plan (DMMP) EOEA No. 11669

Final Environmental Impact Report (FEIR) Appendices A, B, & C - Volume I

for New Bedford and Fairhaven Massachusetts

Office of Coastal Zone Management
City of New Bedford, MA
Town of Fairhaven, MA

October 15, 2003

APPENDIX – VOLUME I

A. Marine Geotechnical Investigation and Sediment Engineering Property Evaluation

B. Marine Geophysical Surveys: Seismic Refraction, Sub- Aqueous Disposal

C. Underwater Archaeological & Hazards Analysis Remote Sensing Survey

APPENDIX A

MARINE GEOTECHNICAL INVESTIGATION AND SEDIMENT ENGINEERING PROPERTY

NEW BEDFORD HARBOR

CONFINED AQUATIC DISPOSAL CELL FEASIBILITY STUDY

GEOTECHNICAL INVESTIGATION AND SEDIMENT ENGINEERING PROPERTY EVALUATION

Prepared for:

Massachusetts Coastal Zone Management Agency
251 Causeway Street, Suite 900
Boston, MA 02202

CZM

Submitted by:

Maguire Group Inc.

MAGUIRE GROUP

July 2003

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- January/February 1988, BW – 109 A/B, 110, 111 and 112

III. CHANNEL INNER PROJECT BORING LOGS
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IV. POPES ISLAND NORTH LABORATORY TESTING DATA
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V. CHANNEL INNER LABORATORY TESTING DATA
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V.	Table 4, Estimated Sediment Engineering Properties

I. Introduction

The two proposed CAD Cell sites are located within New Bedford Harbor, north of the New Bedford Hurricane Barrier, approximately ½-mile apart. The Popes Island North site is the more northerly, the Channel Inner site the more southerly. Maguire Group Inc. developed and implemented the Project's geotechnical work scope, which consisted of the performance of marine borings explored to core bedrock, laboratory testing of retrieved sediment samples, the development of typical subsurface profiles and estimated sediment engineering properties for preliminary CAD Cell feasibility, design and construction considerations. At the Popes Island North site, approximately 90-acres of harbor area was investigated by both geophysical and geotechnical means, while at the Channel Inner site, approximately 80-acres of harbor area was investigated. The Project's fieldwork consisted of integrated geotechnical and geophysical investigation efforts as well as shallow Environmental Program vibra-core sampling of the surficial organic silt stratum within both site areas.

The geophysical seismic refraction surveys were the primary investigatory tool to develop the study area bedrock surface database for preliminary CAD Cell design lower bound limits. The geophysical surveys preceded and guided the locating of marine boring explorations. The marine borings were performed in two phases to provide hard bedrock surface information at critical points, as defined by the geophysical survey needs. The borings also provided representative sediment samples and sampling standard penetration test "SPT" data, from mudline to bedrock depth, necessary for sediment engineering property estimates. The phased boring program approach allowed for an initial broad based geophysical interpretive effort, followed by a subsequent more detailed effort.

Maguire Group Inc. performed the Project's geotechnical work scope in coordination with several sub-consultants:

- Geophysical seismic refraction survey sub-consultant, Apex Environmental Incorporated of Boston, Massachusetts,
- Marine boring sub-contractor: the Guild Drilling Company of East Providence, Rhode Island,
- Lindberg Marine of Fairhaven, Massachusetts supplied the boring program's barge and tug support equipment, as a subcontractor to Guild Drilling,
- Borehole horizontal and vertical survey control sub-consultant: Tibbetts Engineering Corporation of Taunton, Massachusetts and
- Geotechnical laboratory sub-consultant: GZA GeoEnvironmental Incorporated of Hopkinton, Massachusetts.

All geotechnical fieldwork was performed under the full time supervision of a Maguire Group Inc. geotechnical engineer.

II. Geotechnical Boring Program

The geotechnical boring program consisted of eleven (11) marine borings performed in a two-phased program. Borings were drilled at predetermined "critical" locations within the two sites studied, Phase I and Phase II. Critical boring locations were identified by Apex Environmental based upon the results of their seismic refraction survey analyses. The boring locations were selected to verify maximum/minimum bedrock elevations or located in areas of "low confidence" bedrock interpretation. The borings were performed within each proposed CAD Cell site as follows:

Site Area	Marine Borings		Total Borings
	Phase I June/July 2001	Phase II October 2002	
Popes Island North	NBH – 1, 2 and 3A	NBH - 8	4
Channel Inner	NBH – 4, 5, 6 and 7	NBH – 9, 10 and 11	7

During both phases of boring work, the Popes Island North site was completed first. Coordination with local Coast Guard, Harbor Master and Army Corps of Engineers personnel was continuous during the performance of the boring program. As-drilled boring locations, as determined by mobile sub-meter global positioning equipment, ranged between approximately 1 and 12-feet from intended locations. Ten of the eleven borings were advanced to core between 5 and 15-feet of bedrock. The lower the observed bedrock quality, the deeper the core sampling to confirm bedrock conditions. Bedrock core sampling was performed utilizing NV-II diameter, double tube, diamond bit coring equipment advanced in generally standard five-foot long core runs. Channel Inner boring NBH – 5, performed during the Phase I work, was the only boring terminated prematurely at "refusal" to split spoon sampler depth due to impending ship traffic. Due to the consistency of Channel Inner bedrock information derived from the borings, it was decided that re-mobilization at and core sampling of bedrock at NBH-5 was not warranted. The Popes Island North site typically exhibited the shallowest water and the deepest sediment depths, the latter making it the favored site for CAD Cell development from a physical conditions view point.

All marine borings were performed utilizing standard ASTM D 1586 techniques while advanced in soil sediments and ASTM D 2113 techniques while coring bedrock. Refer to Table 1, Boring Program General Information Summary and Table 2, Boring Program Bedrock Information Summary for more detailed and summarized Boring Program information. Refer to Appendix I, Popes Island North Project Boring Logs and Appendix III, Channel Inner Project Boring Logs for the logs of all Project borings.

The Project boring programs were performed by the Guild Drilling Company utilizing truck-mounted drilling equipment located on a "spud" barge of approximate dimensions 115 by 50-feet. A "spud" barge refers to a barge equipped with deployable/retractable cable actuated, vertical steel pipe anchors or "spuds", usually two or four per barge, located at the perimeter corners. Selective manipulation of barge spuds in coordination

with controlled tug and/or work skiff assistance was utilized to position and stabilize the barge on intended boring locations with repeatable accuracy. The boring rig was located at the center, perimeter of the barge's short side. The "business" end of the drill rig, the drill string, was cantilevered off of and advanced out-board of the barge as opposed to interior "moon-pool" type boring operations. The barge and boring drill string were positioned on intended borehole locations by radio coordinated tug and work skiff assistance. Lindberg Marine provided the barge and tug. Guild Drilling provided the drill rig, all boring/sampling equipment, drill crew and a steel work skiff.

Tibbetts Engineering provided horizontal and vertical survey controls for initial equipment positioning at borehole location, as well as for the development of final "as-drilled" boring location. Mobile sub-meter global positioning equipment was utilized to determine initial and final borehole location. Vertical control of the boring work, water surface and thus mudline elevation, was determined by reference to tide boards located on piers adjacent to each of the proposed CAD Cell sites. The tide boards were referenced to the Project's Mean Sea Level (MSL) datum. The MSL datum is equivalent to the National Geodetic Vertical Datum (NGVD) established in 1929.

III. Geotechnical Laboratory Program

The geotechnical laboratory testing was performed on representative sediment samples obtained from the Boring Programs, Phase I and Phase II work. Project laboratory index testing consisted of:

- Fifty-eight (58) grain size analyses, differentiated into twenty-five (25) sieve and thirty-three (33) combined sieve-hydrometer analyses per ASTM D 422,
- Fifteen (15) natural water contents per ASTM D 2416,
- Fourteen (14) Atterberg Limit determinations: liquid, plastic and plasticity index per ASTM D 4318, and
- Twelve (12) organic contents per ASTM D 2974.

The geotechnical laboratory program was undertaken to assist in sediment strata differentiation and sediment engineering property development. The laboratory program was also designed to provide a sediment physical property database, as complete as possible, for this and subsequent CAD Cell design and construction feasibility assessments. The rational for test assignment was developed through an initial visual sample examination. Where sediment sample "fines" (silt/clay content) were visually estimated to be minimal, only sieve analyses were assigned. Where sample fines were judged to exceed approximately 15 percent by weight, combined sieve and hydrometer analyses were assigned. Fifteen percent fines is a reasonable break point to define sediments that are considered "clean" (<15% fines) from an engineering property and behavior viewpoint. Where samples exhibited appreciable organic component or plasticity, typically natural moisture content, Atterberg Limit and/or organic content testing was assigned, dependent on the amount of sample available. Adjacent samples

judged by visual examination to be similar in composition were composited for testing economy. Based upon the laboratory program results, sediment samples were classified according to the Unified Soil Classification System, Group Symbol(s), per ASTM D 2487. Refer to Table 3A, Popes Island North Summary Geotechnical Laboratory Index Testing and Table 3B, Channel Inner Summary Geotechnical Laboratory Index Testing, for summarized sediment laboratory test results and Appendix IV, Popes Island North Laboratory Testing Data and Appendix V, Channel Inner Laboratory Testing Data for raw laboratory data sheets.

No bedrock core samples were tested. However, bedrock samples were visually evaluated and described by Rock Quality Index assignment. Refer to Table 2, Boring Program Bedrock Information and Appendixes I and III, Popes Island North and Channel Inner Project Boring Logs, respectively, for more detailed study area bedrock information.

IV. Geology

From the boring information, the two proposed CAD Cell sites revealed similar geologic stratigraphy, from mudline down:

- Surficial organic sediments, Organic Silt and Peat, are geologically recent, Holocene Era, deposits.
- The Interbedded: silts, sands, and sands and gravels with occasional boulders, are complex bedded Glacial-Drift Pleistocene Age deposits composing the bulk of the stratigraphic column.
- The deepest Glacial Till stratum is generally dense, thin and boulder laden. The Glacial Till stratum was formed by direct glacial ice-contact during the Pleistocene Age.
- The bedrock, Gneissic Granite (Alaskite), is surficially fractured and observed to be in a fresh to slightly weathered condition.

Geologically recent marine organic deposits are typical of that seen regionally in near-shore areas protected from wave action and tidal currents. These deposits were laid down post-sea level rise after the retreat of the Pleistocene Age glaciers. Most of the pollutants derived from the geologically recent industrial age of the New Bedford area tend to be concentrated within only several feet of the existing sediment surface. This finding correlates well with known Harbor sedimentation rates, 1-centimeter per year, and pollutant migration behavior. The surficial organic sediment deposits are seen regionally to be less than approximately 20-feet in thickness.

The interbedded Glacial Drift deposits that make up the bulk of the sediment stratigraphy, include typically granular moraine and out-wash sediments laid-down in complex stratigraphy by glacial melt streams. In near by Buzzards Bay, these deposits are observed in excess of 100-feet in thickness.

The bouldery Glacial Till deposits, which are seen regionally to mantle bedrock are very dense, relatively thin, undifferentiated and the result of direct glacial ice contact deposition.

Bedrock within the New Bedford Harbor area is typically very hard and surficially fractured Granite with occasional quartz intrusions, as observed in the Project boring core samples. The core samples also revealed surficial bedrock to be in a fresh to slightly weathered condition. Bedrock was cored in ten of the eleven Project borings to depths of between 5 and 15-feet. Based upon limited bedrock sampling, surficial Rock Mass Quality as judged by core run RQD, was observed to be slightly higher in the Popes Island North as opposed to the Channel Inner site area, refer to Table 2.

V. Existing Subsurface Conditions and Estimated Sediment Properties

The Popes Island North site generally exhibits water depths of 10-feet or less and sediment thicknesses ranging between approximately 40 and 85-feet. The Channel Inner site generally exhibits water depths in the range of 35-feet within the Federal Navigation Channel and 30-feet within the Federal Maneuvering and Anchorage Areas. Sediment thicknesses in this area range only between approximately 20 and 35-feet. Refer to the following figures, with key items highlighted, for proposed CAD Cell plan/profile configurations, geophysical and geotechnical exploration locations, and developed subsurface profiles:

- Figure 1, Popes Island North and Channel Inner CAD Cell Site Location Plan:
  - Limits of geophysical and geotechnical explorations.
  - Proposed CAD Cell configurations.
- Figure 2, Popes Island North CAD Cell Configuration, Subsurface Profile and Exploration Location Plan:
  - More detailed Popes Island site information,
  - Geophysical survey line locations,
  - Project boring locations,
  - Deep Organic strata in boring NBH-1,
  - Ebasco Services Inc. 1988 boring logs, utilized by Apex Environment Inc. in their geophysical interpretations. E.C. Jordan Co. bore logs: BW – 109 A/B, 110, 111 and 112. Refer to Appendix II, Popes Island North Ebasco Boring Logs,
  - Developed subsurface profile locations A-A' and B-B'.
- Figure 3, Popes Island North Subsurface Profile A-A':
  - Inferred bedrock surface at Profile center line from geophysical interpretations,
  - Projected Project boring information,
  - Proposed small CAD Cell profiles, nos. 2, 3, 4, 5 and 6.

- Figure 4, Popes Island North Subsurface Profile B-B':
  - Inferred bedrock surface at Profile center line from geophysical interpretations,

- Projected Project boring information,
- Proposed large CAD Cell profile, no. 1.

- Figure 5, Channel Inner CAD Cell Configuration, Subsurface Profile and Exploration Location Plan:
  - More detailed Channel Inner site information,
  - Geophysical survey line locations,
  - Project boring locations,
  - Limits of Federal Channel, and Federal Maneuvering and Anchorage Areas,
  - Developed subsurface profile locations C-C' and D-D'.
- Figure 6, Channel Inner Subsurface Profile C-C':
  - Inferred bedrock surface at Profile center line from geophysical interpretations,
  - Projected Project boring information,
  - Proposed small CAD Cell profiles, nos. 1 and 2.
- Figure 7, Channel Inner Subsurface Profile D-D':
  - Inferred bedrock surface at Profile center line from geophysical interpretations,
  - Projected Project boring information,
  - Proposed small CAD Cell profile, no. 3.

It should be noted that Project borings are widely spaced and only general trends in subsurface conditions are revealed, thus the integration of location specific boring with area wide geophysical exploratory techniques. Of note is the extensive Organic Silt and Peat deposits observed in boring NBH-1, located at the north end of the Popes Island North site. Refer to Figure 4, Popes Island North Profile B-B'. During initial cell dredging, the organic sediments are the least stable and exhibit the shallowest stable slope angles. The most prominent stratigraphic feature, the Interbedded Glacial Drift and the deepest sediment stratum, the Glacial Till, are observed to contain boulders, which are problematic to dredging work. The Glacial Drift is thought to contain only occasional boulders, while the more limited thickness Glacial Till significantly more. It is probable that cell dredging will not extend significantly into the Glacial Till stratum, dependent upon the defined Till limits.

In Figure 1, the proposed CAD Cell configurations were developed jointly with Apex Environmental Inc. Distances between CAD Cells were maintained at 100-feet for constructability and cell stability considerations. A 10-foot buffer was maintained between proposed bottom of CAD Cell and the average bedrock surface within the CAD Cell footprint. This buffer accounts for inaccuracies in the defined bedrock surface, variations in the actual bedrock surface and further maintains several feet of dense sediment buffer between cell contained contaminants and the fractured bedrock surface.

In Figure 2, borings performed for an Ebasco Services Inc. 1988 study are shown within the Popes Island North site. The logs of these borings are contained in Appendix II. Apex Environmental utilized these Ebasco Services as well as the Project borings as data points in their bedrock surface interpretations. Only Project boring information is presented in the developed Subsurface Profile Figures 3, 4, 6 and 7.

In the Popes Island North site, accommodation for several small volume dredge projects, ±50,000 yd^3 each, as well as a large volume dredge project, ±1,800,000 yd^3, fits well with revealed subsurface conditions. The relatively shallow sediment depths along the area's eastern, Fairhaven, limits favors a small project cell approach, while the deeper sediment depths along the western bedrock valley, adjacent to Popes Island favors a large project cell approach. If small projects were initially considered for the Popes Island North site, the potential for a dredge material quantity generated to access the eastern, shallow cell and shallow water depth area should be considered during the project estimate phase. In addition, initial small project time estimates should reflect the use of smaller less efficient but more mobile equipment.

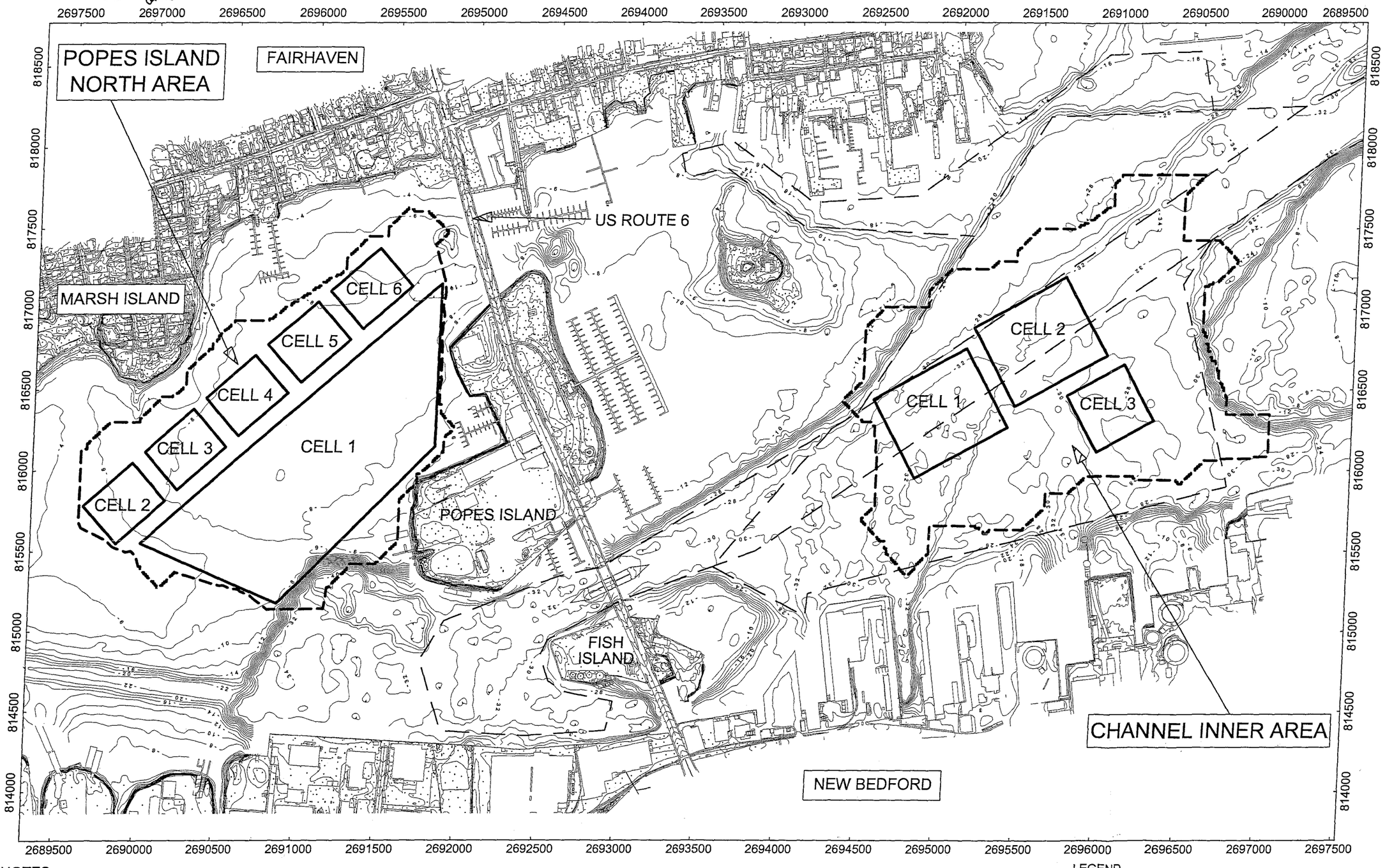
The Channel Inner site is seen as an area of uniformly shallow sediment depth, making even a small project cell quite large in plan-area and inefficient relative to the required total volume of sediment handled in relation to the volume of space available for contaminated sediment storage. The presence of Federal Navigation, Maneuvering and Anchorage areas further complicate this area's development.

The proposed CAD Cell configurations are based upon stable and constructible cell side slopes. It is our considered opinion that stable and constructible cell side slopes of 1Vertical:3Horrizontal (1V:3H) are feasible and appropriate. Table 4, Estimated Sediment Engineering Properties, summarizes our estimates of sediment engineering properties and cell side slopes for preliminary CAD Cell design. Our Project geotechnical evaluation is based upon a review of: boring and sediment laboratory test data, examination of sediment samples, geophysical interpretations and our geotechnical research and experience in the New England area with similar sediment profiles. The stability of cell side slopes is in part a function of exposure time to environmental forces. In the short term, repetitive forces imposed by dredging operations, tidal current and wave loadings as well as storm forces will tend to degrade initially stable sub-marine slopes. In the long term, cell side slopes need to be stable enough to maintain the full depth integrity of sequestered relatively weak contaminated organic sediments. Our recommendation of 1V:3H CAD Cell side slopes considered the variety of sediment types involved as well as a reasonably short-term, single season, exposure period, i.e. cells would likely be dredged and backfilled in one season. Cell capping would probably occur during the subsequent season to allow the contained sediments time to consolidate and gain strength before capping.

It is recommended that a more detailed and area specific marine boring and sediment laboratory testing program be implemented during any subsequent CAD Cell design, when actual project conditions drive specific design and construction objectives. At that time, estimates of dredge material bulking and consolidation due to anticipated dredging, handling and placement techniques can be developed for specific project requirements.

Figures

Figure 1, Popes Island North and Channel Inner CAD Cell Site Locations
Figure 2, Popes Island North CAD Cell Configuration, Subsurface Profile and Exploration Location Plan
Figure 3, Popes Island North Subsurface Profile A-A'
Figure 4, Popes Island North Subsurface Profile B-B'
Figure 5, Channel Inner Cad Cell Configuration, Subsurface Profile and Exploration Location Plan
Figure 6, Channel Inner Subsurface Profile C-C'
Figure 7, Channel Inner Subsurface Profile D-D'



NOTES:

1. Base Plan of the New Bedford Harbor area was obtained from the US Army Corps of Engineers and has not been field verified.
2. Coordinates are shown in the State Plane Coordinate System, Massachusetts Mainland Zone 2001, Referenced to the 1983 North American Datum (NAD83).

POPES ISLAND NORTH AND CHANNEL INNER CAD CELL SITE LOCATIONS

0 600 1200 1800

SCALE: 1"=600' FEET

LEGEND

- FEDERAL NAVIGATION CHANNEL, ANCHORAGE AND MANEUVERING AREA LIMITS (CHANNEL INNER AREA)
- 2 FOOT BATHYMETRIC CONTOUR
- PROPOSED CAD CELL CONFIGURATION
- LIMITS OF GEOPHYSICAL/GEOTECHNICAL EXPLORATION AND INTERPRETATION

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MAGUIRE GROUP

NEW BEDFORD HARBOR
NEW BEDFORD, MASSACHUSETTS
POPES ISLAND NORTH AND CHANNEL INNER CAD CELL SITE LOCATIONS

PROJECT NO.:	16454
DESIGNED BY:	---
DRAWN BY:	---
CHK'D BY:	
DATE:	06/02/03
SCALE:	AS NOTED
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SHEET 1 OF 7

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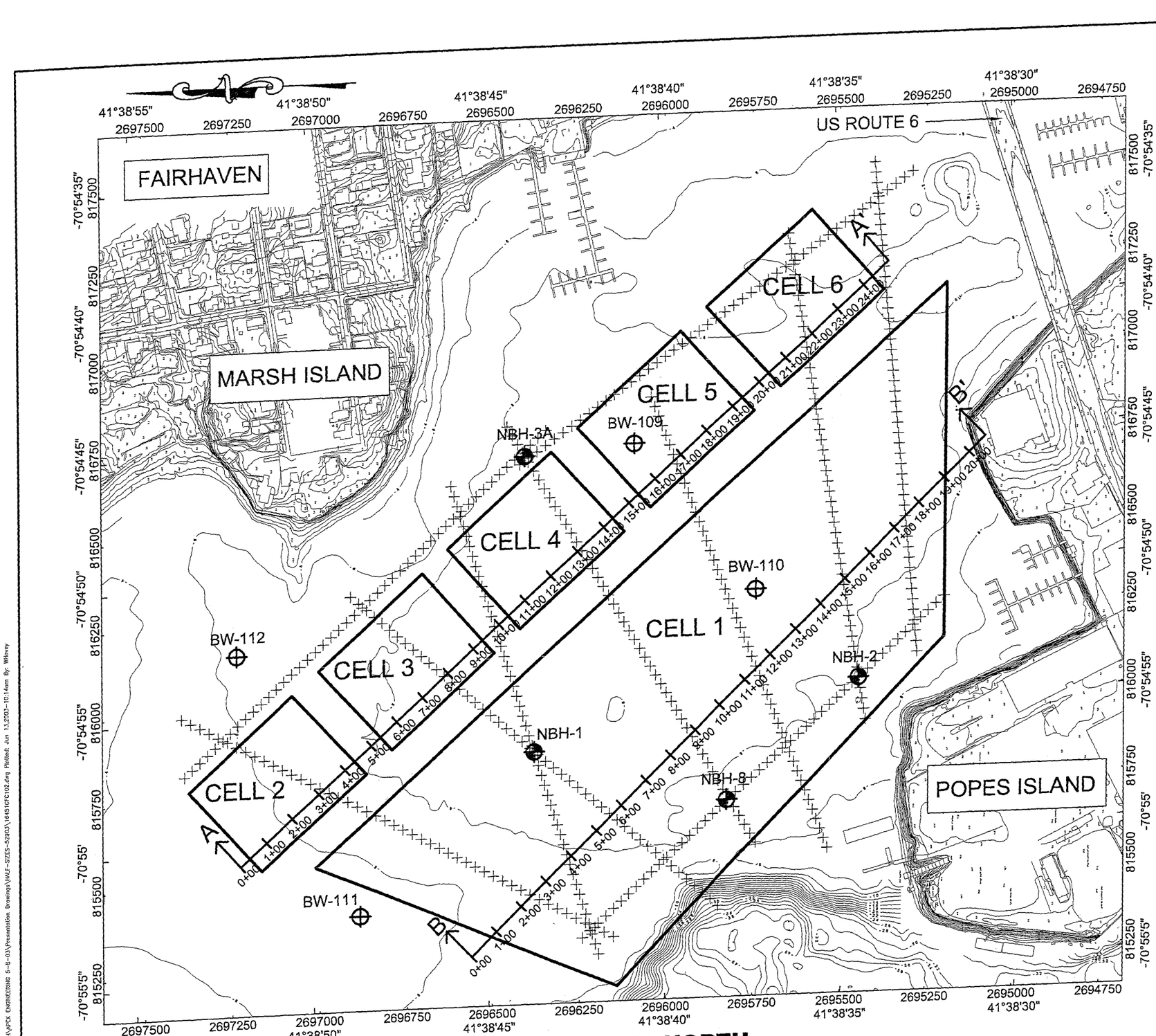

NOTES:

1. Base Plan of the New Bedford Harbor area was obtained from the US Army Corps of Engineers and has not been field verified.
2. Coordinates are shown in the State Plane Coordinate System, Massachusetts Mainland Zone 2001, Referenced to the 1983 North American Datum (NAD83).

LEGEND

NBH-1 — PROJECT BORING LOCATIONS

BW-110 — EBASCO SERVICES 1988 STUDY BORING LOCATIONS

GEOPHYSICAL SURVEY LINES

1 FOOT BATHYMETRIC CONTOUR

PROPOSED CAD CELL CONFIGURATION

A A' — PROFILE LOCATION WITH STATIONING

0+00 1+00 2+00 3+00 4+00

3. SCALE:

0 300 600 900

SCALE: 1"=300' FEET

POPES ISLAND NORTH
CAD CELL CONFIGURATION
SUBSURFACE PROFILE AND EXPLORATION LOCATION PLAN

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NEW BEDFORD, MASSACHUSETTS

POPES ISLAND NORTH CAD CELL CONFIGURATION
SUBSURFACE PROFILE AND EXPLORATION LOCATION PLAN

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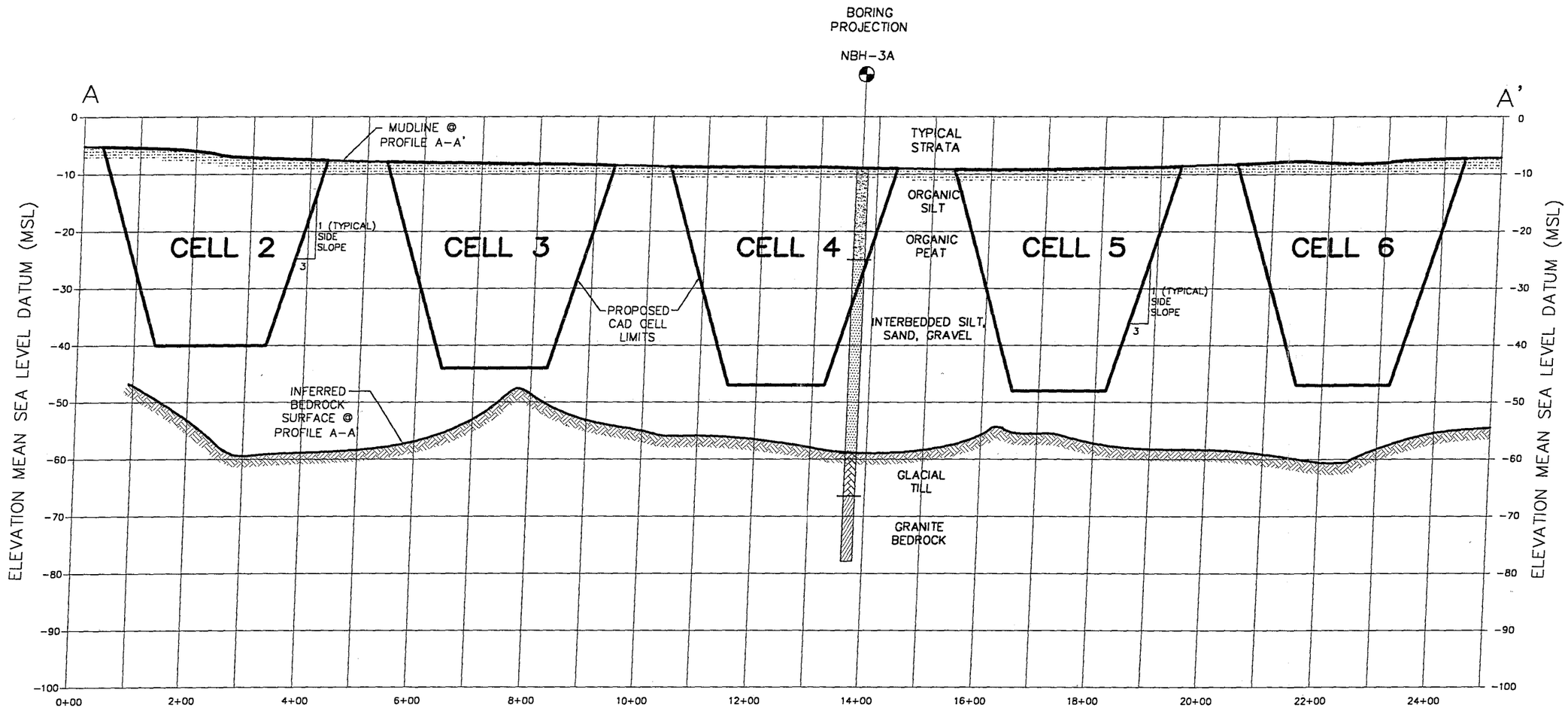

PROFILE STATIONING IN FEET

POPES ISLAND NORTH SUBSURFACE PROFILE A-A'

NOTES:

1. FOR PROFILE ORIENTATION REFER TO FIGURE 2.
2. SCALE:

HORIZONTAL

0 200 400 600

SCALE: 1"=200' FEET

VERTICAL

0 20 40 60

SCALE: 1"=20' FEET

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MAGUIRE GROUP

NEW BEDFORD HARBOR
NEW BEDFORD, MASSACHUSETTS

POPES ISLAND NORTH
SUBSURFACE PROFILE A-A'

PROJECT NO.:	16454
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DRAWN BY:	---
CHK'D BY:	
DATE:	06/02/03
SCALE:	AS NOTED
SHEET NO.	3

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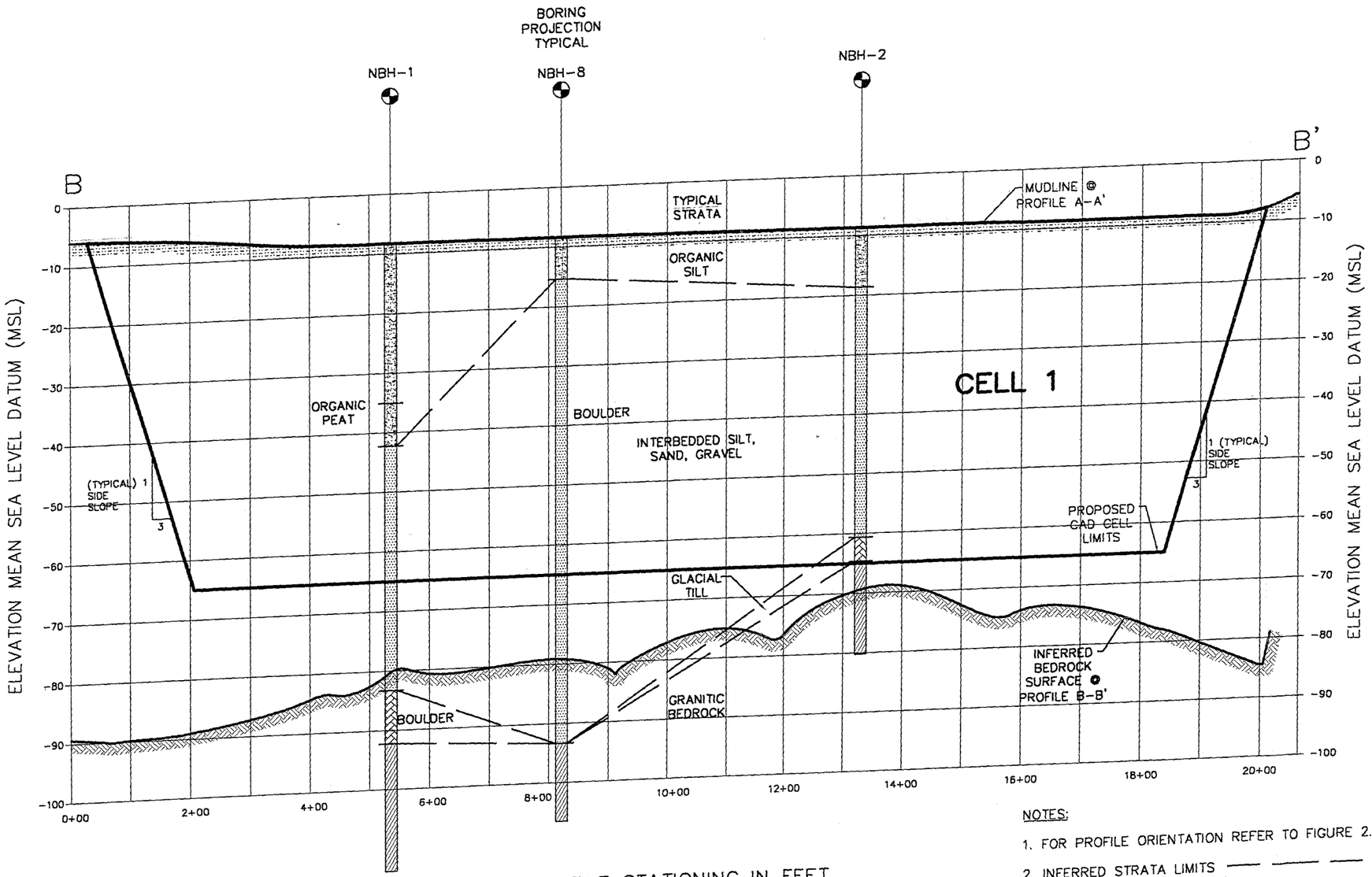

PROFILE STATIONING IN FEET

POPES ISLAND NORTH SUBSURFACE PROFILE B-B'

NOTES:

1. FOR PROFILE ORIENTATION REFER TO FIGURE 2.
2. INFERRED STRATA LIMITS — — — FROM BORING INFORMATION
3. SCALE:

HORIZONTAL

0 200 400 600

SCALE: 1"=200' FEET

VERTICAL

0 20 40 60

SCALE: 1"=20' FEET

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NEW BEDFORD HARBOR
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POPES ISLAND NORTH
SUBSURFACE PROFILE B-B'

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SHEET	4 OF 7

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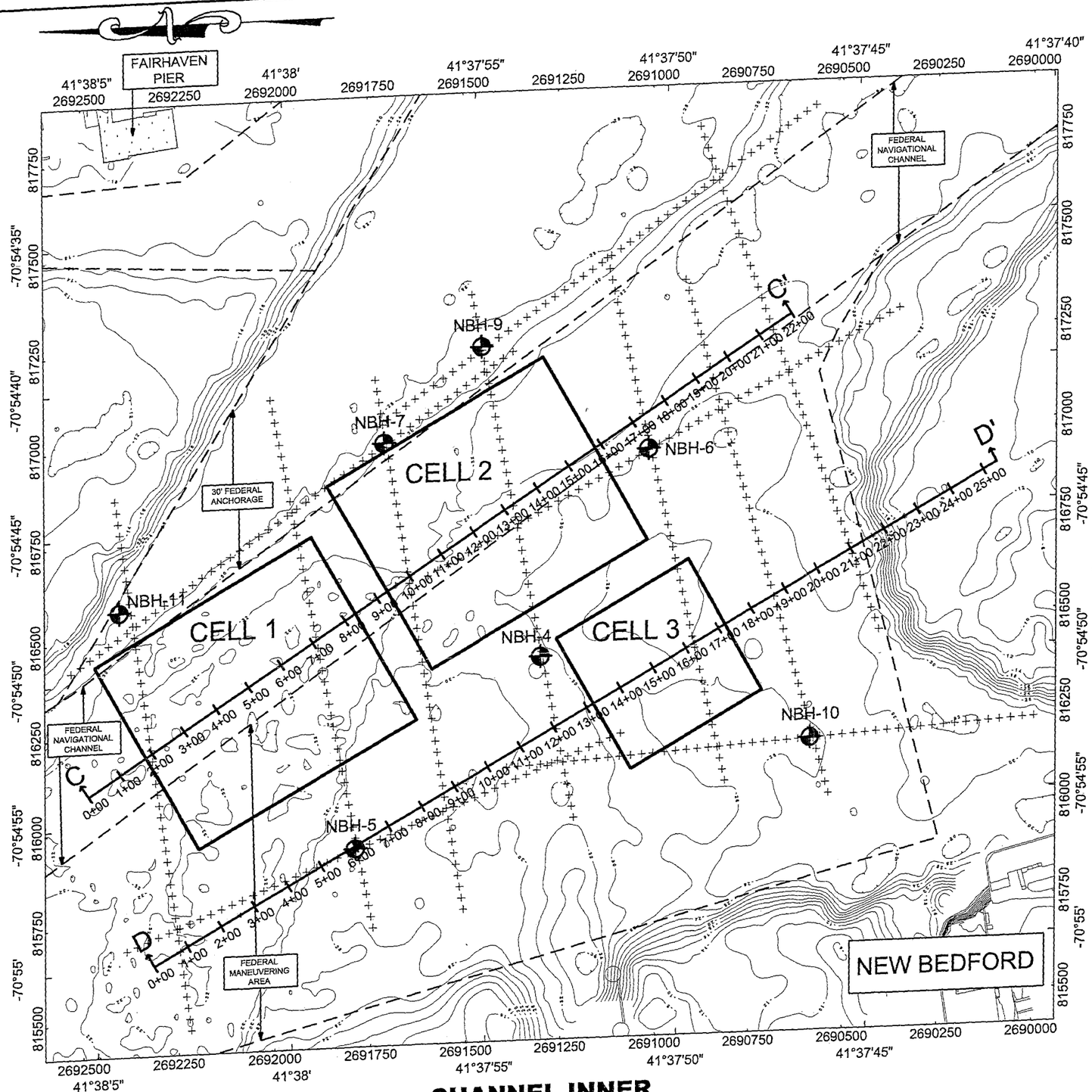

NOTES:

1. Base Plan of the New Bedford harbor area was obtained from the US Army Corps of Engineers and has not been field verified.
2. Coordinates are shown in the State Plane Coordinate System, Massachusetts Mainland Zone 2001, Referenced to the 1983 North American Datum (NAD83).

LEGEND

NBH-7 — PROJECT BORING LOCATIONS

FEDERAL NAVIGATION CHANNEL, ANCHORAGE AND MANEUVERING AREA LIMITS

GEOPHYSICAL SURVEY LINES

2 FOOT BATHYMETRIC CONTOUR

PROPOSED CAD CELL CONFIGURATION

C C' 0+00 1+00 2+00 3+00 4+00 — PROFILE LOCATION WITH STATIONING

3. SCALE:

0 300 600 900

SCALE: 1"=300' FEET

CHANNEL INNER CAD CELL CONFIGURATION SUBSURFACE PROFILE AND EXPLORATION LOCATION PLAN

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NEW BEDFORD HARBOR
NEW BEDFORD, MASSACHUSETTS
CHANNEL INNER CAD CELL CONFIGURATION
SUBSURFACE PROFILE AND EXPLORATION LOCATION PLAN

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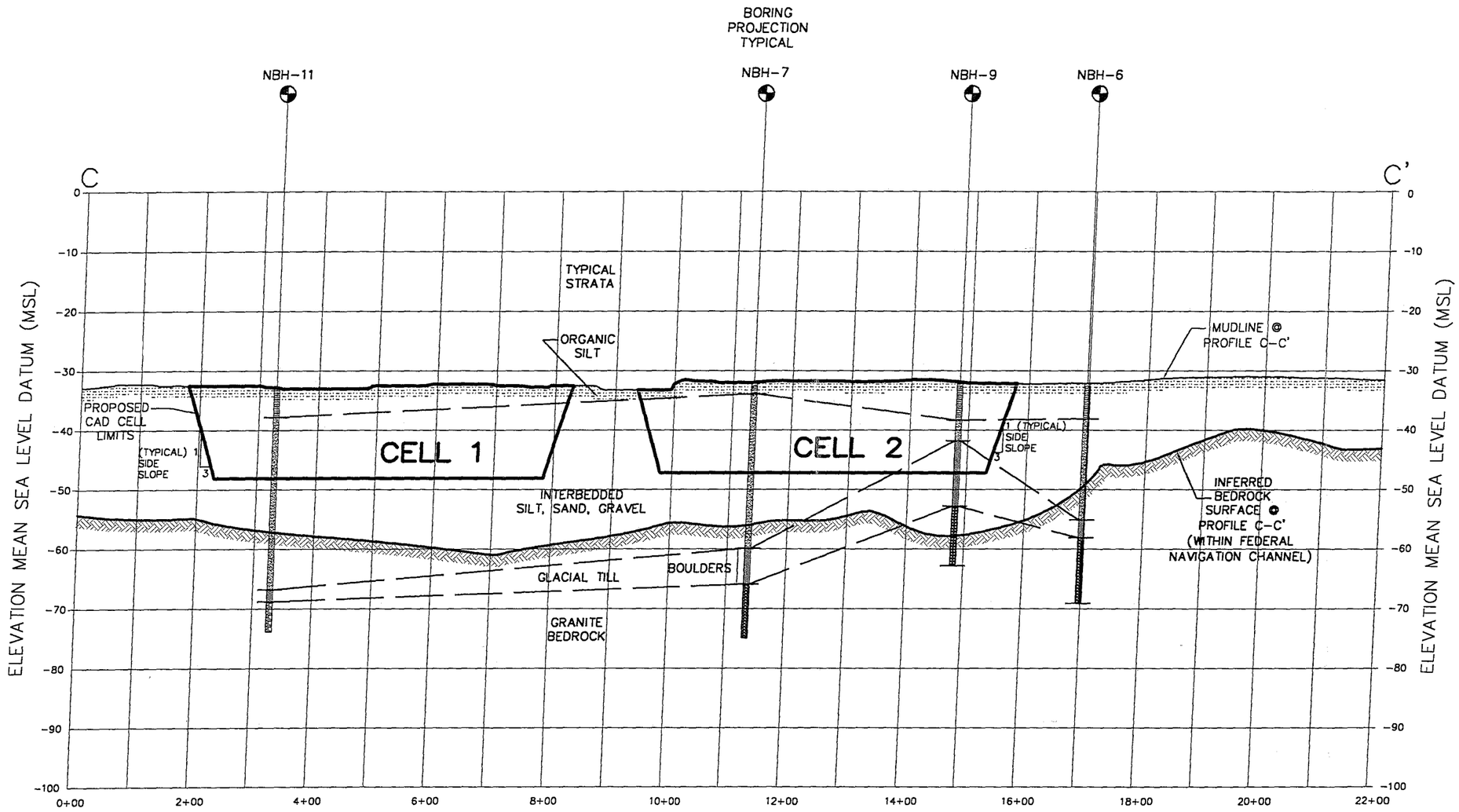

PROFILE STATIONING IN FEET

CHANNEL INNER SUBSURFACE PROFILE C-C'

NOTES:

1. FOR PROFILE ORIENTATION REFER TO FIGURE 5.
2. INFERRED STRATA LIMITS — — — FROM BORING INFORMATION.
3. SCALE: HORIZONTAL

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SCALE: 1"=200' FEET

VERTICAL

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SCALE: 1"=20' FEET

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NEW BEDFORD, MASSACHUSETTS

CHANNEL INNER
SUBSURFACE PROFILE C-C'

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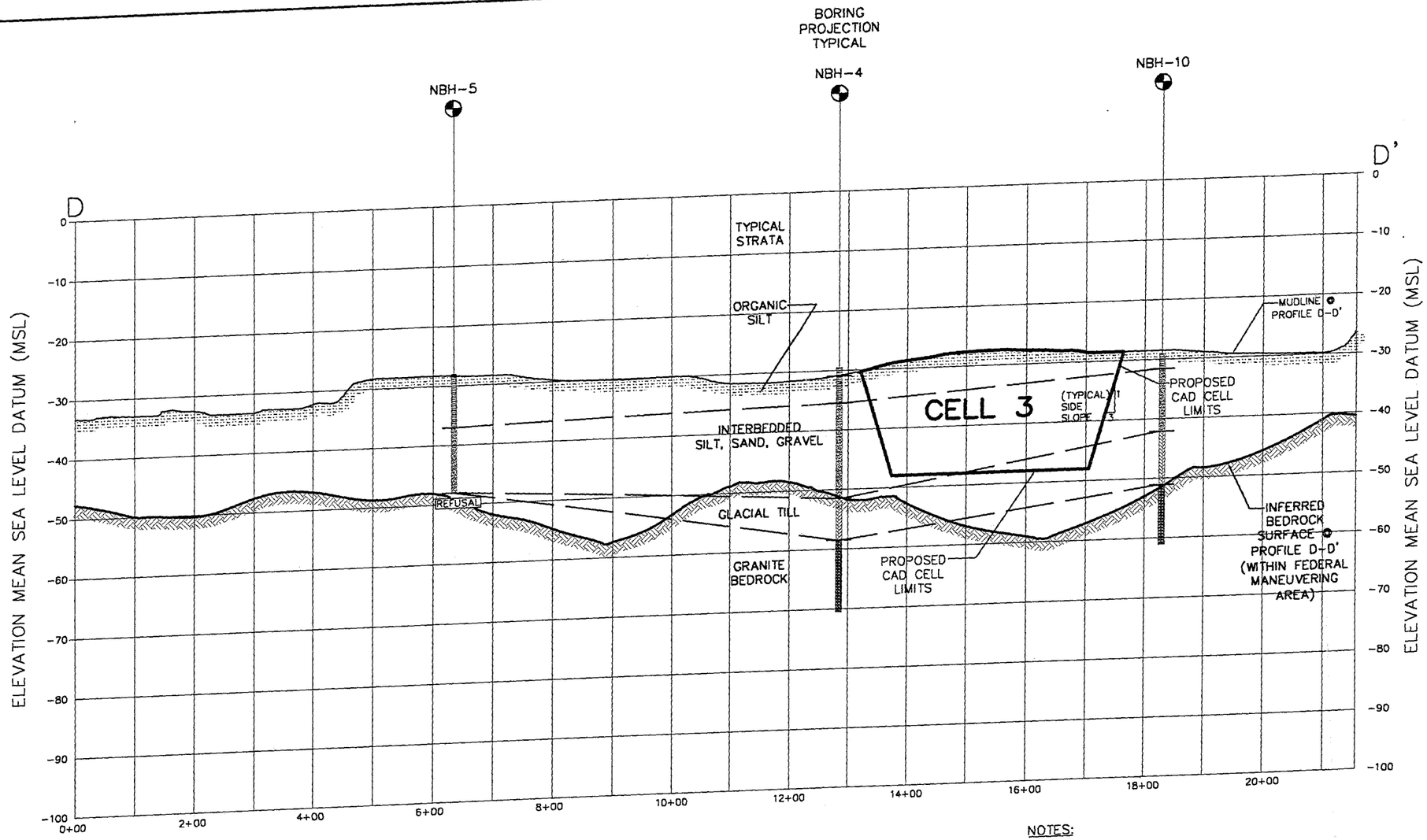

PROFILE STATIONING IN FEET

CHANNEL INNER SUBSURFACE PROFILE D-D'

NOTES:

1. FOR PROFILE ORIENTATION REFER TO FIGURE 5.
2. INFERRED STRATA LIMITS — — — FROM BORING INFORMATION
3. SCALE:

HORIZONTAL

0 200 400 600 FEET

SCALE: 1"= 200'

VERTICAL

0 20 40 60 FEET

SCALE: 1"=20'

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Foxborough, Massachussetts 02035

MAGUIRE GROUP

NEW BEDFORD HARBOR
NEW BEDFORD, MASSACHUSETTS

CHANNEL INNER
SUBSURFACE PROFILE D-D'

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Tables

Table 1, Boring Program General Information Summary
Table 2, Boring Program Bedrock Information Summary
Table 3A Popes Island North Summary
Geotechnical Laboratory Index Testing
Table 3B Channel Inner Summary
Geotechnical Laboratory Index Testing
Table 4, Estimated Sediment Engineering Properties

New Bedford Harbor Confined Aquatic Disposal Cell Feasibility Study

Popes Island Summary Geotechnical Laboratory Index Testing

Table 3A

	Sample Location (Avg.)[2]		Stratum	Test	% Fines[5]			% Sand[5]			% Gravel[5]			Atterberg Limits[7]			Organic	Tot. Wt.	Unified
Boring, Sample	Depth (Ft.)	Elevation (MSL)	ID.[3]	Type[4]	Clay	Silt	Tot. Fines	Fine	Medium	Coarse	Fine	Coarse	Wn[6]	LL	PL	PI	Content %[8]	(Lb/Ft^3)	Classification[10]
Phase I																			
NBH-1, Mudline	0.0	-6.2																	
NBH-1, S-1 thru S-5, C[1]	1.0 to 23.0	-7.2 to -29.2	O	S & H	26	68	94	2	2	1	1	0	47.3	111	41	70	8.8		OH
NBH-1, S-6 thru S-7, C	28.0 to 33.0	-34.2 to -39.2	P	S & H	14	86	100	0	0	0	0	0	384	459	283	176	45.7		PT
NBH-1, S-8	35.0	-41.2	P	S & H	12	75	87	8	5	0	0	0	27.8	46	35	11			OL
NBH-1, S-10	44.5	-50.7	I	S & H	2	38	40	30	14	10	6	0							SM
NBH-1, S-11	50.0	-56.2	I	S	NA[10]	NA	35	27	13	7	18	0							SM
NBH-1, S-12	55.0	-61.2	I	S	NA	NA	11	22	25	12	20	10							SP-SM
NBH-1, S-13 thru S-15, C	60.0 to 72.0	-66.2 to -78.2	I	S	NA	NA	6	19	45	14	13	3							SP-SM
NBH-1, S-16 thru S-17, C	77.0 to 82.5	-83.2 to -88.7	T	S & H	3	12	15	13	28	12	21	11							SM
NBH-2, Mudline	0.0	-7.8																	
NBH-2, S-1 thru S-3, C	1.0 to 10.0	-8.8 to -17.8	O	S & H	9	36	45	41	12	1	1	0	56.6	46	19	27	3.2		OL
NBH-2, S-4	15.0	-22.8	I	S	NA	NA	6	55	38	1	0	0							SP-SM
NBH-2, S-5 thru S-6, C	23.0 to 28.0	-30.8 to -35.8	I	S & H	4	58	62	35	3	0	0	0							ML
NBH-2, S-7	33.0	-40.8	I	S	NA	NA	3	36	56	3	2	0							SP
NBH-2, S-8	39.0	-46.8	I	S	NA	NA	14	27	30	11	18	0							SM
NBH-2, S-9	44.0	-51.8	I	S & H	1	70	71	25	1	1	2	0							ML
NBH-2, S-10	49.0	-56.8	I	S & H	2	86	88	10	2	0	0	0							ML
NBH-3A, Mudline	0.0	-7.2																	
NBH-3A, S-1 thru S-3, C	1.0 to 10.0	-8.2 to -17.2	O	S & H	12	79	91	5	2	1	1	0	105	98	35	63	7.6		OH
NBH-3A, S-4 thru S-5, C	17.5 to 22.5	-24.7 to -29.7	I	S	NA	NA	10	14	19	14	23	20							SW-SM
NBH-3A, S-6	27.0	-34.2	I	S	NA	NA	5	22	33	16	24	0							SP
NBH-3A, S-7 thru S-10, C	32.0 to 47.0	-39.2 to -54.2	I	S & H	1	26	27	67	2	1	3	0							SM
NBH-3A, S-11 thru S-12, C	51.0 to 54.5	-58.2 to -61.7	T	S & H	1	17	18	10	13	10	37	12	10.3	23	18	5			GC-GM
Phase II																			
NBH-8, Mudline	0.0	-7.5																	
NBH-8, S-1	1.0	-8.5	O	S & H	0	11	11	79	7	2	1	0	18		non-plastic		0.4		SM
NBH-8, UP-1	5.0 to 7.0	-12.5 to -14.5	O	S & H	8	37	45	31	21	1	2	0	48	38	19	19	2.6	128.0	SM-OL
NBH-8, S-2	8.0	-15.5	I	S	NA	NA	11	33	26	10	20	0							SM
NBH-8, S-3 thru S-6, C	10.0 to 27.0	-17.5 to -34.5	I	S	NA	NA	6	9	25	13	29	18							SW
NBH-8, S-8 thru S-9, C	41.5 to 49.5	-49.0 to -57.0	I	S	NA	NA	3	26	46	13	12	0							SW
NBH-8, S-10	53.5	-61.0	I	S	NA	NA	3	93	3	1	0	0							SP
NBH-8, S-11 thru S-12, C	57.5 to 69.5	-65.0 to -77.0	I	S	NA	NA	5	15	24	16	22	18							SW
NBH-8, S14	76.5	-84.0	I	S	NA	NA	6	21	53	6	14	0							SP
NBH-8, S15 thru S16, C	80.5 to 87.5	-88.0 to -95.0	I	S	NA	NA	9	27	43	11	10	0							SW

New Bedford Harbor Confined Aquatic Disposal Cell Feasibility Study

Boring Program General Information Summary

Table 1

Boring ID.	As-Drilled Location[1]			Dates Performed	Elevation[2]		Casing Dia. Used[3]	Boring Length (Ft.)		
	Northing	Easting	Distance from Intended (Ft.)		Mudline	Bedrock		Sediment[4]	Roller Bit[5]	Rock Core[6]
Popes Island North										
Phase I										
NBH-1	2696395	815862	12.2	6/20-27, 2001	-6.2	-90.2	3" & 4"	84.0	3.5	15.0
NBH-2	2695446	816043	6.1	6/29-7/2, 2001	-7.8	-63.8	3" & 4"	56.0	3.0	10.0
NBH-3A	2696401	816710	9.0	7/12-13, 2001	-7.2	-64.7	3" & 4"	57.5	0.0	10.0
Phase II										
NBH-8	2695824	815701	6.8	10/15-18, 2002	-7.5	-92.8	3" & 4"	85.3	0.7	11.0
Channel Inner										
Phase I										
NBH-4	2691299	816419	1.3	7/3-5, 2001	-29.5	-58.5	3" & 4"	29.0	1.0	11.0
NBH-5	2691784	815925	8.4	7/5-5, 2001	-27.5	Ref.[7]	3" & 4"	20.3	0.0	Ref.[7]
NBH-6	2691016	816946	5.9	7/9-9, 2001	-28.6	-54.9	3" & 4"	26.0	1.0	10.0
NBH-7	2691702	816981	10.0	7/10-11, 2001	-28.7	-62.7	3" & 4"	34.0	1.0	8.0
Phase II										
NBH-9	2690585	816181	7.0	10/21-22, 2002	-28.0	-49.0	3" & 4"	20.0	1.0	10.0
NBH-10	2691457	817230	2.3	10/22-23, 2002	-29.1	-51.1	3" & 4"	22.0	0.0	10.0
NBH-11	2692371	816542	4.2	10/23, 2002	-26.3	-62.3	3" & 4"	36.0	0.0	5.0

[1] Northing/Easting: Massachusetts State Plane Coordinate System (NAD83), Units - International Feet and distance from intended location, as determined by Tibbetts Engineering Corp.utilizing sub-meter GPS equipment to locate as-drilled boring locations.

[2] Elevation Datum: Mean Sea Level (MSL). The MSL datum is equivalent to the National Geodetic Vertical Datum (NGVD) estiblished in 1929.

[3] Casing Diameters utilized in borings: 3" (NW), 4" (HW)

[4] Boring advance and sampling in soil sediment per ASTM D 1586.

[5] Roller Bit: Boring advance by rotary tricone drilling, used to verify sound rock and seat rock core barrel.

[6] Bedrock core drilling utilizing NV-II diameter, yielding a rock core sample diameter of 1.875-inch, per ASTM D 2113.

[7] Ref.: Boring NBH-5 terminated at "refusal" blow count to split spoon sampler penetration. Bedrock assumed at refusal, elev. -48.1 MSL. Sediment sampling per ASTM D 1586 techniques, refusal defined as 100 or more blows with less than 6-inches of sampler penetration.

New Bedford Harbor Confined Aquatic Disposal Cell Feasibility Study

Foot Notes for Table 2
Boring Program Bedrock Information Summary

1. Bedrock surface elevation, Mean Sea Level (MSL) datum, from bore log.

2. Bedrock core sampling per ASTM D 2113.

3. Bedrock core sample diameter: 1.875-inch (NV-II), diameter of core bit drilling in bedrock: 2.98-inch.

4. Bedrock sampling core run length, typically 5-feet unless rock core "jam" terminates core run.

5. Core run identification as indicated on bore logs.

6. Depth measured in borehole from mudline, down.

7. Elevation Datum: Mean Sea Level (MSL).

8. %Recovery: Ratio of total length of core sample recovered to the total length of core drilled,

9. % RQD, Rock Quality Designation: Summed lengths of all pieces of sound rock core recovered over 4-inches long divided by the length of core drilled, expressed in percent, used as a measure of rock mass quality.

10. Rock Mass Quality, as judged by RQD, is as follows: excellent - 100% to 90%, good - 90% to 75%, fair - 75% to 50%, poor - 50% to 25% and very poor - 25% to 0%.

11. Boring NBH-5 terminated at "refusal" blow count to split spoon sampler penetration due to impending ship traffic. Bedrock assumed at refusal, elev. -48.1 MSL. Sediment sampling per ASTM D 1586 techniques, refusal defined as 100 or more blows with with less than 6-inches of sampler penetration.

New Bedford Harbor Confined Aquatic Disposal Cell Feasibility Study

Boring Program Bedrock Information Summary

Table 2

Boring ID.	Bedrock Type	Bedrock Surface Elev.[1]	Bedrock Core Runs[2] Dia. (in)[3]	Length (Ft.)[4]	ID.[5]	Depth (Ft.)[6]	Elevation (MSL)[7]	% Recovery[8]	% RQD[9]	Rock Mass Quality[10]
Popes Island North										
Phase I										
NBH-1	Granite	-90.2	1.875	5.0	C-1	87.5 to 92.5	-93.7 to -98.7	60	0	very poor
			1.875	5.0	C-2	92.5 to 97.5	-98.7 to -103.7	50	0	very poor
			1.875	5.0	C-3	97.5 to 102.5	-103.7 to -108.7	67	0	very poor
NBH-2	Granite	-63.8	1.875	5.0	C-1	59.0 to 64.0	-66.8 to -71.8	90	78	good
			1.875	5.0	C-2	64.0 to 69.0	-71.8 to -76.8	90	99	excellent
NBH-3A	Granite	-64.7	1.875	5.0	C-1	57.5 to 62.5	-64.7 to -69.7	87	90	good to excellent
			1.875	5.0	C-2	62.5 to 67.5	-69.7 to -74.7	87	85	good
Phase II										
NBH-8	Granite	-92.8	1.875	5.0	C-1	86.0 to 91.0	-93.5 to -98.5	100	30	poor
			1.875	1.0	C-2	91.0 to 92.0	-98.5 to -99.5	100	50	poor to fair
			1.875	5.0	C-3	92.0 to 97.0	-99.5 to -104.5	100	95	excellent
Channel Inner										
Phase I										
NBH-4	Granite	-58.5	1.875	5.0	C-1	30.0 to 35.0	-59.5 to -64.5	57	95	excellent
			1.875	6.0	C-2	35.0 to 41.0	-64.5 to -70.5	100	85	good
NBH-5	Ref.[10]	-48.1[11]								
NBH-6	Granite	-54.9	1.875	5.0	C-1	27.0 to 32.0	-55.6 to -60.6	93	100	excellent
			1.875	5.0	C-2	32.0 to 37.0	-60.6 to -65.6	90	92	excellent
NBH-7	Granite	-62.7	1.875	5.0	C-1	35.0 to 40.0	-63.7 to -68.7	33	40	poor
			1.875	1.5	C-2	40.0 to 41.5	-68.7 to -70.2	33	0	very poor
			1.875	1.5	C-3	41.5 to 43.0	-70.2 to -71.7	33	0	very poor
Phase II										
NBH-9	Granite	-49.0	1.875	5.0	C-1	21.0 to 26.0	-49.0 to -54.0	88	95	excellent
			1.875	2.0	C-2	26.0 to 28.0	-54.0 to -56.0	100	100	excellent
			1.875	3.0	C-3	28.0 to 31.0	-56.0 to -59.0	89	100	excellent
NBH-10	Granite	-51.1	1.875	5.0	C-1	22.0 to 27.0	-51.1 to -56.1	70	98	excellent
			1.875	5.0	C-2	26.0 to 28.0	-54.0 to -56.0	80	99	excellent
NBH-11	Granite	-62.3	1.875	5.0	C-1	36.0 to 41.0	-62.3 to -67.3	100	80	good

New Bedford Harbor
Confined Aquatic Disposal Cell Feasibility Study

Foot Notes for Tables 3A and 3B
Summary Geotechnical Laboratory Index Testing

1. C: composited sample, as indicated, for analyses purposes. Similar, adjacent sediment samples were composited for economy in testing purposes.

2. Sample Location (Avg.):
   a. Depth: Average depth of single sample or range of composite sample in feet below mudline at boring location.
   b. Elevation: Average single sample or range of composite sample referenced to Mean Sea Level (MSL) datum.

3. Stratum ID: Major sediment strata identified
   a. O: Dark gray/brown, loose, ORGANIC SILT, trace fine sand, shells (OH, OL)
   b. P: Brown, loose, FIBEROUS PEAT and organic silt (Pt)
   c. I: Interbedded granular GLACIAL DRIFT stratigraphy (ML, SM, SP, SW) ranging from: loose to medium dense interbedded silts, sands and sand and gravels with occasional boulder sized material.
   d. T: GLACIAL TILL, Gray/brown, medium dense to very dense, FINE TO COARSE SAND, some to and fine to coarse gravel, little to some silt, trace boulders (SM, GC, GM).

4. Test Type:
   a. S&H: Sieve and Hydrometer Analyses per ASTM D 422-63.
   b. S: Sieve Analyses, washed procedure past the no. 200 sieve per ASTM D 422-63.

5. The differentiation of sample grain size components: Fines, Sand and Gravel are as per the Unified Classification System. Refer to item 10, below.

6. Natural water content (Wn) per ASTM D 2216-98 of typically organic soil samples as part of Atterberg Limit analyses.

7. Atterberg Limits per ASTM D 4318-98 (Method A).

8. Organic Content % per ASTM D 2974-87 (Method B & C).

9. Total Weight, tube sample total unit weight.

10. Unified Soil Classification System per ASTM D 2487-90.

11. NA: not available, sieve analysis does not distinguish between sample component silt and clay "fines" fractions.

New Bedford Harbor Confined Aquatic Disposal Cell Feasibility Study

Popes Island Summary Geotechnical Laboratory Index Testing

Table 3A

	Sample Location (Avg.)[2]		Stratum	Test	% Fines[5]			% Sand[5]			% Gravel[5]			Atterberg Limits[7]			Organic	Tot. Wt.	Unified
Boring, Sample	Depth (Ft.)	Elevation (MSL)	ID.[3]	Type[4]	Clay	Silt	Tot. Fines	Fine	Medium	Coarse	Fine	Coarse	Wn[6]	LL	PL	PI	Content %[8]	(Lb/Ft^3)	Classification[10]
Phase I																			
NBH-1, Mudline	0.0	-6.2																	
NBH-1, S-1 thru S-5, C[1]	1.0 to 23.0	-7.2 to -29.2	O	S & H	26	68	94	2	2	1	1	0	47.3	111	41	70	8.8		OH
NBH-1, S-6 thru S-7, C	28.0 to 33.0	-34.2 to -39.2	P	S & H	14	86	100	0	0	0	0	0	384	459	283	176	45.7		PT
NBH-1, S-8	35.0	-41.2	P	S & H	12	75	87	8	5	0	0	0	27.8	46	35	11			OL
NBH-1, S-10	44.5	-50.7	I	S & H	2	38	40	30	14	10	6	0							SM
NBH-1, S-11	50.0	-56.2	I	S	NA[10]	NA	35	27	13	7	18	0							SM
NBH-1, S-12	55.0	-61.2	I	S	NA	NA	11	22	25	12	20	10							SP-SM
NBH-1, S-13 thru S-15, C	60.0 to 72.0	-66.2 to -78.2	I	S	NA	NA	6	19	45	14	13	3							SP-SM
NBH-1, S-16 thru S-17, C	77.0 to 82.5	-83.2 to -88.7	T	S & H	3	12	15	13	28	12	21	11							SM
NBH-2, Mudline	0.0	-7.8																	
NBH-2, S-1 thru S-3, C	1.0 to 10.0	-8.8 to -17.8	O	S & H	9	36	45	41	12	1	1	0	56.6	46	19	27	3.2		OL
NBH-2, S-4	15.0	-22.8	I	S	NA	NA	6	55	38	1	0	0							SP-SM
NBH-2, S-5 thru S-6, C	23.0 to 28.0	-30.8 to -35.8	I	S & H	4	58	62	35	3	0	0	0							ML
NBH-2, S-7	33.0	-40.8	I	S	NA	NA	3	36	56	3	2	0							SP
NBH-2, S-8	39.0	-46.8	I	S	NA	NA	14	27	30	11	18	0							SM
NBH-2, S-9	44.0	-51.8	I	S & H	1	70	71	25	1	1	2	0							ML
NBH-2, S-10	49.0	-56.8	I	S & H	2	86	88	10	2	0	0	0							ML
NBH-3A, Mudline	0.0	-7.2																	
NBH-3A, S-1 thru S-3, C	1.0 to 10.0	-8.2 to -17.2	O	S & H	12	79	91	5	2	1	1	0	105	98	35	63	7.6		OH
NBH-3A, S-4 thru S-5, C	17.5 to 22.5	-24.7 to -29.7	I	S	NA	NA	10	14	19	14	23	20							SW-SM
NBH-3A, S-6	27.0	-34.2	I	S	NA	NA	5	22	33	16	24	0							SP
NBH-3A, S-7 thru S-10, C	32.0 to 47.0	-39.2 to -54.2	I	S & H	1	26	27	67	2	1	3	0							SM
NBH-3A, S-11 thru S-12, C	51.0 to 54.5	-58.2 to -61.7	T	S & H	1	17	18	10	13	10	37	12	10.3	23	18	5			GC-GM
Phase II																			
NBH-8, Mudline	0.0	-7.5																	
NBH-8, S-1	1.0	-8.5	O	S & H	0	11	11	79	7	2	1	0	18		non-plastic		0.4		SM
NBH-8, UP-1	5.0 to 7.0	-12.5 to -14.5	O	S & H	8	37	45	31	21	1	2	0	48	38	19	19	2.6	128.0	SM-OL
NBH-8, S-2	8.0	-15.5	I	S	NA	NA	11	33	26	10	20	0							SM
NBH-8, S-3 thru S-6, C	10.0 to 27.0	-17.5 to -34.5	I	S	NA	NA	6	9	25	13	29	18							SW
NBH-8, S-8 thru S-9, C	41.5 to 49.5	-49.0 to -57.0	I	S	NA	NA	3	26	46	13	12	0							SW
NBH-8, S-10	53.5	-61.0	I	S	NA	NA	3	93	3	1	0	0							SP
NBH-8, S-11 thru S-12, C	57.5 to 69.5	-65.0 to -77.0	I	S	NA	NA	5	15	24	16	22	18							SW
NBH-8, S14	76.5	-84.0	I	S	NA	NA	6	21	53	6	14	0							SP
NBH-8, S15 thru S16, C	80.5 to 87.5	-88.0 to -95.0	I	S	NA	NA	9	27	43	11	10	0							SW

New Bedford Harbor Confined Aquatic Disposal Cell Feasibility Study
Channel Inner Summary Geotechnical Laboratory Index Testing

Table 3B

	Sample Location (Avg.)[2]		Stratum	Test	% Fines[5]			% Sand[5]			% Gravel[5]			Atterberg Limits[7]			Organic	Tot. Wt.[9]	Unified
Boring, Sample	Depth (Ft.)	Elevation (MSL)	ID.[3]	Type[4]	Clay	Silt	Tot. Fines	Fine	Medium	Coarse	Fine	Coarse	Wn[6]	LL	PL	PI	Content %[8]	(Lb/Ft^3)	Classification[10]
Phase I																			
NBH-4, Mudline	0.0	-29.5																	
NBH-4, S-1 thru S-2, C[1]	1.0 to 6.0	-30.5 to -35.5	O	S & H	4	33	37	16	16	7	10	14	64	39	24	15	4.1		SC
NBH-4, S-3	10.0	-39.5	I	S	NA[10]	NA	12	58	26	4	0	0							SM
NBH-4, S-4	17.0	-46.5	I	S	NA	NA	17	43	22	8	5	5							SM
NBH-4, S-5 thru S-6, C	22.0 to 28.0	-51.5 to -57.5	T	S	NA	NA	9	16	24	11	25	15							SP-SM
NBH-5, Mudline	0.0	-27.8																	
NBH-5, S-1 thru S-2, C	1.0 to 5.0	-28.8 to -32.8	O	S & H	7	79	86	11	2	1	0	0	114	103	39	64			OH
NBH-5, S-3	10.0	-37.8	I	S	NA	NA	9	35	20	11	14	11							SW-SM
NBH-5, S-4 thru S-5, C	15.0 to 19.5	-42.8 to -47.3	I	S & H	1	16	17	49	9	7	13	5							SM
NBH-6, Mudline	0.0	-28.6																	
NBH-6, S-1 thru S-2, C	1.0 to 5.0	-29.6 to -33.6	O	S & H	5	60	65	9	10	2	14	0	107	73	39	34	6.6		OL
NBH-6, S-3	8.5	-37.1	I	S & H	0	4	4	12	34	16	34	0							SP
NBH-6, S-4 thru S-5, C	15.0 to 19.5	-43.6 to -48.1	I	S	NA	NA	3	17	38	16	26	0							SP-SM
NBH-6, S-6	23.5 to 26.0	-52.2 to -54.7	T	S	NA	NA	12	18	20	12	23	15							SM
NBH-7, Mudline	0.0	-28.7																	
NBH-7, S-1	1.0	-29.7	O	S & H	12	58	70	16	9	4	1	0	78.3	54	28	26	5.7		CH
NBH-7, S-2	5.0	-33.7	I	S	NA	NA	3	4	20	23	43	7							GP
NBH-7, S-3	10.0	-38.7	I	S & H	1	43	44	32	8	4	12	0							SM
NBH-7, S-4	14.0	-42.7	I	S & H	1	14	15	57	18	6	4	0							SM
NBH-7, S-5 thru S-6, C	19.0 to 24.0	-47.7 to -52.7	I	S & H	1	28	29	66	4	1	0	0							SM
Phase II																			
NBH-9, Mudline	0.0	-28.0																	
NBH-9, S-1	1.0	-29.0	O	S & H	14	72	86	9	5	0	0	0							OL-OH
NBH-9, UP-1	5.0 to 7.0	-33.0 to -35.0	O	S & H	4	33	37	37	12	4	10	0	37	32	19	13	2.5	122	SM-OL
NBH-9, S-2	13.0	-41.0	T	S & H	1	9	10	15	17	10	19	29							SM
NBH-9, S-3	19.0	-47.0	T	S & H	1	14	15	30	14	6	14	21							SM
NBH-10, Mudline	0.0	-29.1																	
NBH-10, S-1	1.0	-30.1	O	S & H	6	29	35	29	13	3	6	14	29	27	19	8	1.6		SM-OL
NBH-10, S-2 thru S-3	5.0 to 12.0	-34.1 to -41.1	I	S	NA	NA	4	22	30	6	38	0							SW
NBH-10, S-4	16.0	-45.1	T	S & H	2	17	19	24	18	10	18	11							SM
NBH-11, Mudline	0.0	-26.3																	
NBH-11, S-1	1.0	-27.3	O	S & H	4	51	55	30	12	3	0	0	56	53	28	25	3.0		OH
NBH-11, S-2	6.0	-32.3	I	S & H	1	4	5	29	54	8	4	0							SP
NBH-11, S-3	10.5	-36.3	I	S & H	2	28	30	69	1	0	0	0							SM
NBH-11, S-4	15.5	-41.8	I	S	NA	NA	11	23	23	13	30	0							SM
NBH-11, S-5 thru S-7	18.5 to 31.0	-44.8 to -57.3	I	S	NA	NA	2	11	16	14	42	15							GW
NBH-11, S-8	35.0	-61.3	T	S & H	1	19	20	39	21	1	9	10							SM

New Bedford Harbor Confined Aquatic Disposal Cell Feasibility Study

Estimated Sediment Engineering Properties

Table 4

Stratum	SPT Value[1] N_{avg}	SPT Value[1] N_{corr}	Avg. Stratum Thickness (Ft.)	Atterberg Limits[2] W_n	Atterberg Limits[2] LL	Atterberg Limits[2] PL	Atterberg Limits[2] PI	Organic Content (%)[3]	Grain Size Components (%)[4] Silt/Clay	Grain Size Components (%)[4] Sand	Grain Size Components (%)[4] Gravel	Unit Weight (lb/ft³)[5] γ_{total}	Unit Weight (lb/ft³)[5] $\gamma_{bouyant}$	Unit Weight (lb/ft³)[5] γ_{dry}	Unified Classification[6]	Effective Stress Parameters[7] c	Effective Stress Parameters[7] ϕ	Recommended Cell Side Slope (Vert:Hor)[8]
Popes Island North																		
Organic Silt (O)	WOR	WOR	17	64	73	29	44	5.6	62	37	1	110	46	66	OH,OL	0	26°	1 : 3
Peat (P)	WOR	WOR	4	206	253	160	93	45.7	94	6	0	95	31	25	P_t, OL	0	26°	1 : 3
Interbedded Glacial Drift (I)	20	18	49	Granular - Non Plastic				NA[9]	17	68	15	126	62	100	SW, SM, SP, ML	0	30°	1 : 3
Glacial Till (T)	40	30	5	Granular - Non to Low Plasticity				NA	17	43	40	135	71	120	SM, GC, GM	0	38°	1 : 3
Channel Inner																		
Organic Silt (O)	WOR	WOR	5	69	54	28	26	4	59	33	8	110	46	66	OH, OL	0	26°	1 : 3
Interbedded Glacial Drift (I)	10	16	16	Granular - Non Plastic				NA	14	66	20	124	60	97	SW, SM, SP	0	30°	1 : 3
Glacial Till (T)	60	60	6	Granular - Non to Low Plasticity				NA	14	51	35	135	71	120	SM, SP	0	38°	1 : 3

[1] N_{avg} = average stratum Standard Penetration Test (SPT) value per ASTM D 1586, N_{corr} = average stratum SPT value corrected for overburden pressure.
[2] Wn = average natural sample water content per ASTM D 2216 - 98; average Atterberg Limits: LL, PL and PI = Liquid Limit, Plastic Limit and Plasticity Index per ASTM D 4318 - 98 (Method A).
[3] Average Organic Content % per ASTM D 2974-87 (Method B & C).
[4] Stratum differentiation into average grain size components: Fines, Sand and Gravel are as per the Unified Classification System. The Interbedded Glacial Drift and Glacial Till strata contain occasional boulder sized materials. Refer to item 6 below.
[5] Estimated stratum average unit weight: total, bouyant and dry.
[6] Unified Soil Classification System per ASTM D 2487-90.
[7] Estimated average effective stress sediment parameters: c = cohesion, ϕ = friction angle, based upon SPT and grain size correlation and regional experience.
[8] Recommended CAD Cell side slope for preliminary design, assumed short term single season dredge/backfill exposure.
[9] NA = Not available, no organics present.

Appendixes

Appendix I

Popes Island North Project Boring Logs

Phase I, June/July 2001

NBH – 1, 2, and 3A

Phase II, October 2002

NBH - 8

GUILD DRILLING CO., INC.

100 WATER STREET • EAST PROVIDENCE, R.I.

TO Maguire Group, Inc.
PROJECT NAME Harbor Aquatic Disposal Cell
REPORT SENT TO above / Feasibility Study

ADDRESS Foxborough, MA
LOCATION New Bedford, MA
OUR JOB NO. 02-011

HOLE NO. NBH-1
PROJ. NO. 16421
SURF. ELEV. -6.2' MSL

GROUND WATER OBSERVATIONS

At _____ after _____ Hours
At _____ after _____ Hours

	CASING	SAMPLER	CORE BAR.
Type	HW-NW	S/S	NV-II
Size I.D.	4" 3"	1-3/8"	
Hammer Wt.	300#	140#	BIT
Hammer Fall	24"	30"	Dia.

DATE

Start	6/20/01
Complete	6/27/01
Boring Foreman	J. Medeiros
Inspector/Engr.	R. SHARPNACK

LOCATION OF BORING

Depth	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Moisture Density or Consist.	Strata Change Elev./ Depth	SOIL OR ROCK IDENTIFICATION Remarks include color, gradation, type of soil etc. Rock-color, type, condition, hardness, drilling time, seams, etc.	SAMPLE No.	Pen"	Rec."
		0.0-2.0	D	Wt.	of	Rods			Dark Gray Organic SILT, trace shells	1	24	12
5												
		7.0-9.0	D	Wt.	of	Rods				2	24	24
10												
		12.0-14.0	D	Wt.	of	Rods				3	24	24
15												
		17.0-19.0	D	Wt.	of	Rods				4	24	24
20												
		22.0-24.0	D	Wt.	of	Rods				5	24	24
25												
		27.0-29.0	D	Wt.	of	Rods				6	24	18
								28.0	Dark Brown PEAT, little silt			
30												
		32.0-34.0	D	Wt.	of	Rods				7	24	12
		34.0-36.0	D	3	4	4		34.0	Gray SILT and fine Sand, trace dark brown peat	8	24	12
35						5						
		38.5-40.5	D	6	10	10		38.5	Gray fine SAND and Silt	9	24	1

GROUND SURFACE TO _____ USED _____ CASING: THEN _____

Sample Type
D=Drive C=Cored W=Washed
UP=Fixed Piston UT=Shelby Tube
TP=Test Pit A=Auger
OE = Open End Rod
* 300# hammer

Proportions Used

trace	0 to 10%
little	10 to 20%
some	20 to 35%
and	35 to 50%

140 lb. Wt x 30" fall on 2" O.D. Sampler

Cohesionless	Density	Cohesive	Consistency	
0-10	Loose	0-4	Soft	30 + Hard
10-30	Med. Dense	4-8	M./Stiff	
30-50	Dense	8-15	Stiff	
50+	Very Dense	15-30	V-Stiff	

SUMMARY:
Earth Boring 87.5'
Rock Coring 15'
Samples 17

HOLE NO. NBH-1

GUILD DRILLING CO., INC.

100 WATER STREET • EAST PROVIDENCE, R.I.

TO Maguire Group, Inc. | ADDRESS Foxborough, MA | HOLE NO. NBH-1

PROJECT NAME Harbor Aquatic Disposal Cell | LOCATION New Bedford, MA | PROJ. NO. 16421

REPORT SENT TO above / Feasibility Study | OUR JOB NO. 02-011 | SURF. ELEV. -6.2' MSL.

Depth	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Moisture Density or Consist.	Strata Change Elev./ Depth	SOIL OR ROCK IDENTIFICATION Remarks include color, gradation, type of soil etc. Rock-color, type, condition, hardness, drilling time, seams, etc.	SAMPLE No.	Pen"	Rec."
						9			Gray fine SAND and Silt			
		43.5-45.5	D	5	4	5				10	24	12
45						9		44.0	Gray fine to medium SAND, some silt, trace fine gravel & coarse sand			
		49.0-51.0	D	4	5	6		49.0	Gray fine to coarse SAND and fine to medium Gravel, little silt	11	24	8
50						7						
		54.0-56.0	D	9	12	18		54.0	Dark Gray & Brown coarse to fine SAND and fine to medium Gravel, little silt (Odor Noted)	12	24	12
55						20						
		59.0-61.0	D	9	4	7		59.0	Grayish Brown medium to coarse SAND, some fine gravel, little silt	13	24	18
60						21						
		64.0-66.0	D	3	4	4				14	24	8
65						9						
70												
		71.0-73.0	D	3	3	9				15	24	18
						11						
75								75.0				
		76.0-78.0	D	53	29	17			Yellow Brown & Gray silty fine to coarse SAND and Gravel	16	24	12
						20						
80									(80' to 81' - Boulder)			
		82.0-82.5	D	100					" some weathered rock	17	6	4
85								84.0				

GROUND SURFACE TO _____ USED _____ CASING: THEN _____

Sample Type
D=Drive C=Cored W=Washed
UP=Fixed Piston UT=Shelby Tube
TP=Test Pit A=Auger
OE = Open End Rod
* 300# hammer

Proportions Used

trace	0 to 10%
little	10 to 20%
some	20 to 35%
and	35 to 50%

140 lb. Wt x 30" fall on 2" O.D. Sampler

Cohesionless	Density	Cohesive	Consistency	
0-10	Loose	0-4	Soft	30 + Hard
10-30	Med. Dense	4-8	M./Stiff	
30-50	Dense	8-15	Stiff	
50+	Very Dense	15-30	V-Stiff	

SUMMARY:

Earth Boring 87.5'
Rock Coring 15'
Samples 17

HOLE NO. NBH-1

GUILD DRILLING CO., INC.

100 WATER STREET • EAST PROVIDENCE, R.I.

TO Maguire Group, Inc. | ADDRESS Foxborough, MA | HOLE NO. NBH-1

PROJECT NAME Harbor Aquatic Disposal Cell | LOCATION New Bedford, MA | PROJ. NO. 16421

REPORT SENT TO above / Feasibility Study | OUR JOB NO. 02-011 | SURF. ELEV. -6.2' MSL

Depth	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From To 0-6	6-12	12-18	Moisture Density or Consist.	Strata Change Elev./ Depth	SOIL OR ROCK IDENTIFICATION Remarks include color, gradation, type of soil etc. Rock-color, type, condition, hardness, drilling time, seams, etc.	SAMPLE No.	Pen"	Rec."
		87.5-92.5	C						Gray GRANITE	C1	60	36
		RQD = 0%										60%
90												
		92.5-97.5	C							C2	60	30
		RQD = 0%										50%
95												
		97.5-102.5	C							C3	60	40
		RQD = 0%										66.7%
100												
								102.5	Bottom of Boring 102.5'			

GROUND SURFACE TO _____ USED _____ CASING: THEN _____

Sample Type
D=Drive C=Cored W=Washed
UP=Fixed Piston UT=Shelby Tube
TP=Test Pit A=Auger
OE = Open End Rod
* 300# hammer

Proportions Used

trace	0 to 10%
little	10 to 20%
some	20 to 35%
and	35 to 50%

140 lb. Wt x 30" fall on 2" O.D. Sampler

Cohesionless	Density	Cohesive	Consistency	
0-10	Loose	0-4	Soft	30 + Hard
10-30	Med. Dense	4-8	M./Stiff	
30-50	Dense	8-15	Stiff	
50+	Very Dense	15-30	V-Stiff	

SUMMARY:
Earth Boring 87.5'
Rock Coring 15'
Samples 17

HOLE NO. NBH-1

GUILD DRILLING CO., INC.

100 WATER STREET • EAST PROVIDENCE, R.I.

SHEET 1 OF 2

TO Maguire Group, Inc.
PROJECT NAME Harbor Aquatic Disposal Cell
REPORT SENT TO above / Feasibility Study

ADDRESS Foxborough, MA
LOCATION New Bedford, MA
OUR JOB NO. 02-011

HOLE NO. NBH-2
PROJ. NO. 16421
SURF. ELEV. -7.8' MSL

GROUND WATER OBSERVATIONS

At _____ after ____ Hours

At _____ after ____ Hours

	CASING	SAMPLER	CORE BAR.
Type	HW-NW	S/S	NV-II
Size I.D.	4" 3"	1-3/8"	
Hammer Wt.	300#	140#	BIT
Hammer Fall	24"	30"	Dia.

DATE	
Start	6/29/01
Complete	7/2/01
Boring Foreman	J. Medeiros
Inspector/Engr.	R. SHARPNACK

LOCATION OF BORING

Depth	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Moisture Density or Consist.	Strata Change Elev./ Depth	SOIL OR ROCK IDENTIFICATION Remarks include color, gradation, type of soil etc. Rock-color, type, condition, hardness, drilling time, seams, etc.	SAMPLE No.	Pen"	Rec."
		0.0-2.0	D	Wt.	of	Rods			Black Organic SILT, trace shells	1	24	8
		~~3.5-5.5~~	~~D~~	~~Wt.~~	~~of~~	~~Rods~~				~~2~~	~~24~~	~~20~~
5												
		9.0-11.0	D	Wt.	of	Rods				3	24	24
10						11		10.0	Gray Brown fine SAND, little silt & medium sand			
		14.0-16.0	D	WOR	3	3		14.0	Brown fine to medium SAND, trace silt	4	24	10
15						5						
20												
		22.0-24.0	D	Wt.	Rods	3		22.0	Gray silty fine SAND	5	24	15
						3						
25												
		27.0-29.0	D	3	4	4				6	24	22
						3						
30												
		32.0-34.0	D	5	9	13		32.0	Gray medium to fine SAND, trace silt, coarse sand & fine gravel	7	24	10
						12						
35												
		38.0-40.0	D	11	7	7		36.0	Gray fine to coarse SAND, some fine to medium gravel, little silt	8	24	6
						10						

GROUND SURFACE TO _____ USED _____ CASING: THEN _____

Sample Type
D=Drive C=Cored W=Washed
UP=Fixed Piston UT=Shelby Tube
TP=Test Pit A=Auger
OE = Open End Rod
* 300# hammer

Proportions Used

trace	0 to 10%
little	10 to 20%
some	20 to 35%
and	35 to 50%

140 lb. Wt x 30" fall on 2" O.D. Sampler

Cohesionless	Density	Cohesive	Consistency
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M./Stiff
30-50	Dense	8-15	Stiff
50+	Very Dense	15-30	V-Stiff
		30 +	Hard

SUMMARY:
Earth Boring 59'
Rock Coring 10'
Samples 11

HOLE NO. NBH-2

GUILD DRILLING CO., INC.

100 WATER STREET • EAST PROVIDENCE, R.I.

SHEET 2 OF 2

TO Maguire Group, Inc.
PROJECT NAME Harbor Aquatic Disposal Cell
REPORT SENT TO above / Feasibility Study

ADDRESS Foxborough, MA
LOCATION New Bedford, MA
OUR JOB NO. 02-011

HOLE NO. NBH-2
PROJ. NO. 16421
SURF. ELEV. -7.8' MSL

Depth	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Moisture Density or Consist.	Strata Change Elev./ Depth	SOIL OR ROCK IDENTIFICATION Remarks include color, gradation, type of soil etc. Rock-color, type, condition, hardness, drilling time, seams, etc.	SAMPLE No.	Pen"	Rec.'
		43.0-45.0	D	6	9	15			Gray Brown silty fine SAND (compact), trace fine gravel	9	24	10
45						14						
								46.0				
		48.0-50.0	D	8	5	9			Gray silty very fine SAND	10	24	12
50						7						
								52.0				
		53.5-55.5	D	34	15	11			TILL	11	24	0
55						11						
								56.0				
							Min/Ft					
		59.0-64.0	C				5		Gray GRANITE	C1	60	54
60		RQD = 78%					7					90%
							7					
							5					
							7					
		64.0-69.0	C				6			C2	60	54
65		RQD = 99%					6					90%
							5					
							5					
							6					
								69.0	Bottom of Boring 69'			

GROUND SURFACE TO _____ USED _____ CASING: THEN _____

Sample Type
D=Drive C=Cored W=Washed
UP=Fixed Piston UT=Shelby Tube
TP=Test Pit A=Auger
OE = Open End Rod
*300# hammer

Proportions Used	
trace	0 to 10%
little	10 to 20%
some	20 to 35%
and	35 to 50%

140 lb. Wt x 30" fall on 2" O.D. Sampler

Cohesionless	Density	Cohesive	Consistency	
0-10	Loose	0-4	Soft	30 + Hard
10-30	Med. Dense	4-8	M./Stiff	
30-50	Dense	8-15	Stiff	
50+	Very Dense	15-30	V-Stiff	

SUMMARY:
Earth Boring 59'
Rock Coring 10'
Samples 11

HOLE NO. NBH-2

GUILD DRILLING CO., INC.

100 WATER STREET • EAST PROVIDENCE, R.I.

SHEET 1 OF 2

TO Maguire Group, Inc.
PROJECT NAME Harbor Aquatic Disposal Cell
REPORT SENT TO above / Feasibility Study

ADDRESS Foxborough, MA
LOCATION New Bedford, MA
OUR JOB NO. 02-011

HOLE NO. NBH-3A
PROJ. NO. 16421
SURF. ELEV. -7.2' MSL

GROUND WATER OBSERVATIONS

At _____ after _____ Hours

At _____ after _____ Hours

	CASING	SAMPLER	CORE BAR.
Type	HW-NW	S/S	NV-II
Size I.D.	4" 3"	1-3/8"	
Hammer Wt.	300#	140#	BIT
Hammer Fall	24"	30"	Dia.

DATE	
Start	7/12/01
Complete	7/13/01
Boring Foreman	J. Medeiros
Inspector/Engr.	R. SHARPNACK

LOCATION OF BORING

Depth	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Moisture Density or Consist.	Strata Change Elev./ Depth	SOIL OR ROCK IDENTIFICATION Remarks include color, gradation, type of soil etc. Rock-color, type, condition, hardness, drilling time, seams, etc.	SAMPLE No.	Pen"	Rec."
		0.0-2.0	D	Wt.	of	Rods			Black Organic SILT	1	24	6
5		4.0-6.0	D	Wt.	of	Rods			" color change to Gray	2	24	24
10		9.0-11.0	D	Wt.	of	Rods				3	24	24
								11.0	PEAT, some organic silt			
15												
		16.5-18.5	D	8	8	20 22		16.0	Brown fine to coarse SAND, some fine to medium gravel, trace silt & shells	4	24	2
20												
		21.5-23.5	D	2	3	3 8		21.5	Gray fine to coarse SAND, some silt & fine to coarse gravel	5	24	5
25		26.0-28.0	D	3	2	3 5		26.0	Brown coarse to fine SAND, some fine gravel, little silt	6	24	4
30		31.0-33.0	D	3	3	4 5		31.0	Light Brown fine SAND, some silt, little fine gravel	7	24	1
35		37.0-39.0	D	5	5	6 8				8	24	0

GROUND SURFACE TO _____ USED _____ CASING: THEN _____

Sample Type
D=Drive C=Cored W=Washed
UP=Fixed Piston UT=Shelby Tube
TP=Test Pit A=Auger
OE = Open End Rod
* 300# hammer

Proportions Used	
trace	0 to 10%
little	10 to 20%
some	20 to 35%
and	35 to 50%

140 lb. Wt x 30" fall on 2" O.D. Sampler

Cohesionless	Density	Cohesive	Consistency	
0-10	Loose	0-4	Soft	30 + Hard
10-30	Med. Dense	4-8	M./Stiff	
30-50	Dense	8-15	Stiff	
50+	Very Dense	15-30	V-Stiff	

SUMMARY:
Earth Boring 57.5'
Rock Coring 10'
Samples 12

HOLE NO. NBH-3A

GUILD DRILLING CO., INC.

100 WATER STREET • EAST PROVIDENCE, R.I.

SHEET 2 OF 2

TO Maguire Group, Inc. | ADDRESS Foxborough, MA | HOLE NO. NBH-3A

PROJECT NAME Harbor Aquatic Disposal Cell | LOCATION New Bedford, MA | PROJ. NO. 16421

REPORT SENT TO above / Feasibility Study | OUR JOB NO. 02-011 | SURF. ELEV. -7.2' MSL

Depth	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Moisture Density or Consist.	Strata Change Elev./ Depth	SOIL OR ROCK IDENTIFICATION Remarks include color, gradation, type of soil etc. Rock-color, type, condition, hardness, drilling time, seams, etc.	SAMPLE No.	Pen"	Rec."
		41.0-43.0	D	2	3	3			Brown fine SAND, little silt	9	24	8
						2						
45												
		46.0-48.0	D	1	1	2				10	24	12
						3						
50		50.0-52.0	D	26	30	33		50.0	Brown weathered GRANITE and silty Sand	11	24	12
						33						
		54.0-54.5	D	100					" color change to Gray with little sand	12	6	4
55												
							Min/Ft					
		57.5-62.5	C				5	57.5	GRANITE	C1	60	52
		RQD = 90%					5					86.7%
60							6					
							6					
							5					
		62.5-67.5	C				5			C2	60	58
		RQD = 85%					5					96.7%
65							5					
							5					
							5					
								67.5	Bottom of Boring 67.5'			

GROUND SURFACE TO _____ USED _____ CASING: THEN _____

Sample Type
D=Drive C=Cored W=Washed
UP=Fixed Piston UT=Shelby Tube
TP=Test Pit A=Auger
OE = Open End Rod
* 300# hammer

Proportions Used

trace	0 to 10%
little	10 to 20%
some	20 to 35%
and	35 to 50%

140 lb. Wt x 30" fall on 2" O.D. Sampler

Cohesionless	Density	Cohesive	Consistency
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M./Stiff
30-50	Dense	8-15	Stiff
50+	Very Dense	15-30	V-Stiff
		30 +	Hard

SUMMARY:
Earth Boring 57.5'
Rock Coring 10'
Samples 12

HOLE NO. NBH-3A

GUILD DRILLING CO., INC.

100 WATER STREET • EAST PROVIDENCE, R.I.

TO Maguire Group, Inc.
PROJECT NAME Aquatic Disposal Project
REPORT SENT TO above

ADDRESS Foxborough, MA
LOCATION New Bedford, MA
OUR JOB NO. 03-100

HOLE NO. NBH-8
PROJ. NO. 16421
SURF. ELEV. -7.5'

GROUND WATER OBSERVATIONS		CASING	SAMPLER	CORE BAR.	DATE	
At _____ after ____ Hours	Type	HW-NW	S/S	NV-II	Start	10/15/02
	Size I.D.	4" 3"	1-3/8"		Complete	10/18/02
At _____ after ____ Hours	Hammer Wt.	300#	140#	BIT	Boring Foreman	G. Brouillette
	Hammer Fall	24"	30"	Dia.	Inspector/Engr.	R. SHARPNACK

LOCATION OF BORING On Water

Depth	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Moisture Density or Consist.	Strata Change Elev./ Depth	SOIL OR ROCK IDENTIFICATION Remarks include color, gradation, type of soil etc. Rock-color, type, condition, hardness, drilling time, seams, etc.	SAMPLE No.	Pen"	Rec."
		0.0-2.0	D		Pushed				MUCK	1	24	24
5		5.0-7.0	UP						Dark Brown to Gray fine SAND and Silt	UP1	24	22
		7.0-9.0	D	10	21	16 / 9		7.0	Gray Brown fine to medium SAND, little silt, coarse sand & fine to medium gravel	2	24	22
10		10.0-12.0	D	4	5	5 / 12		9.0	Gray fine to coarse SAND, trace silt & fine to coarse gravel,	3	24	3
15		15.0-17.0	D	22	25	30 / 13		14.0	Gray fine to coarse SAND and Gravel, trace silt	4	24	5
20		20.0-22.0	D	16	17	16 / 14				5	24	7
25		25.0-27.0	D	9	6	6 / 4				6	24	3
30		30.0-30.3	D	75/3"					(@ 30' - Boulder)	7	3	0
35												

GROUND SURFACE TO _____ USED _____ CASING: THEN _____

Sample Type
D=Drive C=Cored W=Washed
UP=Fixed Piston UT=Shelby Tube
TP=Test Pit A=Auger
OE = Open End Rod
* 300# hammer

Proportions Used	
trace	0 to 10%
little	10 to 20%
some	20 to 35%
and	35 to 50%

140 lb. Wt x 30" fall on 2" O.D. Sampler

Cohesionless	Density	Cohesive	Consistency
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M./Stiff
30-50	Dense	8-15	Stiff
50+	Very Dense	15-30	V-Stiff
		30 +	Hard

SUMMARY:
Earth Boring 86'
Rock Coring 11'
Samples 16

HOLE NO. NBH-8

GUILD DRILLING CO., INC.

100 WATER STREET • EAST PROVIDENCE, R.I.

SHEET 2 OF 3

TO Maguire Group, Inc.
PROJECT NAME Aquatic Disposal Project
REPORT SENT TO above

ADDRESS Foxborough, MA
LOCATION New Bedford, MA
OUR JOB NO. 03-100

HOLE NO. NBH-8
PROJ. NO. 16421
SURF. ELEV. -7.5

Depth	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Moisture Density or Consist.	Strata Change Elev./ Depth	SOIL OR ROCK IDENTIFICATION Remarks include color, gradation, type of soil etc. Rock-color, type, condition, hardness, drilling time, seams, etc.	SAMPLE No.	Pen"	Rec.
		41.5-43.5	D	27	35	38 / 40			Grayish Brown fine to coarse SAND, little fine gravel, trace silt	8	24	4
45												
		47.5-49.5	D	11	6	7 / 9		47.5	Gray coarse to fine SAND, some fine to medium gravel, trace silt	9	24	2
50												
		52.5-54.5	D	37	41	47 / 47		52.5	Gray Brown fine SAND, trace silt	10	24	24
55								56.0				
		57.5-59.5	D	7	4	4 / 7			Gray fine to coarse SAND, some fine to coarse gravel, trace silt	11	24	3
60												
		62.5-64.5	D	16	13	7 / 7			" little fine gravel	12	24	2
65												
		67.5-69.5	D	23	20	12 / 14		67.5	Gray fine SAND, little silt	13	24	1
70												
75		75.5-77.5	D	19	8	9 / 10		75.5	Gray fine to coarse SAND, little fine to medium gravel, trace silt	14	24	4
80		80.5-82.5	D	21	10	12 / 10		80.5	Grayish Brown coarse to fine SAND, trace silt & fine gravel	15	24	18
85		85.0-85.3	D	120/3"				84.0	Gray fine to coarse SAND and Gravel, some silt & weathered rock	16	3	3
		86.0-91.0	C	(RQD=30%)				85.3	Gray GRANITE	C1	60	60

GROUND SURFACE TO _____ USED _____ CASING: THEN _____

Sample Type
D=Drive C=Cored W=Washed
UP=Fixed Piston UT=Shelby Tube
TP=Test Pit A=Auger
OE = Open End Rod
* 300# hammer

Proportions Used

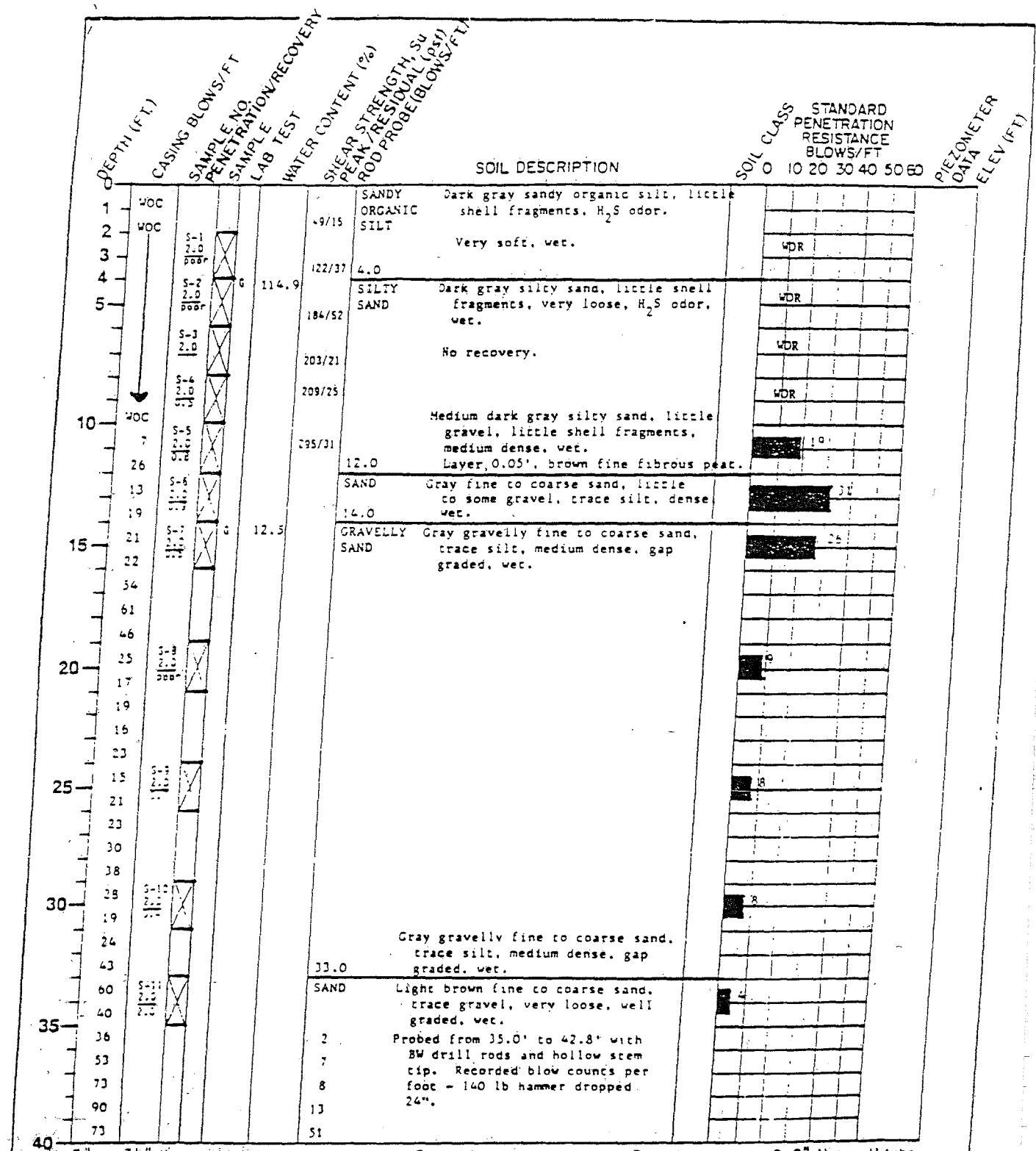
trace	0 to 10%
little	10 to 20%
some	20 to 35%
and	35 to 50%

140 lb. Wt x 30" fall on 2" O.D. Sampler

Cohesionless	Density	Cohesive	Consistency	
0-10	Loose	0-4	Soft	30 + Hard
10-30	Med. Dense	4-8	M./Stiff	
30-50	Dense	8-15	Stiff	
50+	Very Dense	15-30	V-Stiff	

SUMMARY:
Earth Boring 86'
Rock Coring 11'
Samples 16

HOLE NO. NBH-8



PRELIMINARY GEOTECHNICAL INVESTIGATION
OF ENGINEERING PROPERTIES
NEW BEDFORD HARBOR SUPERFUND SITE
BRISTOL COUNTY, MASSACHUSETTS

E.C. JORDAN CO.
CONSULTING ENGINEERS

Engineering Log of: BW-109A

Page 1/2

Project No.	Date Drilled	Sheet A-12
4959-19	2/4 - 2/9/88	

DEPTH (FT.)	CASING BLOWS/FT.	SAMPLE NO. PENETRATION/RECOVERY	SAMPLE LAB TEST	WATER CONTENT (%)	SHEAR STRENGTH, Su PEAK/RESIDUAL (psf) ROD PROBE (BLOWS/FT.)	SOIL DESCRIPTION	SOIL CLASS.	STANDARD PENETRATION RESISTANCE BLOWS/FT 0 10 20 30 40 50 60	PIEZOMETER DATA	ELEV (FT.)
40										
41	90				72	Grayish brown fine to medium sand, dense to very dense.				
42	175 197				172 62 - 100+	NO PENETRATION				
43		*R-1			42.8	BEDROCK AT 42.8 FEET				
44		5.3/2.5				Gray muscovite/biotite gneiss, trace garnet inclusions, some chloritization, schistose, friable.				
45										
					48.1	RQD = 12.3%				
50						BOTTOM OF EXPLORATION AT DEPTH OF 48.1 FEET				
55						* Rock core obtained with a double barrel N core and NWX core bit.				
60										
65										
70										
75										
80										

U: 3" or 3½" thin wall tube S: split spoon R: rock C: 2" thin wall tube

PRELIMINARY GEOTECHNICAL INVESTIGATION
OF ENGINEERING PROPERTIES
NEW BEDFORD HARBOR SUPERFUND SITE
BRISTOL COUNTY, MASSACHUSETTS

E.C. JORDAN CO.
CONSULTING ENGINEERS

Engineering Log of: BW-109A

Page 2/2

Project No. 4959-19

Date Drilled 2/4 - 2/9/88

Sheet A-13

DEPTH (FT.)	CASING BLOWS/FT	SAMPLE NO. PENETRATION/RECOVERY	SAMPLE	LAB TEST	WATER CONTENT (%)	SHEAR STRENGTH, Su PEAK/RESIDUAL (psf) ROD PROBE (BLOWS/FT.)	SOIL DESCRIPTION	SOIL CLASS.	STANDARD PENETRATION RESISTANCE BLOWS/FT 0 10 20 30 40 50 60	PIEZOMETER DATA	ELEV. (FT)
0							Refer to Boring Log BW-109A for soil descriptions.				
1											
2		U-1									
3		H 2.0									
4		1.3									
5											
		U-2					No recovery.				
		H 2.0									
		0.0									
10						10.0	BOTTOM OF EXPLORATION AT DEPTH OF 10.0 FEET. NO REFUSAL ENCOUNTERED.				
15											
20											
25											
30											
35											
40											

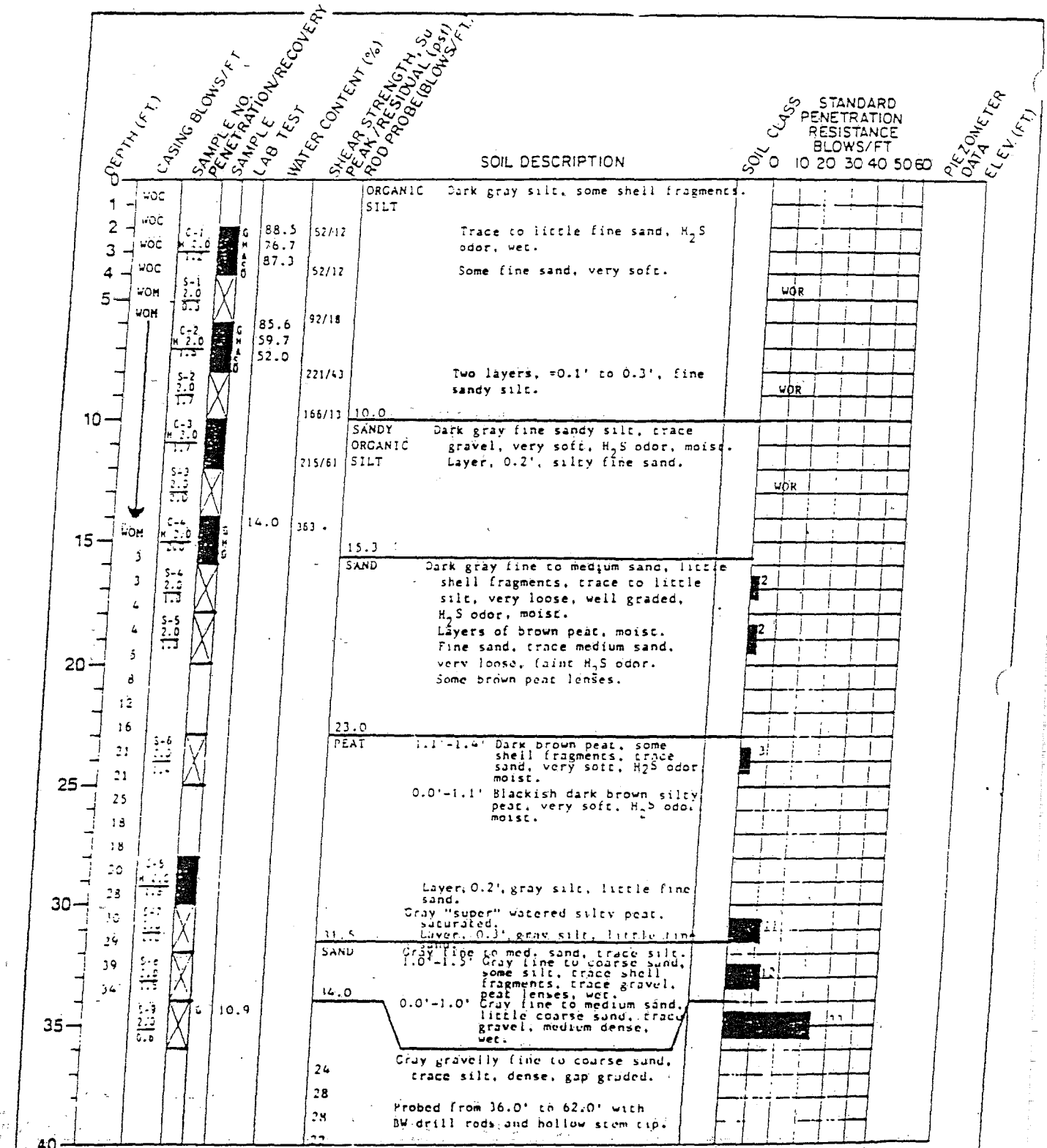
U: 3" or 3½" thin wall tube S: split spoon R: rock C: 2" thin wall tube

PRELIMINARY GEOTECHNICAL INVESTIGATION
OF ENGINEERING PROPERTIES
NEW BEDFORD HARBOR SUPERFUND SITE
BRISTOL COUNTY, MASSACHUSETTS

E.C. JORDAN CO.
CONSULTING ENGINEERS

Engineering Log of: BW-109B

Project No.	Date Drilled	
4959-19	2/9/88	Sheet A-14



PRELIMINARY GEOTECHNICAL INVESTIGATION
OF ENGINEERING PROPERTIES
NEW BEDFORD HARBOR SUPERFUND SITE
BRISTOL COUNTY, MASSACHUSETTS

E.C. JORDAN CO.
CONSULTING ENGINEERS

Engineering Log of: BW-110 Page 1/2

Project No. 4934-19 | Date Drilled 2/9 - 2/10/88 | Sheet A-15

DEPTH (FT.)	CASING BLOWS/FT	SAMPLE NO. PENETRATION/RECOVERY	SAMPLE	LAB TEST	WATER CONTENT (%)	SHEAR STRENGTH, Su PEAK/RESIDUAL (psf) ROD PROBE (BLOWS/FT.)	SOIL DESCRIPTION	SOIL CLASS	STANDARD PENETRATION RESISTANCE BLOWS/FT 0 10 20 30 40 50 60	PIEZOMETER DATA	ELEV (FT)
40						31	Probed from 36.0' to 62.0' with BW drill rods and hollow stem tip. Recorded blow counts per foot - 140 lb. hammer dropped 30".				
41						16					
42						18					
43						23					
44						39					
45						53					
						45					
						33					
						21					
						14					
50						20					
						14					
						13					
						20					
						14					
55						19					
						18					
						16					
						45					
						102					
60						124					
						274					
						62.0	*REFUSAL SURFACE ENCOUNTERED AT DEPTH OF 62.0 FEET				
65											
							* Refusal of drilling tools and sampling equipment with methods used. Refusal surface is assumed to represent bedrock.				
70											
75											
80											

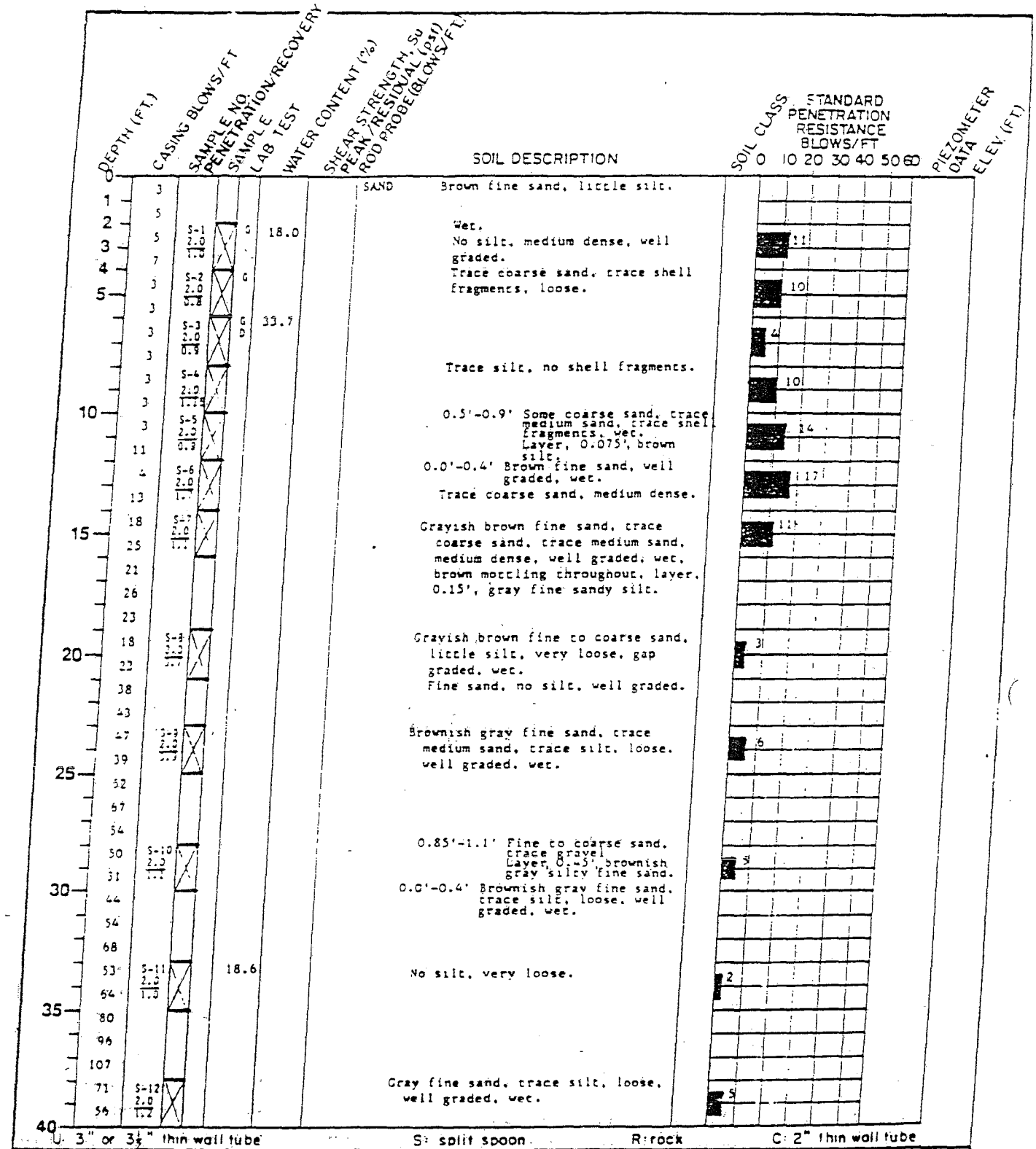
U: 3" or 3½" thin wall tube S: split spoon R: rock C: 2" thin wall tube

PRELIMINARY GEOTECHNICAL INVESTIGATION
OF ENGINEERING PROPERTIES
NEW BEDFORD HARBOR SUPERFUND SITE
BRISTOL COUNTY, MASSACHUSETTS

E.C. JORDAN CO.
CONSULTING ENGINEERS

Engineering Log of: BW-110 Page 2/2

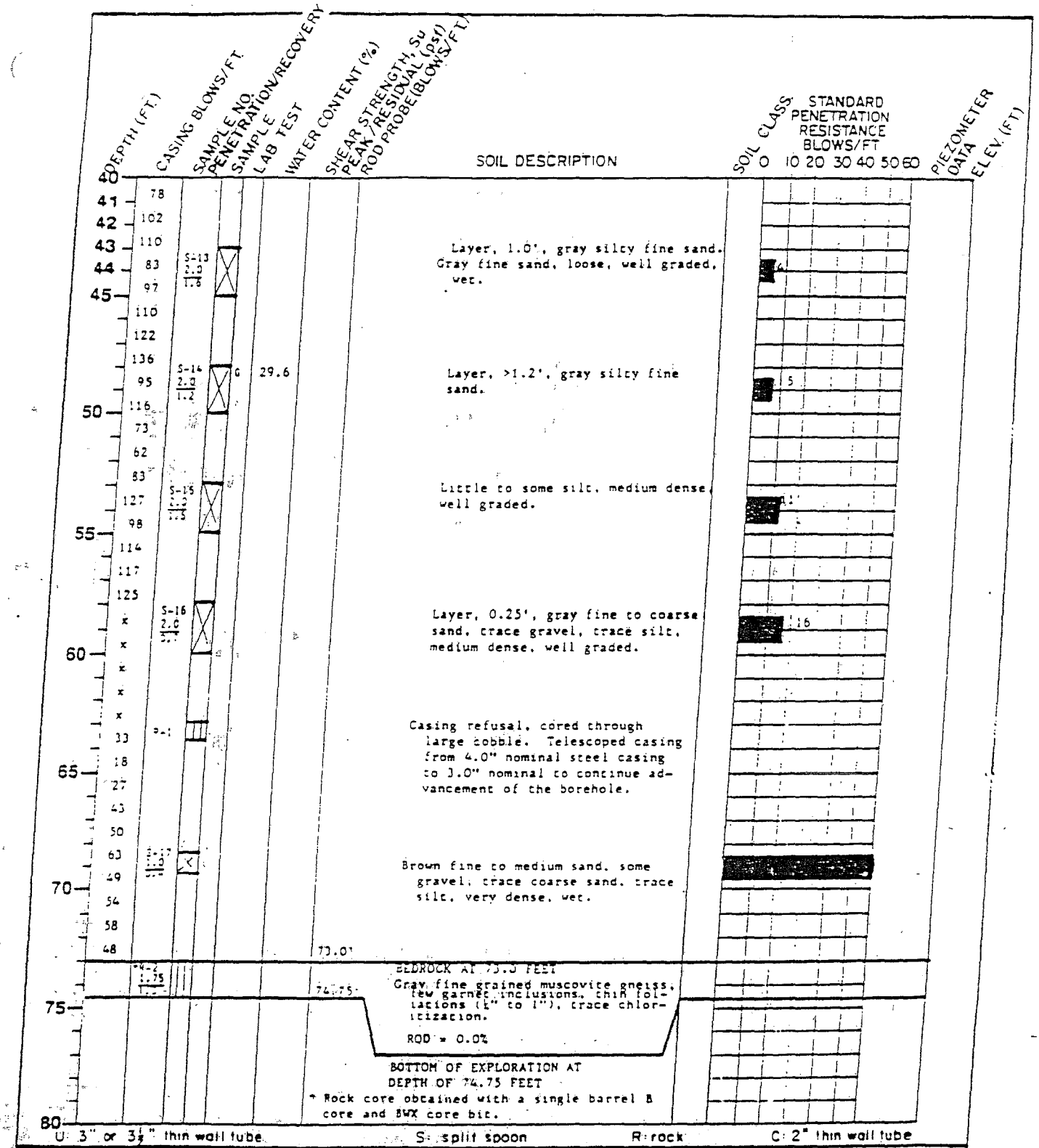
Project No. 4959-19 | Date Drilled 2/9 - 2/10/88 | Sheet A-16



PRELIMINARY GEOTECHNICAL INVESTIGATION
OF ENGINEERING PROPERTIES
NEW BEDFORD HARBOR SUPERFUND SITE
BRISTOL COUNTY, MASSACHUSETTS

E.C. JORDAN CO.
CONSULTING ENGINEERS

Engineering Log of: BW-111		Page 1/2
Project No. 4959-19	Date Drilled 1/28 - 2/3/88	Sheet A-17



PRELIMINARY GEOTECHNICAL INVESTIGATION
OF ENGINEERING PROPERTIES
NEW BEDFORD HARBOR SUPERFUND SITE
BRISTOL COUNTY, MASSACHUSETTS

E.C.JORDAN CO.
CONSULTING ENGINEERS

Engineering Log of: BW-111		Page 2/2
Project No. 4959-19	Date Drilled 1/28 - 2/3/88	Sheet A-18

DEPTH (FT.)	CASING BLOWS/FT.	SAMPLE NO. PENETRATION/RECOVERY	SAMPLE	LAB TEST	WATER CONTENT (%)	SHEAR STRENGTH, Su PEAK/RESIDUAL (psf) ROD PROBE (BLOWS/FT.)	SOIL DESCRIPTION	SOIL CLASS	STANDARD PENETRATION RESISTANCE BLOWS/FT 0 10 20 30 40 50 60	PIEZOMETER DATA ELEV. (FT.)
0										
1	WOC						ORGANIC SILT — Dark gray organic silt, some shell fragments, H_2S odor.			
2	WOC				110/15		Trace shell fragments, very soft, wet.			
2.5										
3	WOC	S-1 2.0 0.9	G M O	38.0			SILTY SAND — Dark gray silty fine sand, trace medium sand, very loose, H_2S odor, wet.		WOM	
4	WOC									
5	WOM	S-2 2.0 0.0					No recovery		WOM	
6.0	WOM									
	1	S-3 2.0 0.6	G	22.6			SAND — Dark brown fine to coarse sand, trace silt, very loose, wet. Layer, <0.1', peat.		4	
	4									
	12	S-4 2.0 1.0					Brown fine sand, little medium sand, trace coarse sand, medium dense, wet.		29	
10	19									
	22	S-5 2.0 1.0					Trace medium sand, trace gravel, trace silt, very dense, little mottling.		55	
	22									
	12	S-6 2.0 1.35					Brownish gray fine sand, little gravel, trace coarse sand, trace medium sand, dense, wet.		46	
	21									
15	18	S-7 2.0 0.7					Little to some gravel, gap graded.		33	
	30									
	34									
	53									
	35									
20	9	S-8 2.0 1.0	S	17.6			Some gravel, little coarse sand, loose.		8	
	13									
	26									
	38									
	12	S-9 2.0 1.35					Grayish brown fine to medium sand, some gravel, trace coarse sand, loose, wet.		6	
25	14									
	32									
	36									
	64									
	23	S-10 2.0 1.1	S	17.6			Little coarse sand.			
30	28									
	53									
	53									
	53						0.4'-0.7' Grayish brown coarse sand, little gravel, trace med. sand, trace fine sand, medium dense.			
	x	S-11 2.0 1.7								
34.0	x									
35							SILTY SAND (Glacial Till) — 0.0'-0.4' Gray silty fine sand, little to some gravel, little coarse sand, trace medium sand, trace clay, medium dense, wet.			
	42						Probed from 35.0' to 42.8' with BW drill rods and hollow stem tip. Recorded blow counts per foot - 140 lb. hammer dropped 24".			
	42									
	29									
40	53									

U: 3" or 3½" thin wall tube S: split spoon R: rock C: 2" thin wall tube

PRELIMINARY GEOTECHNICAL INVESTIGATION
OF ENGINEERING PROPERTIES
NEW BEDFORD HARBOR SUPERFUND SITE
BRISTOL COUNTY, MASSACHUSETTS

E.C. JORDAN CO.
CONSULTING ENGINEERS

Engineering Log of: BW-112		Page 1/2
Project No. 4959-19	Date Drilled 2/3/88	Sheet A-19

DEPTH (FT.)	CASING BLOWS/FT.	SAMPLE NO. PENETRATION/RECOVERY	SAMPLE	LAB TEST	WATER CONTENT (%)	SHEAR STRENGTH, Su PEAK/RESIDUAL (psf) ROD PROBE (BLOWS/FT.)	SOIL DESCRIPTION	SOIL CLASS.	STANDARD PENETRATION RESISTANCE BLOWS/FT 0 10 20 30 40 50 60	PIEZOMETER DATA	ELEV. (FT.)
40											
41						110					
42						183	NO PENETRATION				
						100+					
43						42.8	*REFUSAL SURFACE ENCOUNTERED AT DEPTH OF 42.8 FEET				
44											
45											
50											
55											
60											
65											
70											
75											
80											

* Refusal of drilling tools and sampling equipment with methods used. Refusal surface is assumed to represent bedrock.

U: 3" or 3½" thin wall tube S: split spoon R: rock C: 2" thin wall tube

PRELIMINARY GEOTECHNICAL INVESTIGATION
OF ENGINEERING PROPERTIES
NEW BEDFORD HARBOR SUPERFUND SITE
BRISTOL COUNTY, MASSACHUSETTS

E.C. JORDAN CO.
CONSULTING ENGINEERS

Engineering Log of: BW-112		Page 2/2
Project No. 4959-19	Date Drilled 2/3/88	Sheet A-20

Appendix III

Channel Inner Project Boring Logs

Phase I, July 2001, NBH – 4, 5, 6 and 7
Phase II, October 2002, NBH – 9, 10 and 11

GUILD DRILLING CO., INC.

100 WATER STREET • EAST PROVIDENCE, R.I.

SHEET 1 OF 2

TO Maguire Group, Inc. | ADDRESS Foxborough, MA | HOLE NO. NBH-4

PROJECT NAME Harbor Aquatic Disposal Cell | LOCATION New Bedford, MA | PROJ. NO. 16421

REPORT SENT TO above / Feasibility Study | OUR JOB NO. 02-011 | SURF. ELEV. -29.5' MLW

GROUND WATER OBSERVATIONS		CASING	SAMPLER	CORE BAR.	DATE	
At _____ after ____ Hours	Type	HW-NW	S/S	NV-II	Start	7/3/01
	Size I.D.	4" 3"	1-3/8"		Complete	7/5/01
At _____ after ____ Hours	Hammer Wt.	300#	140#	BIT	Boring Foreman	J. Medeiros
	Hammer Fall	24"	30"	Dia.	Inspector/Engr.	R. Sharpnack

LOCATION OF BORING

Depth	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Moisture Density or Consist.	Strata Change Elev./ Depth	SOIL OR ROCK IDENTIFICATION Remarks include color, gradation, type of soil etc. Rock-color, type, condition, hardness, drilling time, seams, etc.	SAMPLE No.	Pen"	Rec."
		0.0-2.0	D	Wt.	of	Rods			Black Organic SILT, trace shells	1	24	6
5		5.0-7.0	D	Wt.	Rods	3				2	24	24
						4		6.0	Black & Gray Brown fine to coarse SAND, some silt & gravel			
								8.0				
		9.0-11.0	D	1	2	2			Tan fine SAND, little medium sand, trace silt	3	24	8
10						3						
15												
		16.0-18.0	D	3	5	8		16.0	Tan fine to coarse SAND, little silt & fine gravel	4	24	8
						9						
20												
		21.0-23.0	D	10	9	10				5	24	6
						29		22.0	Brown & Dark Brown coarse to fine SAND and fine to coarse Gravel, little silt			
25												
		27.0-29.0	D	29	22	19			" color change to Yellow Brown	6	24	8
						100						
							Min/Ft	29.0				
30		30.0-35.0	C				4		QUARTZ & Green Red GRANITE	C1	60	34
		RQD = 95%					1				56.7%	
							5					
							6					
							7					
35		35.0-41.0	C				7	35.0		C2	72	72
		RQD = 85%					6		Green Gray GRANITE		100%	
							6					
							8					
							8					

GROUND SURFACE TO _____ USED _____ CASING: THEN _____

Sample Type
D=Drive C=Cored W=Washed
UP=Fixed Piston UT=Shelby Tube
TP=Test Pit A=Auger
OE = Open End Rod
* 300# hammer

Proportions Used	
trace	0 to 10%
little	10 to 20%
some	20 to 35%
and	35 to 50%

140 lb. Wt x 30" fall on 2" O.D. Sampler

Cohesionless	Density	Cohesive	Consistency	
0-10	Loose	0-4	Soft	30 + Hard
10-30	Med. Dense	4-8	M./Stiff	
30-50	Dense	8-15	Stiff	
50+	Very Dense	15-30	V-Stiff	

SUMMARY:
Earth Boring 30'
Rock Coring 11'
Samples 6

HOLE NO. NBH-4

GUILD DRILLING CO., INC.

100 WATER STREET • EAST PROVIDENCE, R.I.

SHEET 2 OF 2

HOLE NO. NBH-4

PROJ. NO. K0421

SURF. ELEV. -29.5' MLLW

TO Maguire Group, Inc.

PROJECT NAME Harbor Aquatic Disposal Cell

REPORT SENT TO above / Feasibility Study

ADDRESS Foxborough, MA

LOCATION New Bedford, MA

OUR JOB NO. 02-011

Depth	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Moisture Density or Consist.	Strata Change Elev./ Depth	SOIL OR ROCK IDENTIFICATION Remarks include color, gradation, type of soil etc. Rock-color, type, condition, hardness, drilling time, seams, etc.	SAMPLE No.	Pen"	Rec.'
							8	41.0	Bottom of Boring 41'			

GROUND SURFACE TO _____ USED _____ CASING: THEN _____

Sample Type
D=Drive C=Cored W=Washed
UP=Fixed Piston UT=Shelby Tube
TP=Test Pit A=Auger
OE = Open End Rod
* 300# hammer

Proportions Used

trace	0 to 10%
little	10 to 20%
some	20 to 35%
and	35 to 50%

140 lb. Wt x 30" fall on 2" O.D. Sampler

Cohesionless	Density	Cohesive	Consistency
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M./Stiff
30-50	Dense	8-15	Stiff
50+	Very Dense	15-30	V-Stiff
		30 +	Hard

SUMMARY:

Earth Boring 30'

Rock Coring 11'

Samples 6

HOLE NO. NBH-4

GUILD DRILLING CO., INC.

100 WATER STREET • EAST PROVIDENCE, R.I.

SHEET 1 OF 1

TO Maguire Group, Inc.
PROJECT NAME Harbor Aquatic Disposal Cell
REPORT SENT TO above / Feasibility Study

ADDRESS Foxborough, MA
LOCATION New Bedford, MA
OUR JOB NO. 02-011

HOLE NO. NBH-5
PROJ. NO. 16421
SURF. ELEV. -27.8' MLLW

GROUND WATER OBSERVATIONS

At _____ after _____ Hours

At _____ after _____ Hours

	CASING	SAMPLER	CORE BAR.
Type	HW	S/S	
Size I.D.	4"	1-3/8"	
Hammer Wt.	300#	140#	BIT
Hammer Fall	24"	30"	

DATE	
Start	7/5/01
Complete	7/5/01
Boring Foreman	J. Medeiros
Inspector/Engr.	R. Sharpnack

LOCATION OF BORING

Depth	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Moisture Density or Consist.	Strata Change Elev./ Depth	SOIL OR ROCK IDENTIFICATION Remarks include color, gradation, type of soil etc. Rock-color, type, condition, hardness, drilling time, seams, etc.	SAMPLE No.	Pen"	Rec."
		0.0-2.0	D	Wt.	of	Rods			Black Organic SILT	1	24	12
5		4.0-6.0	D	Wt.	of	Rods				2	24	14
10		9.0-11.0	D	5	4	3		9.0	Brown fine to coarse SAND, some fine to coarse gravel, little silt	3	24	8
						4		12.0				
15		14.0-16.0	D	14	9	5			Brown silty fine SAND, little fine gravel	4	24	6
						6						
20		19.0-20.3	D	30	14	100/3"			" some coarse sand & fine to medium gravel	5	15	3
								20.3	Bottom of Boring 20.3'			

GROUND SURFACE TO _____ USED _____ CASING: THEN _____

Sample Type
D=Drive C=Cored W=Washed
UP=Fixed Piston UT=Shelby Tube
TP=Test Pit A=Auger
OE = Open End Rod
* 300# hammer

Proportions Used	
trace	0 to 10%
little	10 to 20%
some	20 to 35%
and	35 to 50%

140 lb. Wt x 30" fall on 2" O.D. Sampler

Cohesionless	Density	Cohesive	Consistency	
0-10	Loose	0-4	Soft	30 + Hard
10-30	Med. Dense	4-8	M./Stiff	
30-50	Dense	8-15	Stiff	
50+	Very Dense	15-30	V-Stiff	

SUMMARY:
Earth Boring 20.3
Rock Coring _____
Samples 5

HOLE NO. NBH-5

GUILD DRILLING CO., INC.

100 WATER STREET • EAST PROVIDENCE, R.I.

SHEET 1 OF 1

TO Maguire Group, Inc.
PROJECT NAME Harbor Aquatic Disposal Cell
REPORT SENT TO above / Feasibility Study

ADDRESS Foxborough, MA
LOCATION New Bedford, MA
OUR JOB NO. 02-011

HOLE NO. NBH-6
PROJ. NO. 16421
SURF. ELEV. -28.6' MLLW

GROUND WATER OBSERVATIONS

At _____ after _____ Hours

At _____ after _____ Hours

	CASING	SAMPLER	CORE BAR.
Type	HW-NW	S/S	NV-II
Size I.D.	4" 3"	1-3/8"	
Hammer Wt.	300#	140#	BIT
Hammer Fall	24"	30"	Dia.

DATE

Start	7/9/01
Complete	7/9/01
Boring Foreman	J. Medeiros
Inspector/Engr.	R. Sharpnack

LOCATION OF BORING

Depth	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Moisture Density or Consist.	Strata Change Elev./ Depth	SOIL OR ROCK IDENTIFICATION Remarks include color, gradation, type of soil etc. Rock-color, type, condition, hardness, drilling time, seams, etc.	SAMPLE No.	Pen"	Rec."
		0.0-2.0	D	Wt.	of	Rods			Black Organic SILT	1	24	11
5		4.0-6.0	D	Wt.	Rods	3			" trace shells	2	24	20
						10		6.0	Rusty Brown coarse to fine SAND, some fine to medium gravel, trace silt			
		7.5-9.5	D	11	6	6				3	24	7
						8						
10												
15		14.0-16.0	D	5	4	4			" color change to Brown	4	24	6
						6						
20		18.5-20.5	D	3	2	3			" & fine Gravel	5	24	2
						5						
25		23.5-25.5	D	36	30	42		23.5	Brown fine to coarse SAND and Gravel, little silt	6	24	7
						31						
							Min/Ft	26.0				
		27.0-32.0	C				7		GRANITE	C1	60	56
		RQD = 100%					8					93.3%
30							8					
							8					
							8					
		32.0-37.0	C				7			C2	60	54
		RQD = 92%					7					90%
35							7					
							7					
							7					
								37.0	Bottom of Boring 37'			

GROUND SURFACE TO _____ USED _____ CASING: THEN _____

Sample Type
D=Drive C=Cored W=Washed
UP=Fixed Piston UT=Shelby Tube
TP=Test Pit A=Auger
OE = Open End Rod
* 300# hammer

Proportions Used

trace	0 to 10%
little	10 to 20%
some	20 to 35%
and	35 to 50%

140 lb. Wt x 30" fall on 2" O.D. Sampler

Cohesionless	Density	Cohesive	Consistency	
0-10	Loose	0-4	Soft	30 + Hard
10-30	Med. Dense	4-8	M./Stiff	
30-50	Dense	8-15	Stiff	
50+	Very Dense	15-30	V-Stiff	

SUMMARY:
Earth Boring 27'
Rock Coring 10'
Samples 6

HOLE NO. NBH-6

GUILD DRILLING CO., INC.

100 WATER STREET • EAST PROVIDENCE, R.I.

SHEET 1 OF 2

TO Maguire Group, Inc.
PROJECT NAME Harbor Aquatic Disposal Cell
REPORT SENT TO above / Feasibility Study

ADDRESS Foxborough, MA
LOCATION New Bedford, MA
OUR JOB NO. 02-011

HOLE NO. NBH-7
PROJ. NO. 10421
SURF. ELEV. -28.7' MLLW

GROUND WATER OBSERVATIONS

At _____ after _____ Hours

At _____ after _____ Hours

	CASING	SAMPLER	CORE BAR.
Type	HW-NW	S/S	NV-II
Size I.D.	4" 3"	1-3/8"	
Hammer Wt.	300#	140#	BIT
Hammer Fall	24"	30"	Dia.

DATE	
Start	7/10/01
Complete	7/11/01
Boring Foreman	J. Medeiros
Inspector/Engr.	R. Sharpnack

LOCATION OF BORING

Depth	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Moisture Density or Consist.	Strata Change Elev./ Depth	SOIL OR ROCK IDENTIFICATION Remarks include color, gradation, type of soil etc. Rock-color, type, condition, hardness, drilling time, seams, etc.	SAMPLE No.	Pen"	Rec."
		0.0-2.0	D	Wt.	of	Rods			Black Organic SILT, little shells	1	24	22
								2.0				
		4.0-6.0	D	2	2	4			Gray fine to coarse SAND and fine to medium Gravel, little silt, trace shells (organic)	2	24	20
5						8						
		9.0-11.0	D	5	6	7		9.0	Light Brown silty fine SAND, little fine to medium gravel	3	24	12
10						10						
		13.0-15.0	D	4	6	10		13.0	Brown fine to medium SAND, little silt & coarse sand, trace fine gravel	4	24	9
15						11						
		18.0-20.0	D	3	4	6		18.0	Brown fine SAND, little silt	5	24	8
20						6						
		23.0-25.0	D	2	4	3				6	24	12
25						5						
								28.0	BOULDERS			
30												
35							Min/Ft	34.0				
		35.0-40.0	C				5		Weathered GRANITE	C1	60	20
		RQD = 40%					7					33.3%
							8					
							3					
							3					

GROUND SURFACE TO _____ USED _____ CASING: THEN _____

Sample Type
D=Drive C=Cored W=Washed
UP=Fixed Piston UT=Shelby Tube
TP=Test Pit A=Auger
OE = Open End Rod
* 300# hammer

Proportions Used

trace	0 to 10%
little	10 to 20%
some	20 to 35%
and	35 to 50%

140 lb. Wt x 30" fall on 2" O.D. Sampler

Cohesionless	Density	Cohesive	Consistency	
0-10	Loose	0-4	Soft	30 + Hard
10-30	Med. Dense	4-8	M./Stiff	
30-50	Dense	8-15	Stiff	
50+	Very Dense	15-30	V-Stiff	

SUMMARY:
Earth Boring 35'
Rock Coring 8'
Samples 6

HOLE NO. NBH-7

GUILD DRILLING CO., INC.

100 WATER STREET • EAST PROVIDENCE, R.I.

SHEET 2 OF 2

TO Maguire Group, Inc.
PROJECT NAME Harbor Aquatic Disposal Cell
REPORT SENT TO above / Feasibility Study

ADDRESS Foxborough, MA
LOCATION New Bedford, MA
OUR JOB NO. 02-011

HOLE NO. NBH-7
PROJ. NO. 16421
SURF. ELEV. -28.7' MLLW

Depth	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From To 0-6	6-12	12-18	Moisture Density or Consist.	Strata Change Elev./ Depth	SOIL OR ROCK IDENTIFICATION Remarks include color, gradation, type of soil etc. Rock-color, type, condition, hardness, drilling time, seams, etc.	SAMPLE No.	Pen"	Rec."
		40.0-41.5	C	RQD	= 0%		19		Weathered GRANITE	C2	18	6
												33.3%
		~~41.5-43.0~~	~~C~~	~~RQD~~	~~= 0%~~		8			~~C3~~	~~18~~	~~6~~
												33.3%
								43.0	Bottom of Boring 43'			

GROUND SURFACE TO _____ USED _____ CASING: THEN _____

Sample Type
D=Drive C=Cored W=Washed
UP=Fixed Piston UT=Shelby Tube
TP=Test Pit A=Auger
OE = Open End Rod
* 300# hammer

Proportions Used

trace	0 to 10%
little	10 to 20%
some	20 to 35%
and	35 to 50%

140 lb. Wt x 30" fall on 2" O.D. Sampler

Cohesionless	Density	Cohesive	Consistency	
0-10	Loose	0-4	Soft	30 + Hard
10-30	Med. Dense	4-8	M./Stiff	
30-50	Dense	8-15	Stiff	
50+	Very Dense	15-30	V-Stiff	

SUMMARY:
Earth Boring 35'
Rock Coring 8'
Samples 6

HOLE NO. NBH-7

GUILD DRILLING CO., INC.

100 WATER STREET • EAST PROVIDENCE, R.I.

SHEET 1 OF 1

TO Maguire Group, Inc.
PROJECT NAME Aquatic Disposal Project
REPORT SENT TO above

ADDRESS Foxborough, MA
LOCATION New Bedford, MA
OUR JOB NO. 03-100

HOLE NO. NBH-9
PROJ. NO. 16421
SURF. ELEV. -28.0'

GROUND WATER OBSERVATIONS		CASING	SAMPLER	CORE BAR.	DATE	
At _____ after ____ Hours	Type	HW-NW	S/S	NV-II	Start	10/21/02
	Size I.D.	4" 3"	1-3/8"		Complete	10/22/02
At _____ after ____ Hours	Hammer Wt.	300#	140#	BIT	Boring Foreman	G. Brouillette
	Hammer Fall	24"	30"	Dia.	Inspector/Engr.	R. SHARPNACK

LOCATION OF BORING On Water

Depth	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Moisture Density or Consist.	Strata Change Elev./ Depth	SOIL OR ROCK IDENTIFICATION Remarks include color, gradation, type of soil etc. Rock-color, type, condition, hardness, drilling time, seams, etc.	SAMPLE No.	Pen"	Rec."
		0.0-2.0	D	Wt.	of	Rods			Black Organic SILT, trace sea shells	1	24	24
5		5.0-7.0	UP							UP1	24	18
								6.5				
10												
		12.0-14.0	D	61	54	30			Brown Gray fine to coarse SAND and Gravel, little silt	2	24	10
						49						
15												
		18.0-20.0	D	50	29	43				3	24	10
						88						
20												
		21.0-26.0	C (RQD=95%)					21.0	Pink GRANITE	C1	60	53
25												
		26.0-28.0	C (RQD=100%)							C2	24	24
		28.0-31.0	C (RQD=100%)							C3	36	32
30												
								31.0	Bottom of Boring 31'			

GROUND SURFACE TO _____ USED _____ CASING: THEN _____

Sample Type
D=Drive C=Cored W=Washed
UP=Fixed Piston UT=Shelby Tube
TP=Test Pit A=Auger
OE = Open End Rod
* 300# hammer

Proportions Used	
trace	0 to 10%
little	10 to 20%
some	20 to 35%
and	35 to 50%

140 lb. Wt x 30" fall on 2" O.D. Sampler

Cohesionless	Density	Cohesive	Consistency	
0-10	Loose	0-4	Soft	30 + Hard
10-30	Med. Dense	4-8	M./Stiff	
30-50	Dense	8-15	Stiff	
50+	Very Dense	15-30	V-Stiff	

SUMMARY:
Earth Boring 21'
Rock Coring 10'
Samples 3

HOLE NO. NBH-9

GUILD DRILLING CO., INC.

100 WATER STREET • EAST PROVIDENCE, R.I.

SHEET 1 OF 1

TO Maguire Group, Inc.
PROJECT NAME Aquatic Disposal Project
REPORT SENT TO above

ADDRESS Foxborough, MA
LOCATION New Bedford, MA
OUR JOB NO. 03-100

HOLE NO. NBH-10
PROJ. NO. 16421
SURF. ELEV. -29.1'

GROUND WATER OBSERVATIONS		CASING	SAMPLER	CORE BAR.	DATE	
At _____ after ____ Hours	Type	HW-NW	S/S	NV-II	Start	10/22/02
	Size I.D.	4" 3"	1-3/8"		Complete	10/23/02
At _____ after ____ Hours	Hammer Wt.	300#	140#	BIT	Boring Foreman	G. Brouillette
	Hammer Fall	24"	30"	Dia.	Inspector/Engr.	R. SHARPNACK

LOCATION OF BORING On Water

Depth	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Moisture Density or Consist.	Strata Change Elev./ Depth	SOIL OR ROCK IDENTIFICATION Remarks include color, gradation, type of soil etc. Rock-color, type, condition, hardness, drilling time, seams, etc.	SAMPLE No.	Pen"	Rec."
		0.0-2.0	D	Wt.	of	Rods			Black Organic SILT and Sea Shells	1	24	11
								2.5				
5		5.0-7.0	D	6	7	16			Brown fine to coarse SAND, some fine gravel, trace silt	2	24	3
						33						
10		10.0-12.0	D	3	2	3			" & fine Gravel	3	24	24
						5						
								13.0				
15		15.0-17.0	D	38	20	25			Brown silty fine to medium SAND and Gravel	4	24	10
						34						
20												
		22.0-27.0	C	(RQD=98%)				22.0	Pink GRANITE	C1	60	42
25												
		27.0-32.0	C	(RQD=99%)						C2	60	48
30												
								32.0	Bottom of Boring 32'			

GROUND SURFACE TO _____ USED _____ CASING: THEN _____

Sample Type
D=Drive C=Cored W=Washed
UP=Fixed Piston UT=Shelby Tube
TP=Test Pit A=Auger
OE = Open End Rod
* 300# hammer

Proportions Used	
trace	0 to 10%
little	10 to 20%
some	20 to 35%
and	35 to 50%

140 lb. Wt x 30" fall on 2" O.D. Sampler

Cohesionless	Density	Cohesive	Consistency	
0-10	Loose	0-4	Soft	30 + Hard
10-30	Med. Dense	4-8	M./Stiff	
30-50	Dense	8-15	Stiff	
50+	Very Dense	15-30	V-Stiff	

SUMMARY:
Earth Boring 22'
Rock Coring 10'
Samples 4

HOLE NO. NBH-10

GUILD DRILLING CO., INC.

100 WATER STREET • EAST PROVIDENCE, R.I.

SHEET 1 OF 2

TO Maguire Group, Inc.
PROJECT NAME Aquatic Disposal Project
REPORT SENT TO above

ADDRESS Foxborough, MA
LOCATION New Bedford, MA
OUR JOB NO. 03-100

HOLE NO. NBH-11
PROJ. NO. 16421
SURF. ELEV. -26.25'

GROUND WATER OBSERVATIONS		CASING	SAMPLER	CORE BAR.	DATE	
At _____ after ____ Hours	Type	HW-NW	S/S	NV-II	Start	10/23/02
	Size I.D.	4" 3"	1-3/8"		Complete	10/23/02
At _____ after ____ Hours	Hammer Wt.	300#	140#	BIT	Boring Foreman	G. Brouillette
	Hammer Fall	24"	30"	Dia.	Inspector/Engr.	R. SHARPNACK

LOCATION OF BORING On Water

Depth	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Moisture Density or Consist.	Strata Change Elev./Depth	SOIL OR ROCK IDENTIFICATION Remarks include color, gradation, type of soil etc. Rock-color, type, condition, hardness, drilling time, seams, etc.	SAMPLE No.	Pen"	Rec."
		0.0-2.0	D	Wt.	of	Rods			Black Gray Organic SILT and Sea Shells	1	24	24
5		5.0-7.0	D	2	2	3 4		5.0	Gray fine to coarse SAND, little silt, trace fine gravel	2	24	8
10		9.5-11.5	D	7	7	9 10		9.5	Gray silty very fine SAND	3	24	12
15		14.5-16.5	D	6	3	5 6		14.0	Gray fine to coarse SAND and fine to medium Gravel, trace silt	4	24	5
20		19.5-21.5	D	15	9	2 2				5	24	4
25		24.0-26.0	D	11	4	8 20		24.0	Brown fine to coarse SAND and fine Gravel, trace silt	6	24	2
30		29.0-31.0	D	23	19	18 10		29.0	Brown fine to medium SAND and fine to coarse Gravel, trace silt	7	24	2
35		34.0-36.0	D	20	20	50 50		34.0	Brown fine SAND, little to some silt, little medium sand, trace fine to coarse gravel	8	24	9
		36.0-41.0	C	(RQD=80%)				36.0	Pink GRANITE	C1	60	60

GROUND SURFACE TO _____ USED _____ CASING: THEN _____

Sample Type
D=Drive C=Cored W=Washed
UP=Fixed Piston UT=Shelby Tube
TP=Test Pit A=Auger
OE = Open End Rod
* 300# hammer

Proportions Used

trace	0 to 10%
little	10 to 20%
some	20 to 35%
and	35 to 50%

140 lb. Wt x 30" fall on 2" O.D. Sampler

Cohesionless	Density	Cohesive	Consistency
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M./Stiff
30-50	Dense	8-15	Stiff
50+	Very Dense	15-30	V-Stiff
		30 +	Hard

SUMMARY:
Earth Boring 36'
Rock Coring 5'
Samples 8

HOLE NO. NBH-11

GUILD DRILLING CO., INC.

100 WATER STREET • EAST PROVIDENCE, R.I.

SHEET 2 OF 2

HOLE NO. NBH-11

PROJ. NO. 16421

SURF. ELEV. -26.25

TO Maguire Group, Inc.

PROJECT NAME Aquatic Disposal Project

REPORT SENT TO above

ADDRESS Foxborough, MA

LOCATION New Bedford, MA

OUR JOB NO. 03-100

Depth	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From To 0-6	6-12	12-18	Moisture Density or Consist.	Strata Change Elev./ Depth	SOIL OR ROCK IDENTIFICATION Remarks include color, gradation, type of soil etc. Rock-color, type, condition, hardness, drilling time, seams, etc.	SAMPLE No.	Pen"	Rec."
								41.0	Bottom of Boring 41'			

GROUND SURFACE TO _____ USED _____ CASING: THEN _____

Sample Type
D=Drive C=Cored W=Washed
UP=Fixed Piston UT=Shelby Tube
TP=Test Pit A=Auger
OE = Open End Rod
* 300# hammer

Proportions Used	
trace	0 to 10%
little	10 to 20%
some	20 to 35%
and	35 to 50%

140 lb. Wt x 30" fall on 2" O.D. Sampler

Cohesionless	Density	Cohesive	Consistency
0-10	Loose	0-4	Soft
10-30	Med. Dense	4-8	M./Stiff
30-50	Dense	8-15	Stiff
50+	Very Dense	15-30	V-Stiff
		30 +	Hard

SUMMARY:

Earth Boring 36'

Rock Coring 5'

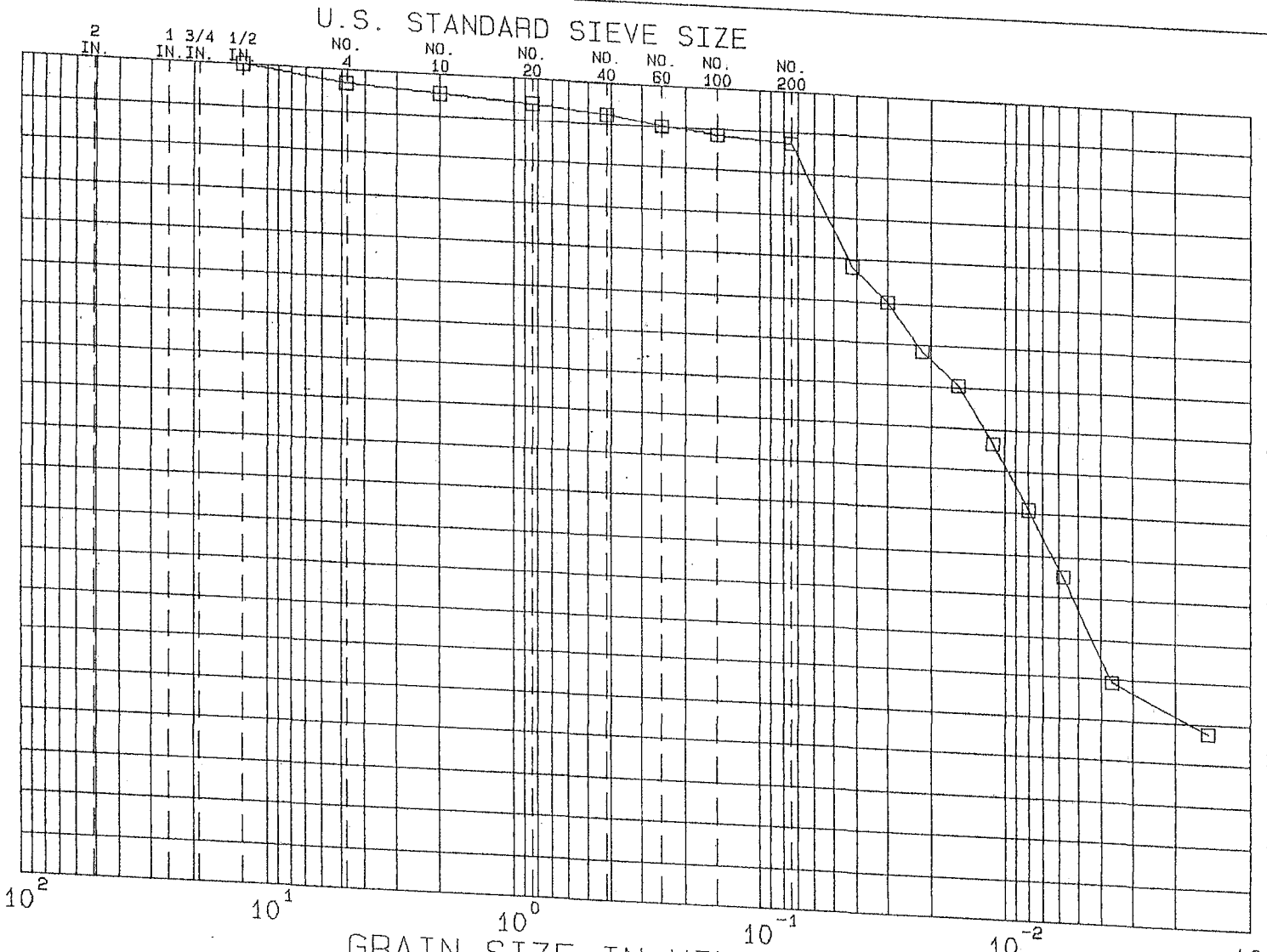
Samples 8

HOLE NO. NBH-11

Appendix IV

Popes Island North Laboratory Testing Data

Phase I, NBH – 1, 2, and 3A
Phase II, NBH – 8



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

TEST NO.	MATERIAL SOURCE	REMARKS
S1.1	BORING NO. NBH-1 S.N.S1-S5, D=0-24'	Dk.Grey Organic silt (OH)

NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

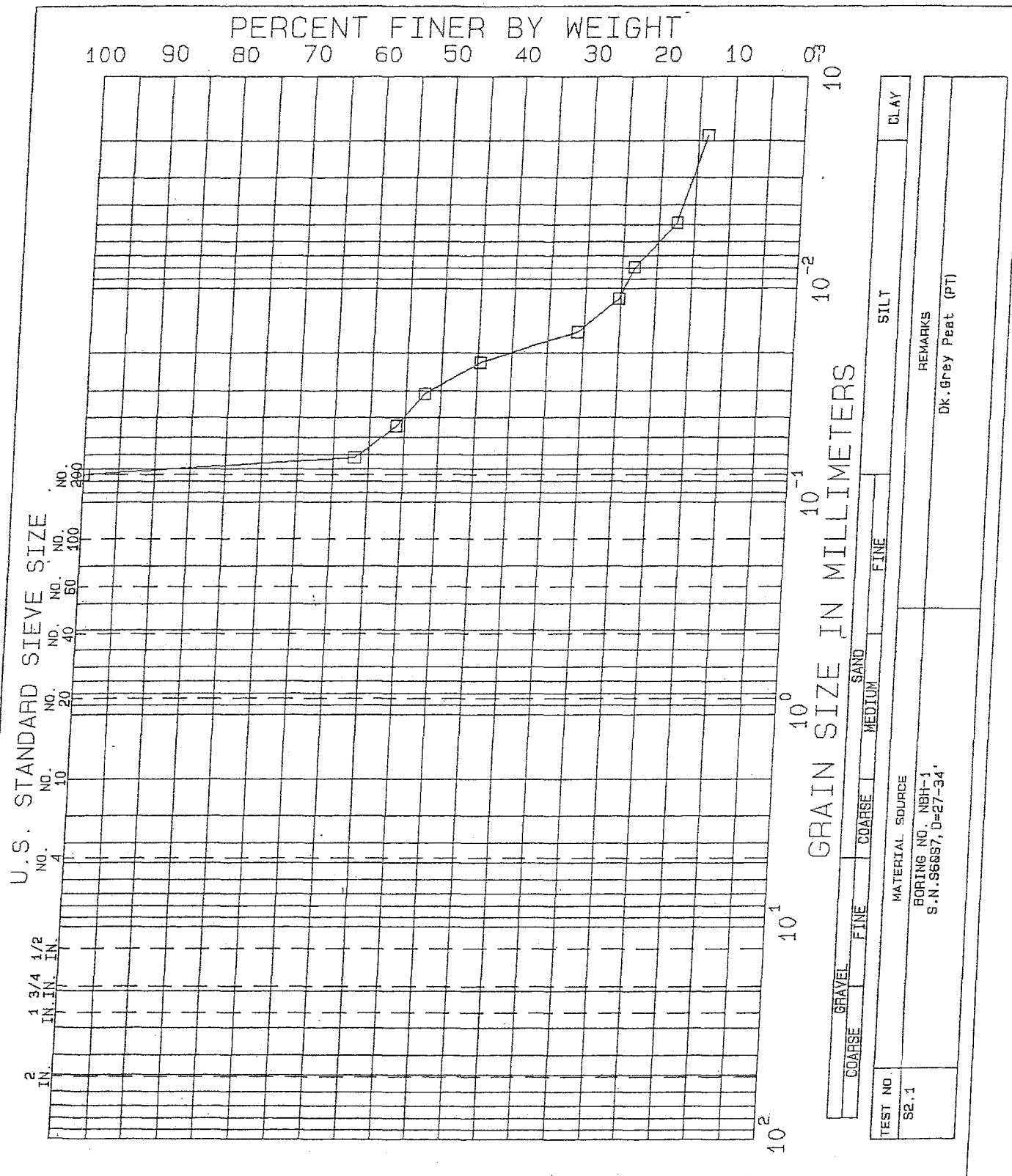
GRADATION TESTS

BORING NO. NBH-1
SAMPLE S1-S-5
DEPTH 0-24'
TECH. mst
REVIEWER MCM

TEST SERIES NO. 1
DATE SEPT. 01

FILE L16926

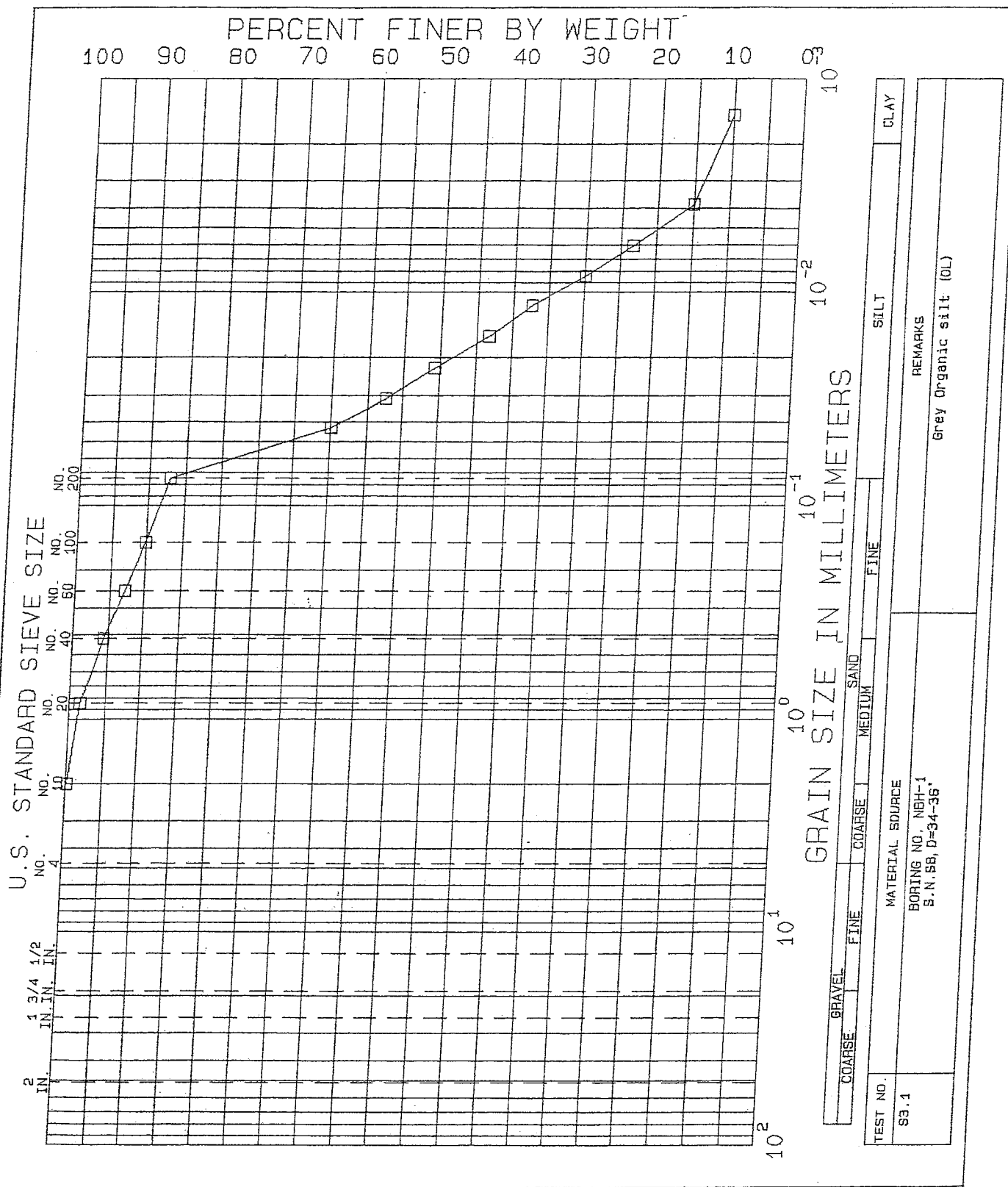
GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS



NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

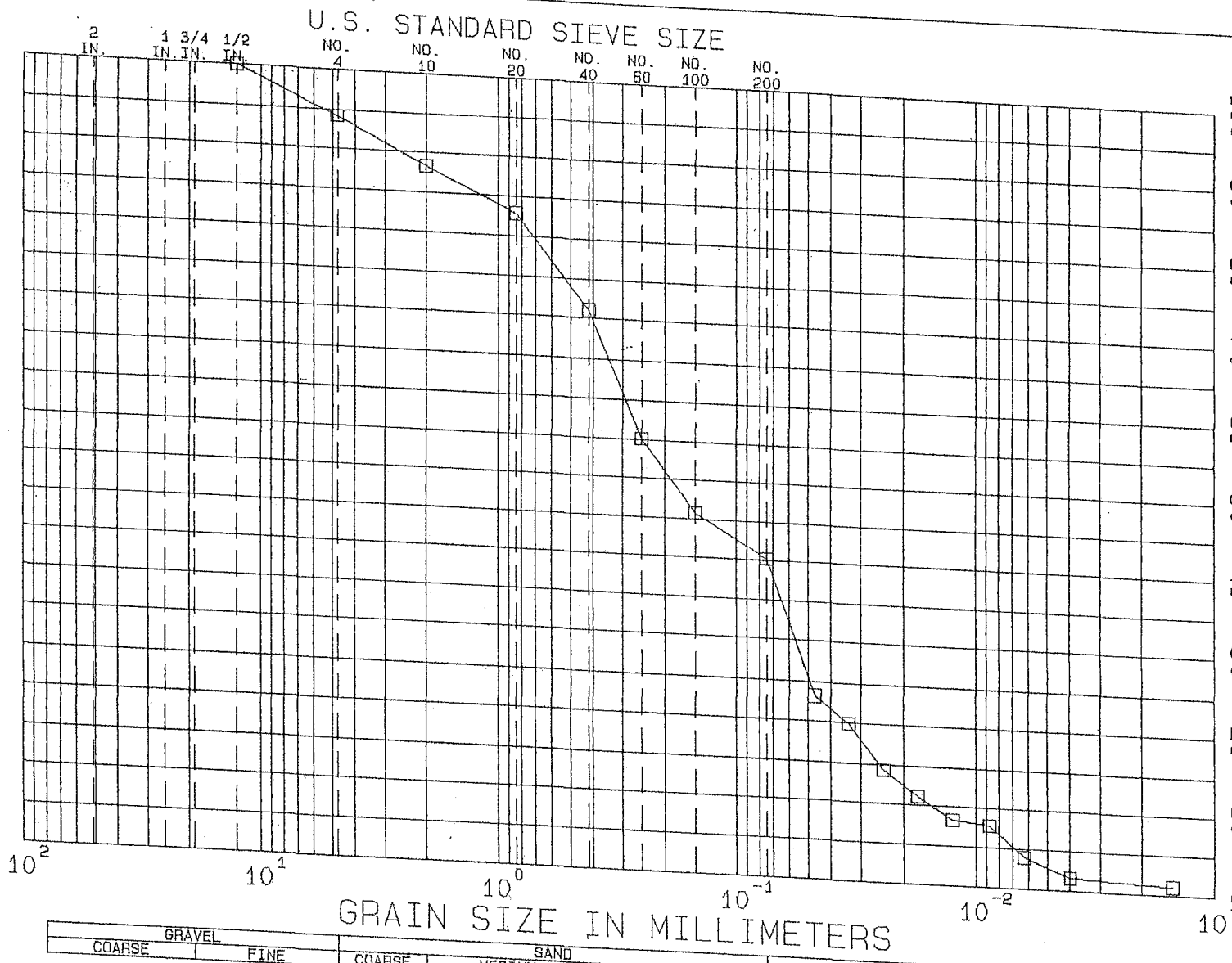
BORING NO.	NBH-1	TEST SERIES	
SAMPLE	S6&S7	NO.	2
DEPTH	27-34'	DATE	SEPT. 01
TECH.	mst		
REVIEWER	MCM	FILE	L16928



NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO.	NBH-1	TEST SERIES	
SAMPLE	S8	NO.	3
DEPTH	34-36'	DATE	SEPT. 01
TECH.	mst		
REVIEWER	MCM	FILE	L16928



TEST NO.	MATERIAL SOURCE	REMARKS
S4.1	BORING NO. NBH-1 S.N.S10, D=43.5-45.5'	Grey Silty sand (SM)

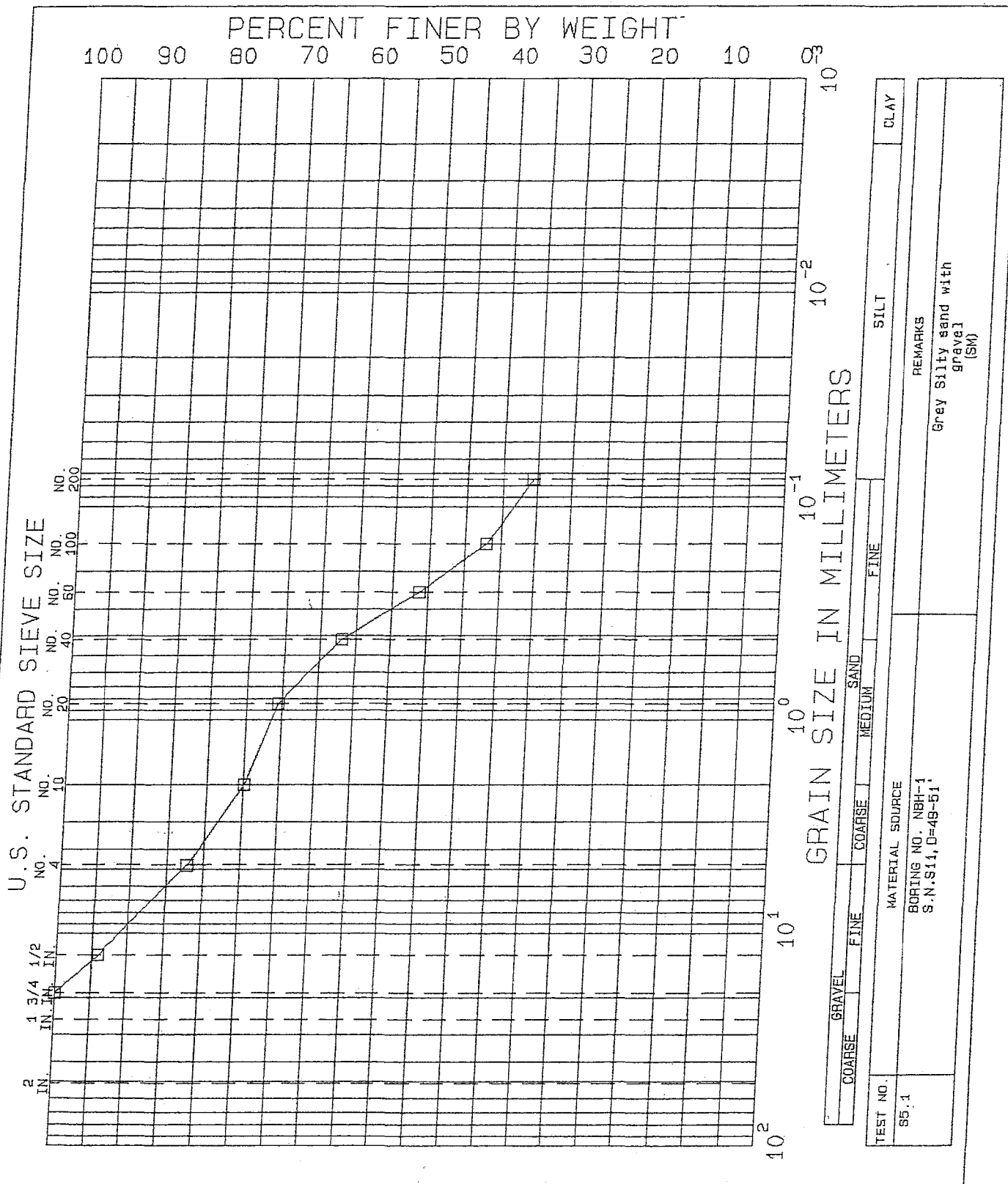
NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-1
SAMPLE S10
DEPTH 43.5-45.5'
TECH. mst
REVIEWER MCM

TEST SERIES NO. 4
DATE SEPT. 01
FILE L16928

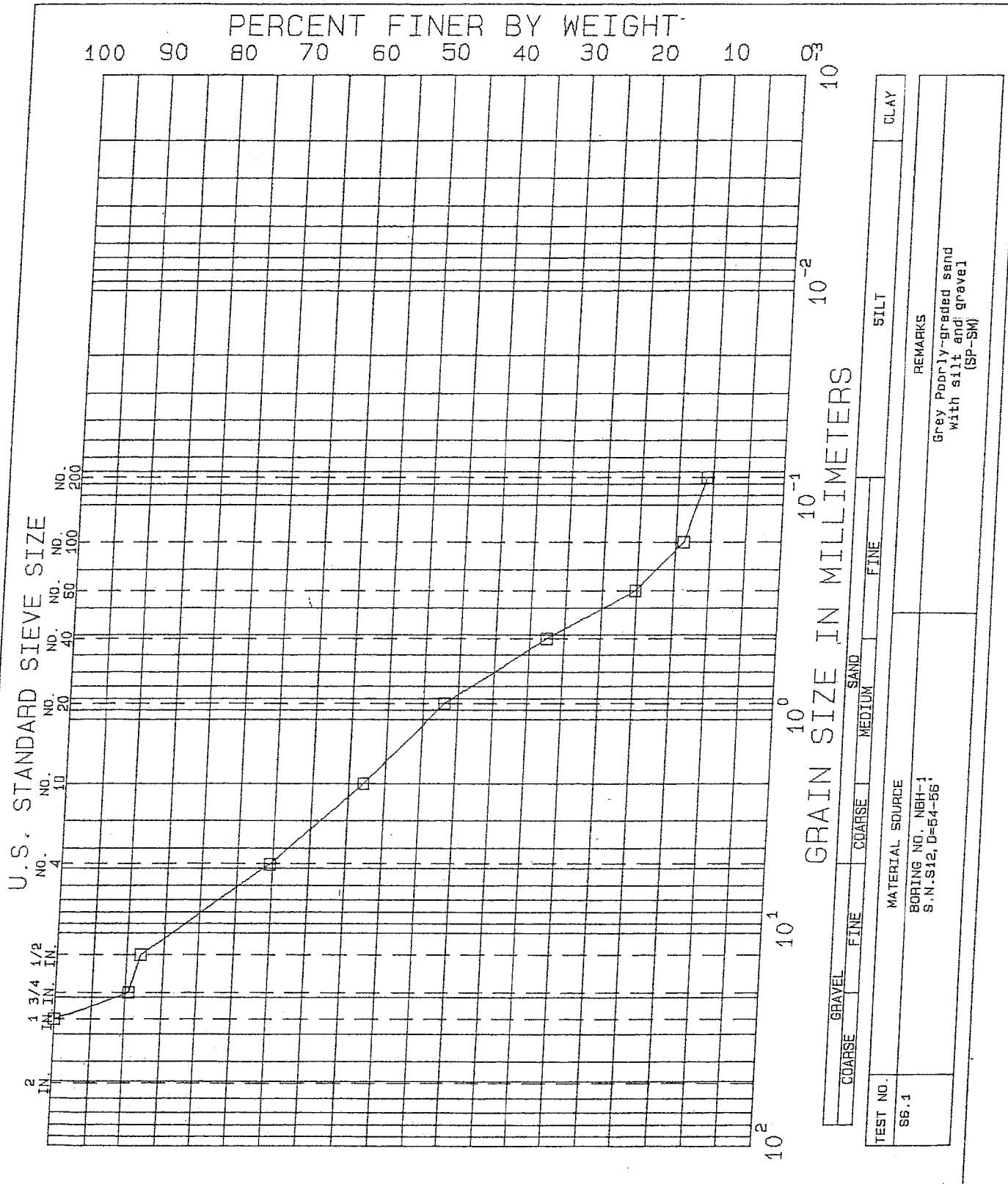
GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS



NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

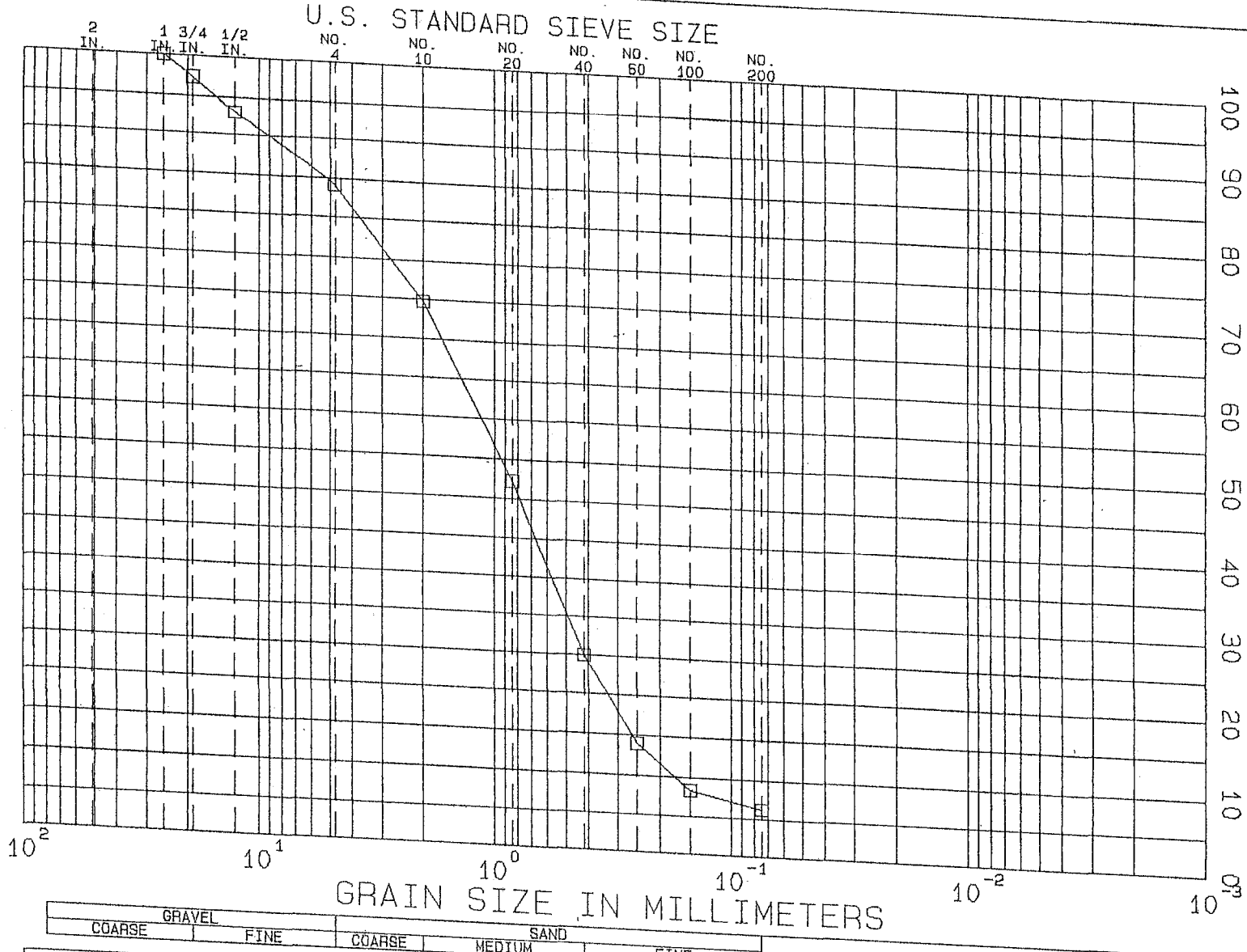
BORING NO.	NBH-1	TEST SERIES	
SAMPLE	S11	NO.	5
DEPTH	49-51'	DATE	SEPT. 01
TECH.	mst		
REVIEWER	MCM	FILE	L16928



NEW BEDFORD HARBOR FEASIBILITY
STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO.	NBH-1	TEST SERIES	
SAMPLE	S12	NO.	6
DEPTH	54-56'	DATE	SEPT. 01
TECH.	mst		
REVIEWER	MCM	FILE	L16928



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

TEST NO.	MATERIAL SOURCE	REMARKS
S7.1	BORING NO. NBH-1 S.N.S13-S15, D=59-73'	Brown Poorly-graded sand with silt and gravel (SP-SM)

NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

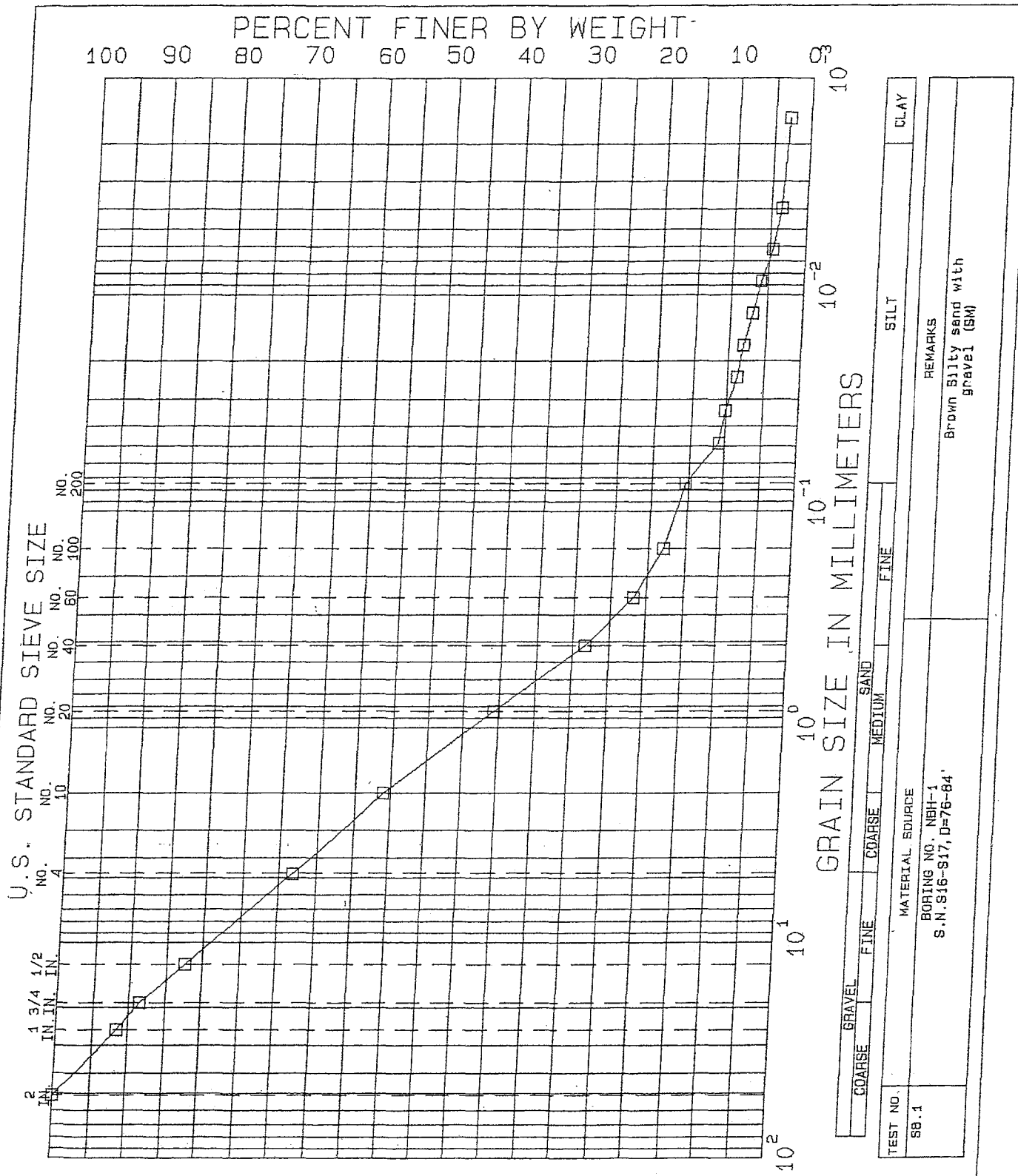
GRADATION TESTS

BORING NO. NBH-1
SAMPLE S13-15
DEPTH 59-73'
TECH. mst
REVIEWER MCM

TEST SERIES NO. 7
DATE SEPT. 01

FILE L16928

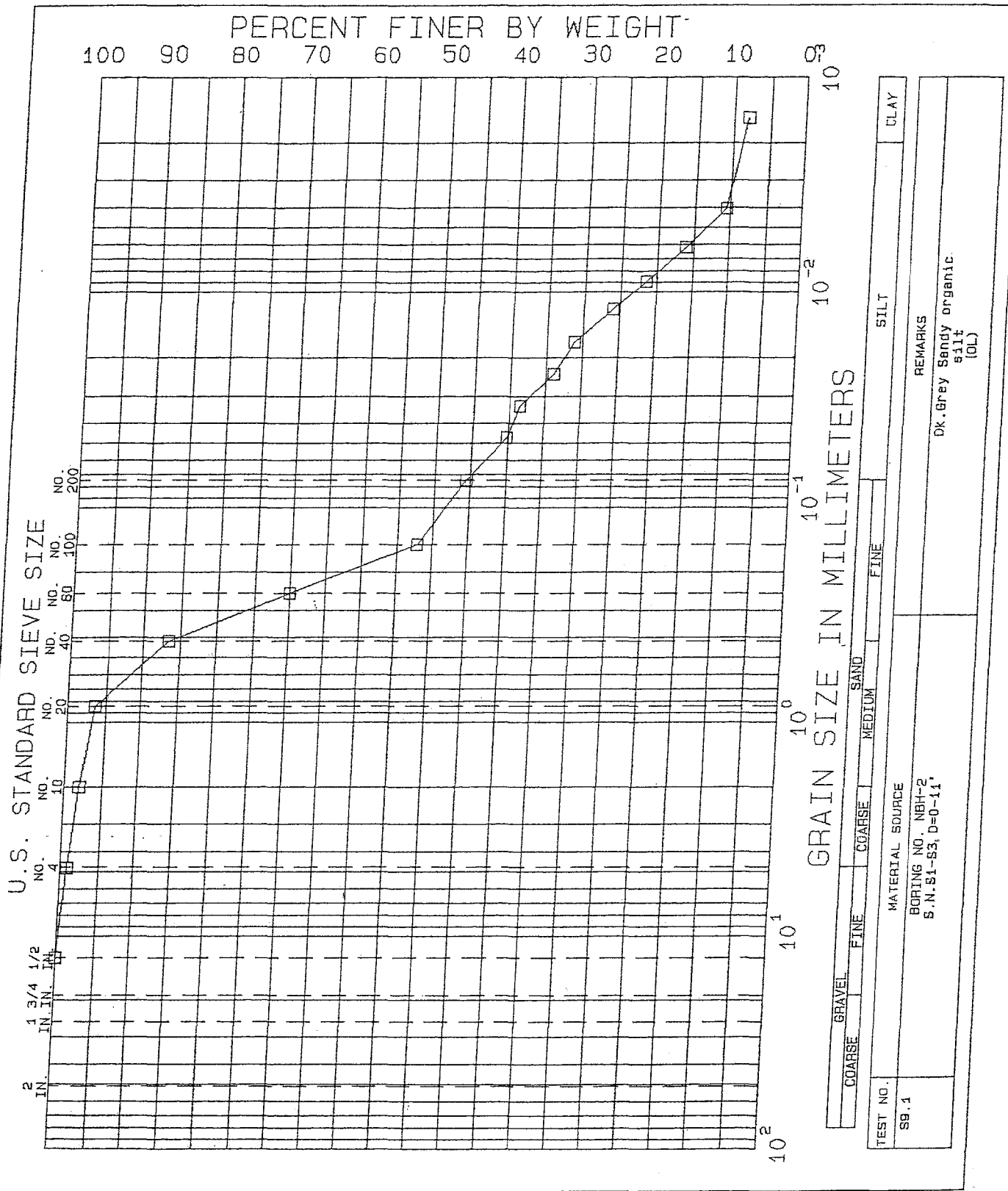
GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS



NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

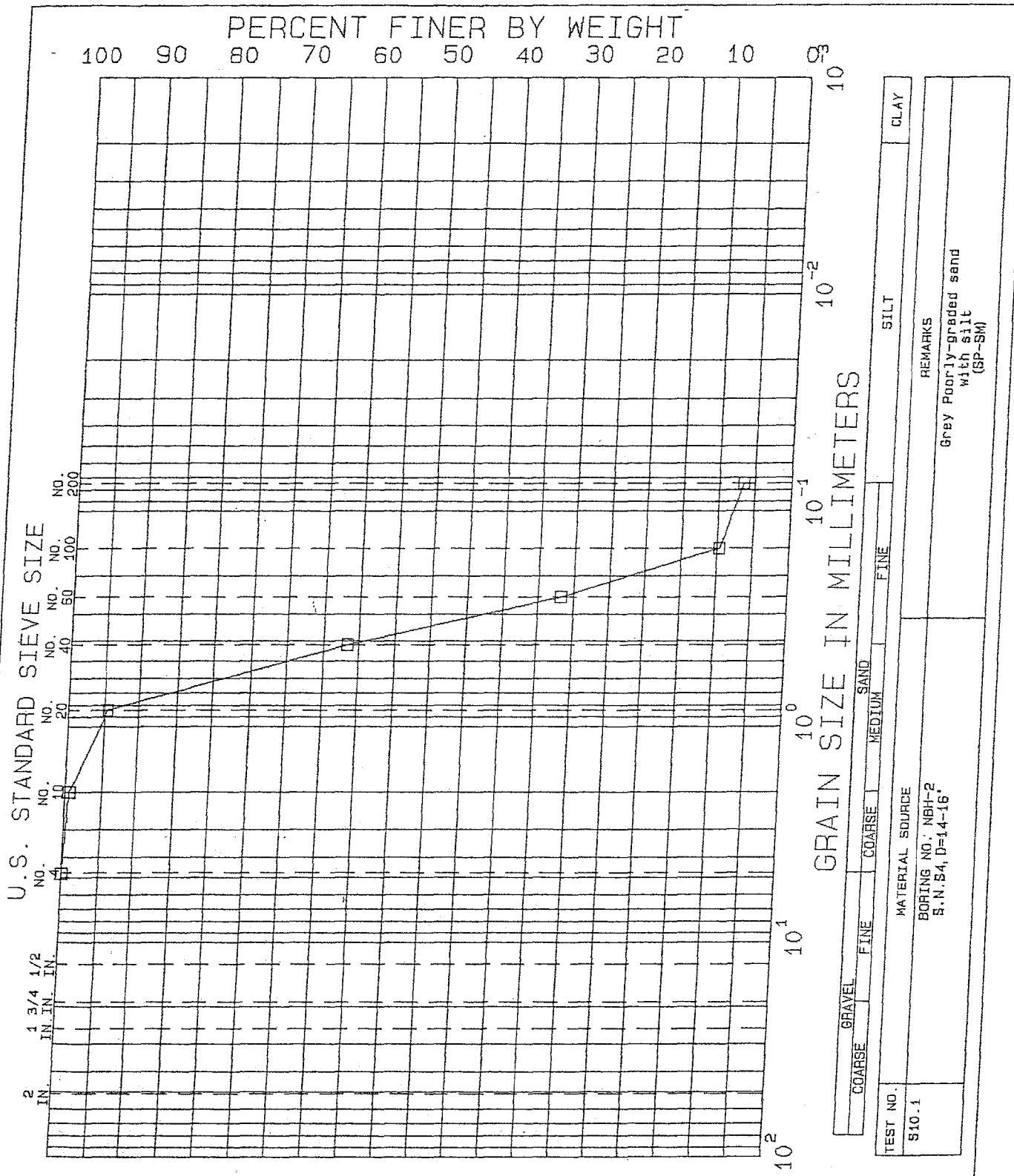
BORING NO.	NBH-1	TEST SERIES	
SAMPLE	S16&17	NO.	8
DEPTH	76-84'	DATE	SEPT. 01
TECH.	mst		
REVIEWER	MCM	FILE	L16928



NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

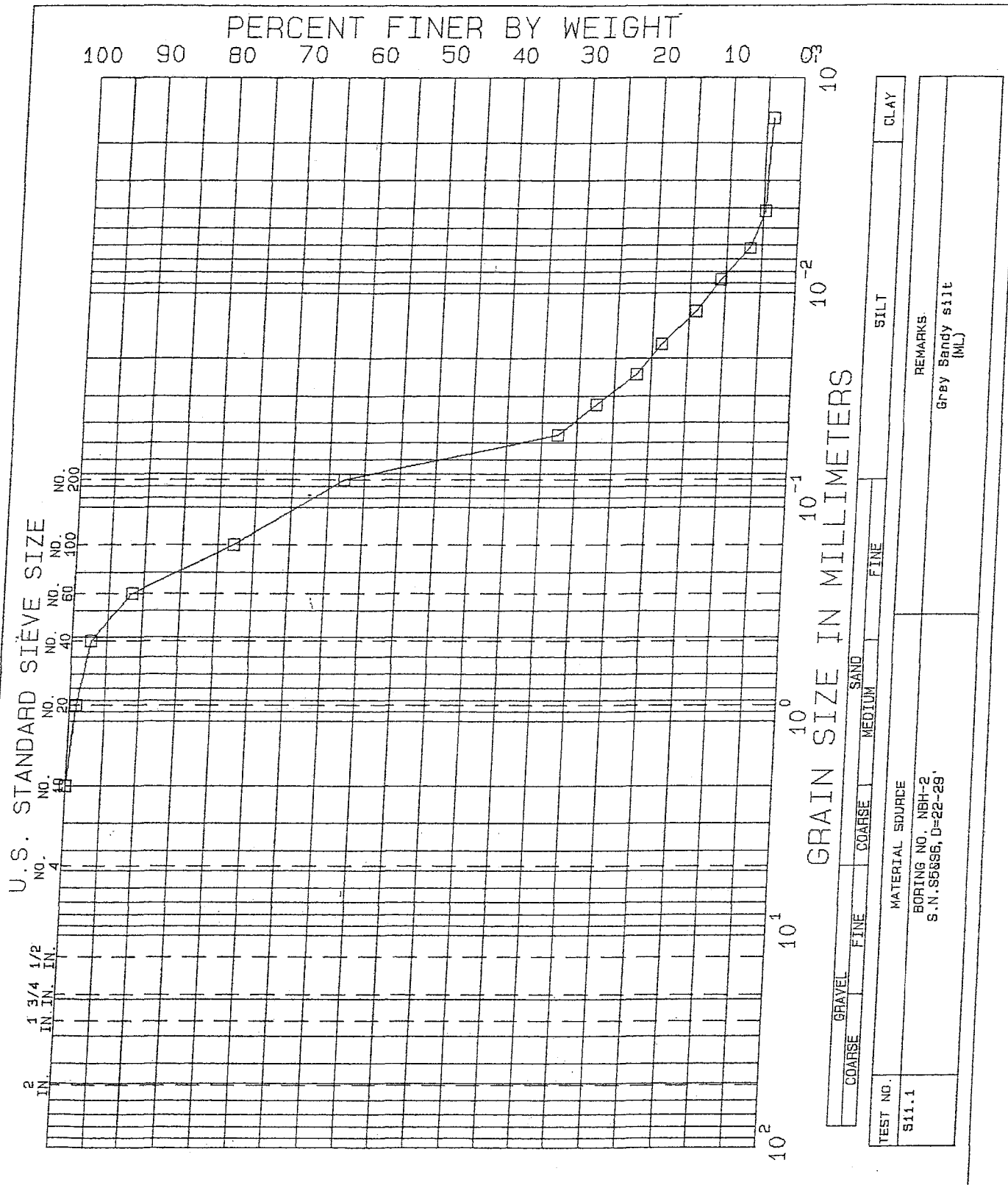
BORING NO.	NBH-2	TEST SERIES	
SAMPLE	S1-S3	NO.	9
DEPTH	0-11'	DATE	SEPT. 01
TECH.	mst		
REVIEWER	MCM	FILE	L16928



NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

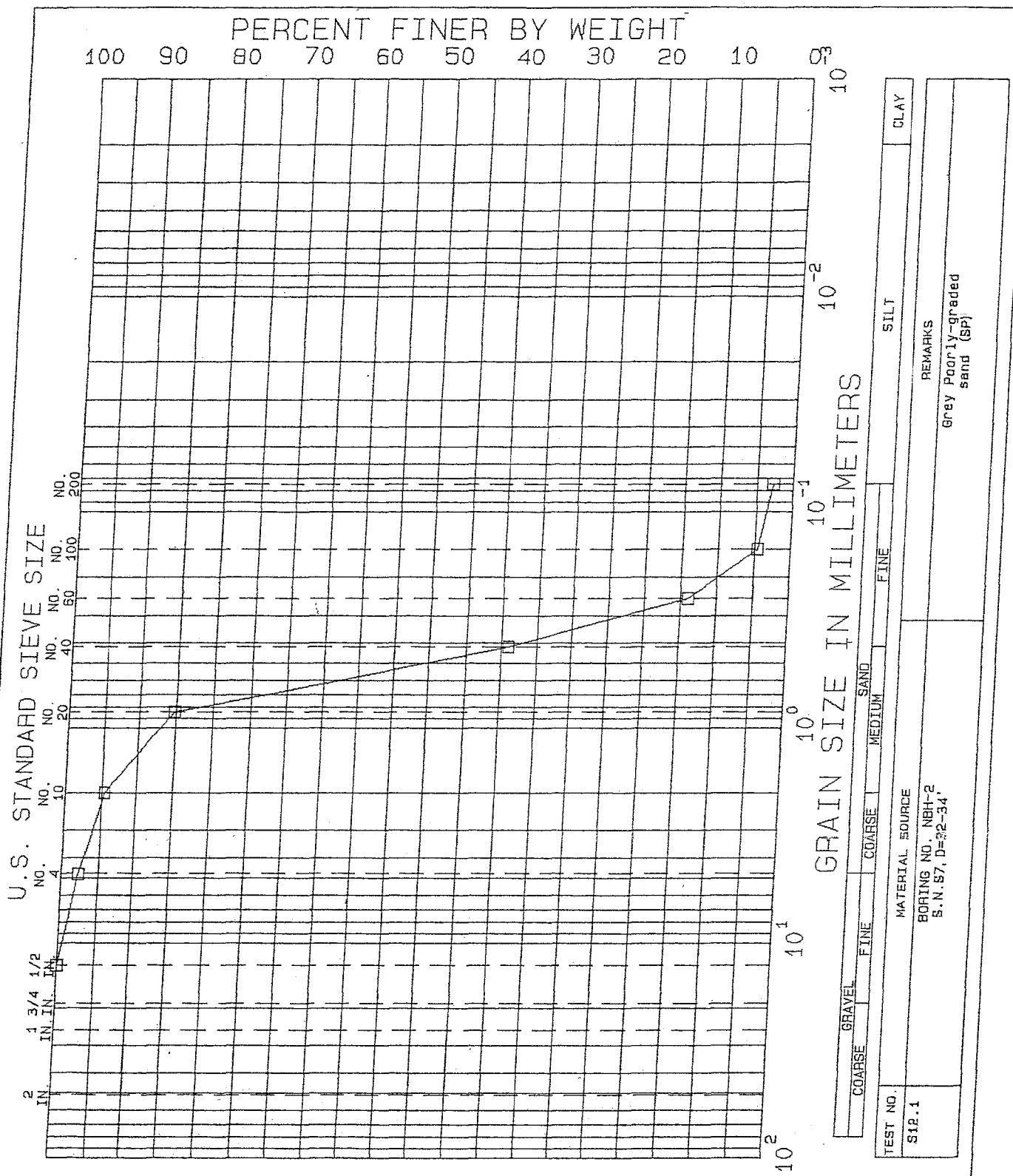
BORING NO.	NBH-2	TEST SERIES	
SAMPLE	S4	NO.	10
DEPTH	14-16'	DATE	SEPT. 01
TECH.	mst		
REVIEWER	MCM	FILE	L16928



NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

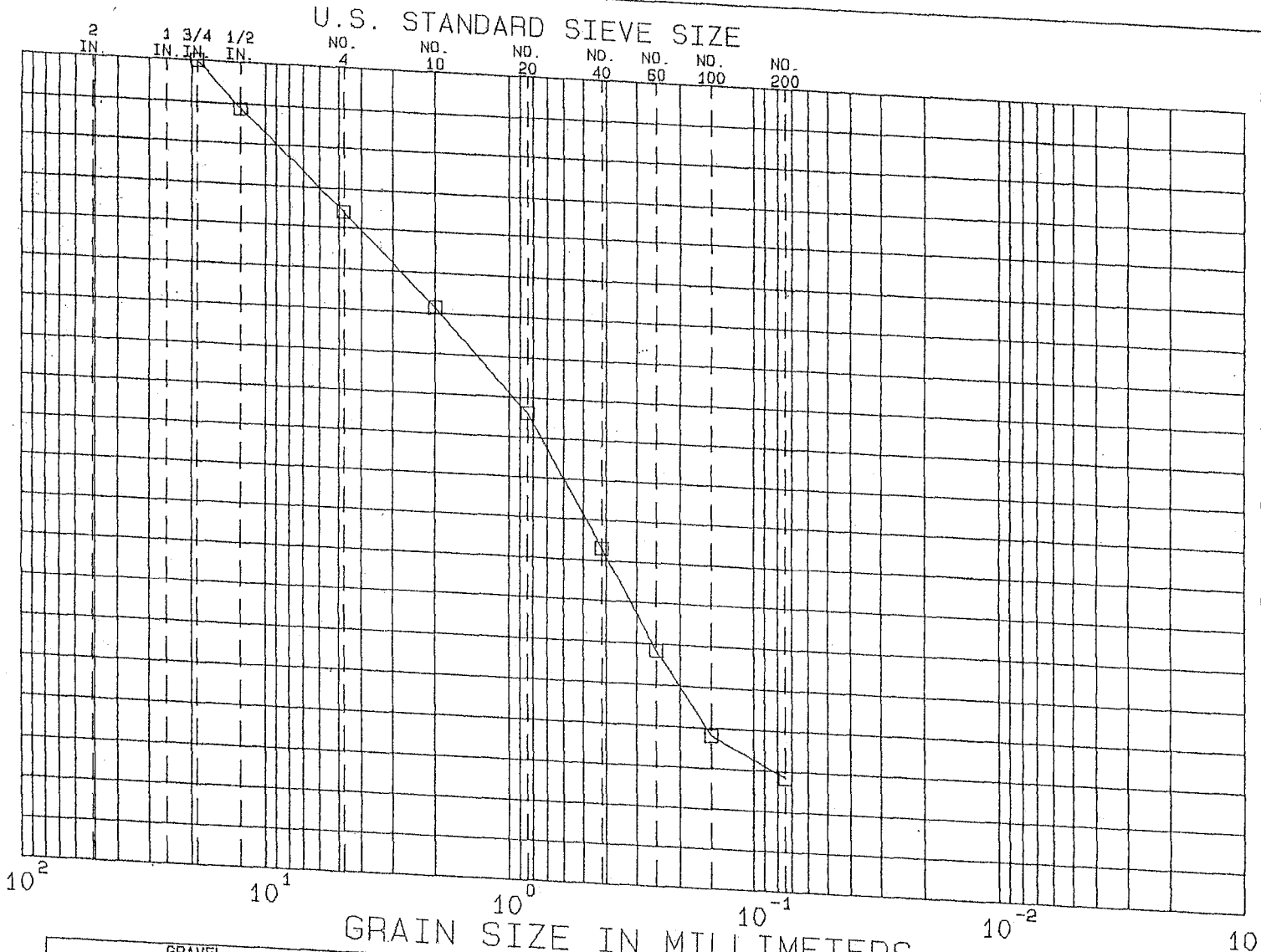
BORING NO.	NBH-2	TEST SERIES	
SAMPLE	S5&S6	NO.	11
DEPTH	22-29'	DATE	SEPT. 01
TECH.	mst		
REVIEWER	MCM	FILE	L16928



NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO.	NBH-2	TEST SERIES	
SAMPLE	S7	NO.	12
DEPTH	32-34'	DATE	SEPT. 01
TECH.	mst		
REVIEWER	MCM	FILE	L16928



TEST NO.	MATERIAL SOURCE	REMARKS
S12.1	BORING NO. NBH-2 S.N.S8, D=38-40'	Grey Silty sand with gravel (SM)

NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-2
SAMPLE S8
DEPTH 38-40'
TECH. mst
REVIEWER MCM

TEST SERIES NO. 13
DATE SEPT. 01

FILE L16928

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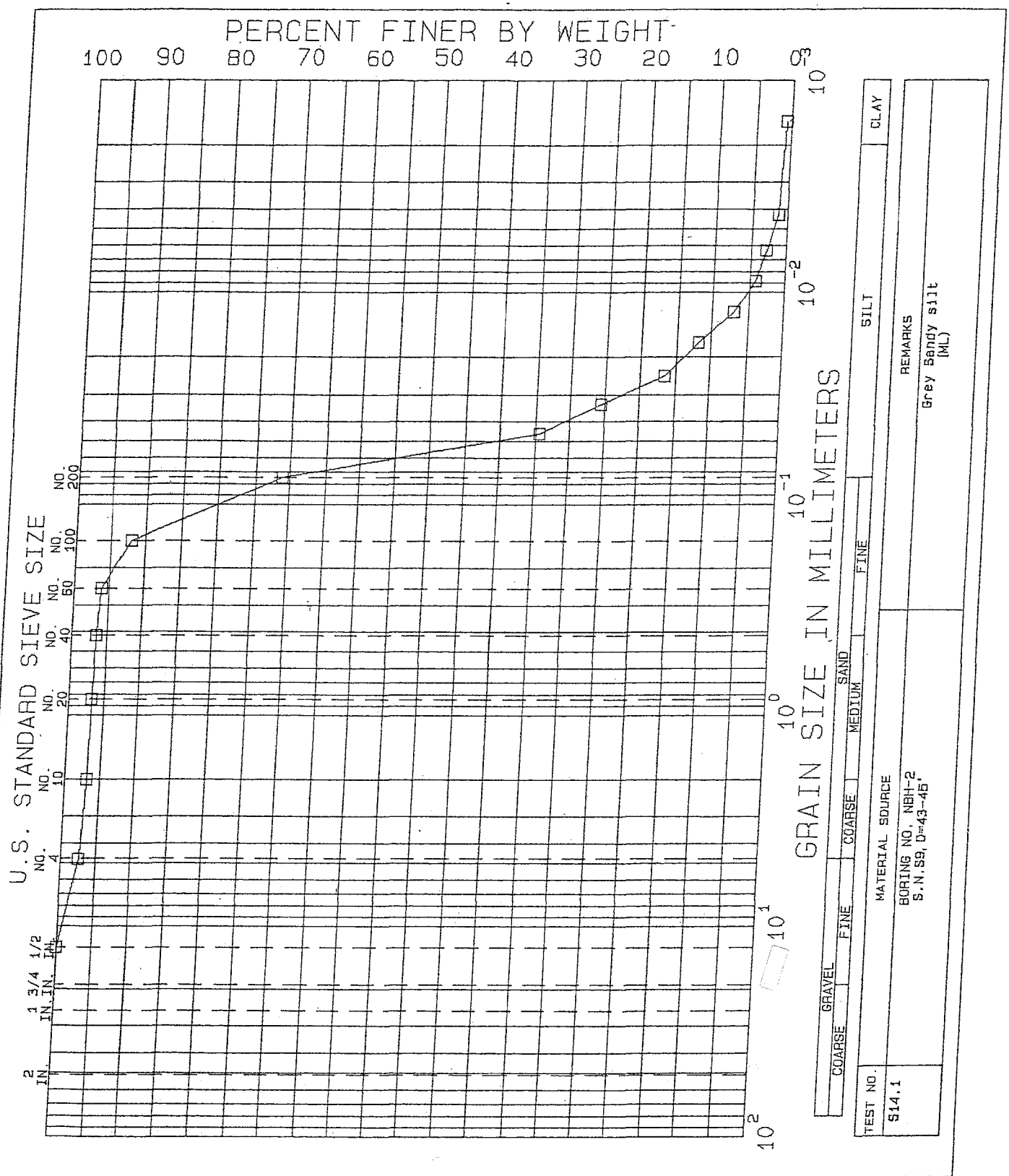
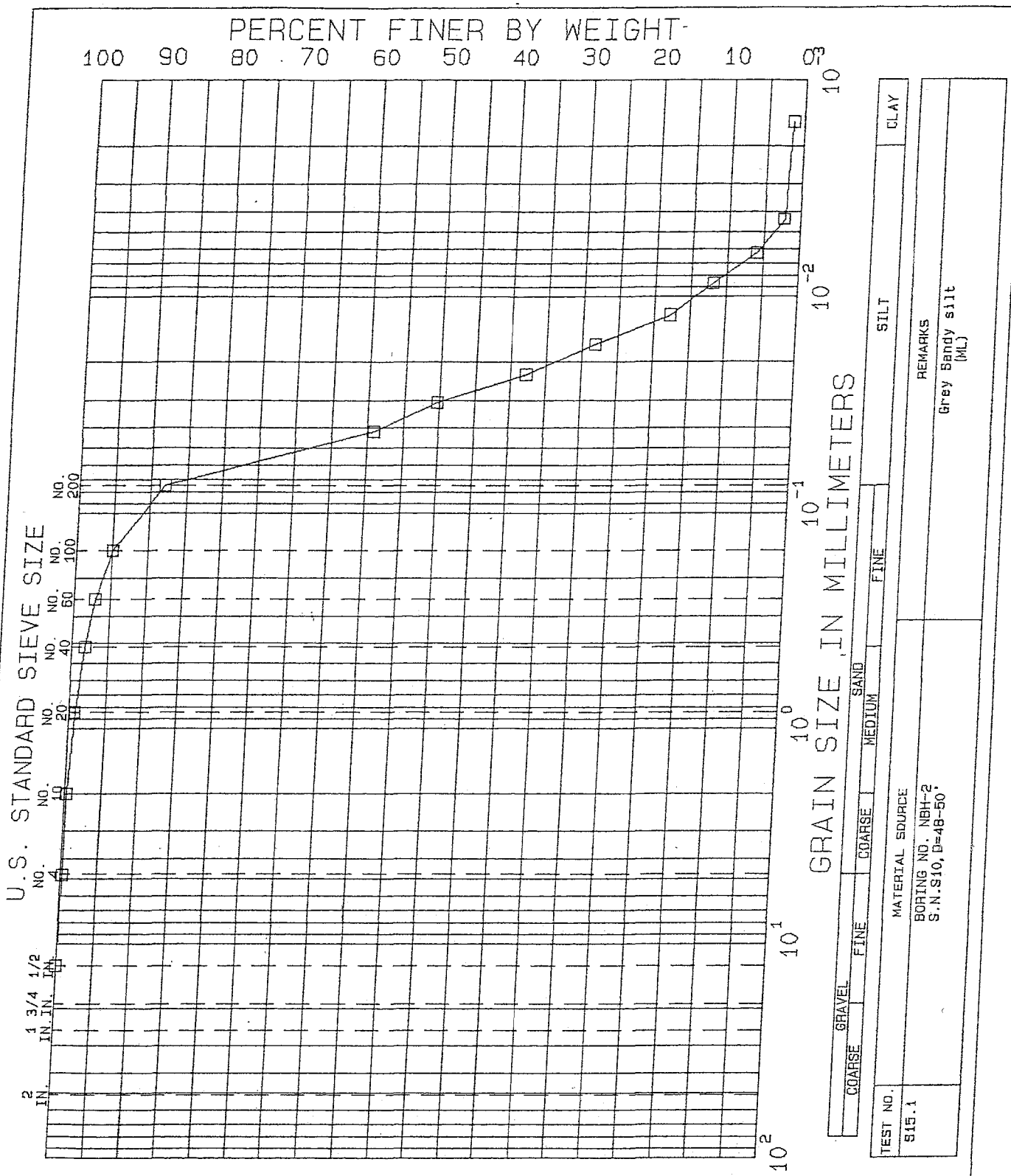


NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO.	NBH-2	TEST SERIES	
SAMPLE	S9	NO.	14
DEPTH	43-45'	DATE	SEPT. 01
TECH.	mst		
REVIEWER	MCM	FILE	L16928

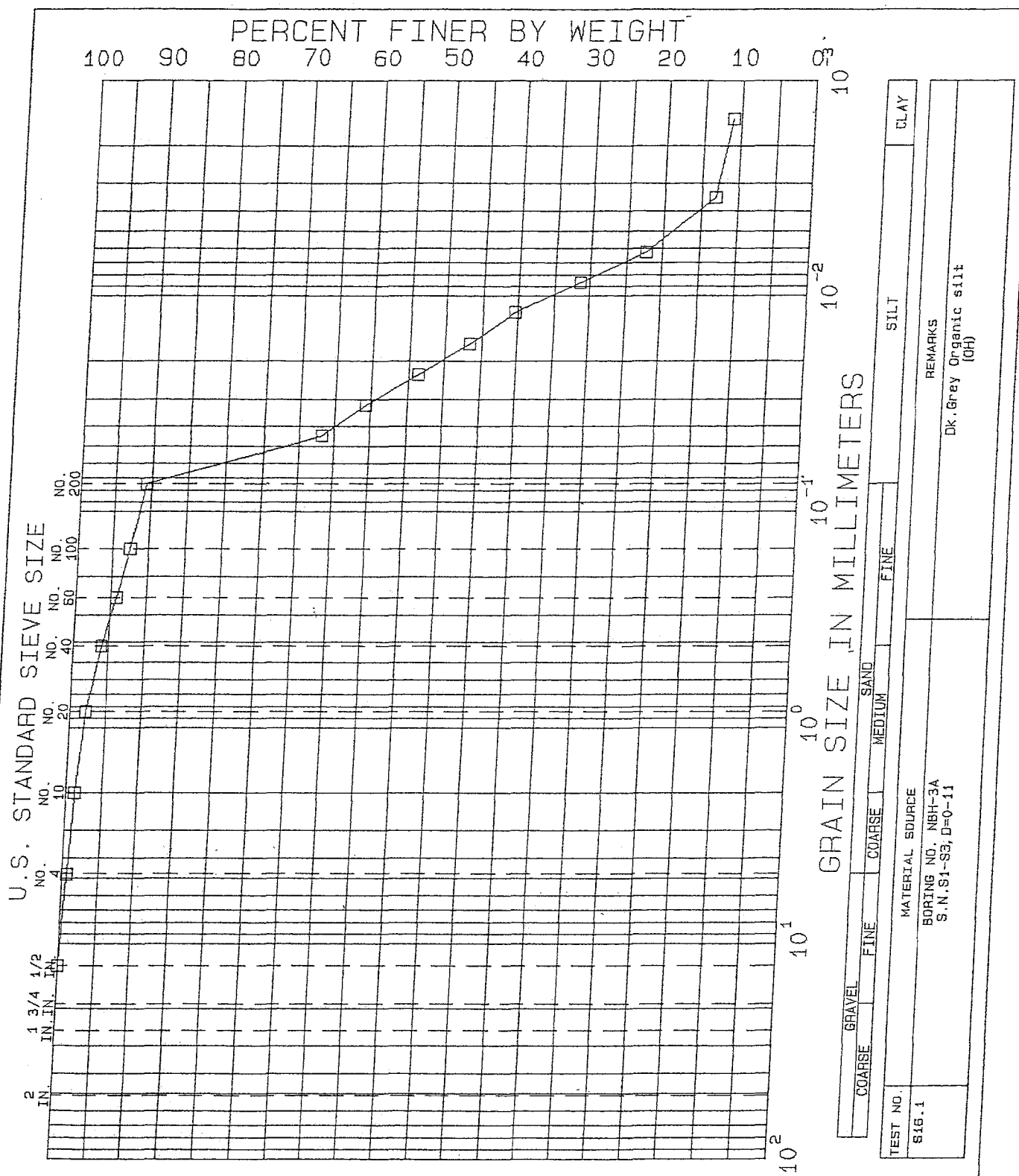
GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS



NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

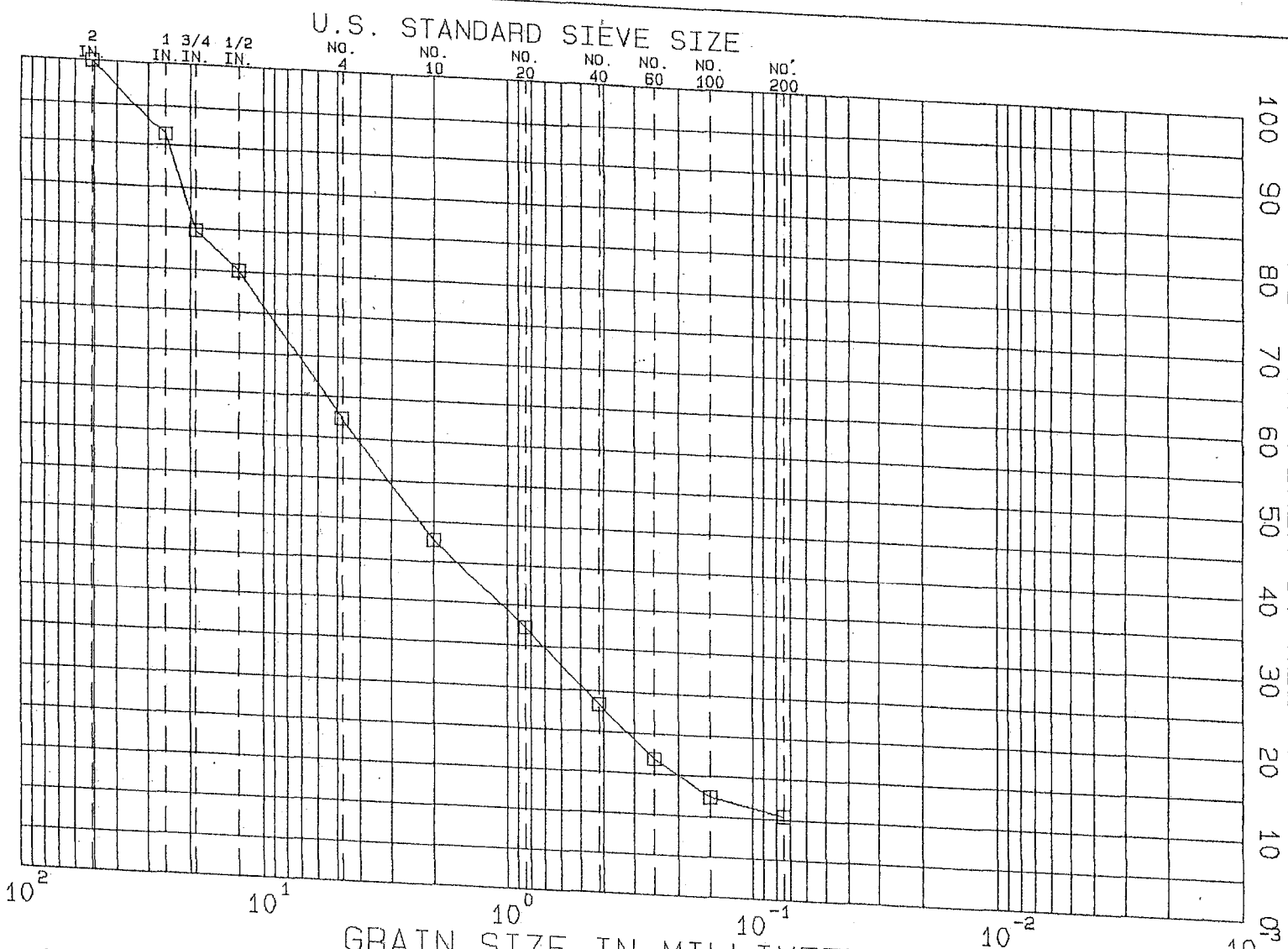
BORING NO.	NBH-2	TEST SERIES	
SAMPLE	S10	NO.	15
DEPTH	48-50'	DATE	SEPT. 01
TECH.	mst		
REVIEWER	MCM	FILE	L16928



NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO.	NBH-3A	TEST SERIES	
SAMPLE	S1-S3	NO.	16
DEPTH	0-11'	DATE	SEPT. 01
TECH.	mst		
REVIEWER	MCM	FILE	L16928



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

TEST NO.	MATERIAL SOURCE	REMARKS
S17.1	BORING NO. NBH-3A S.N.S4-S5, D=16.5-23.5	Grey-Brown Well-graded sand with silt and gravel (SW-SM)

NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

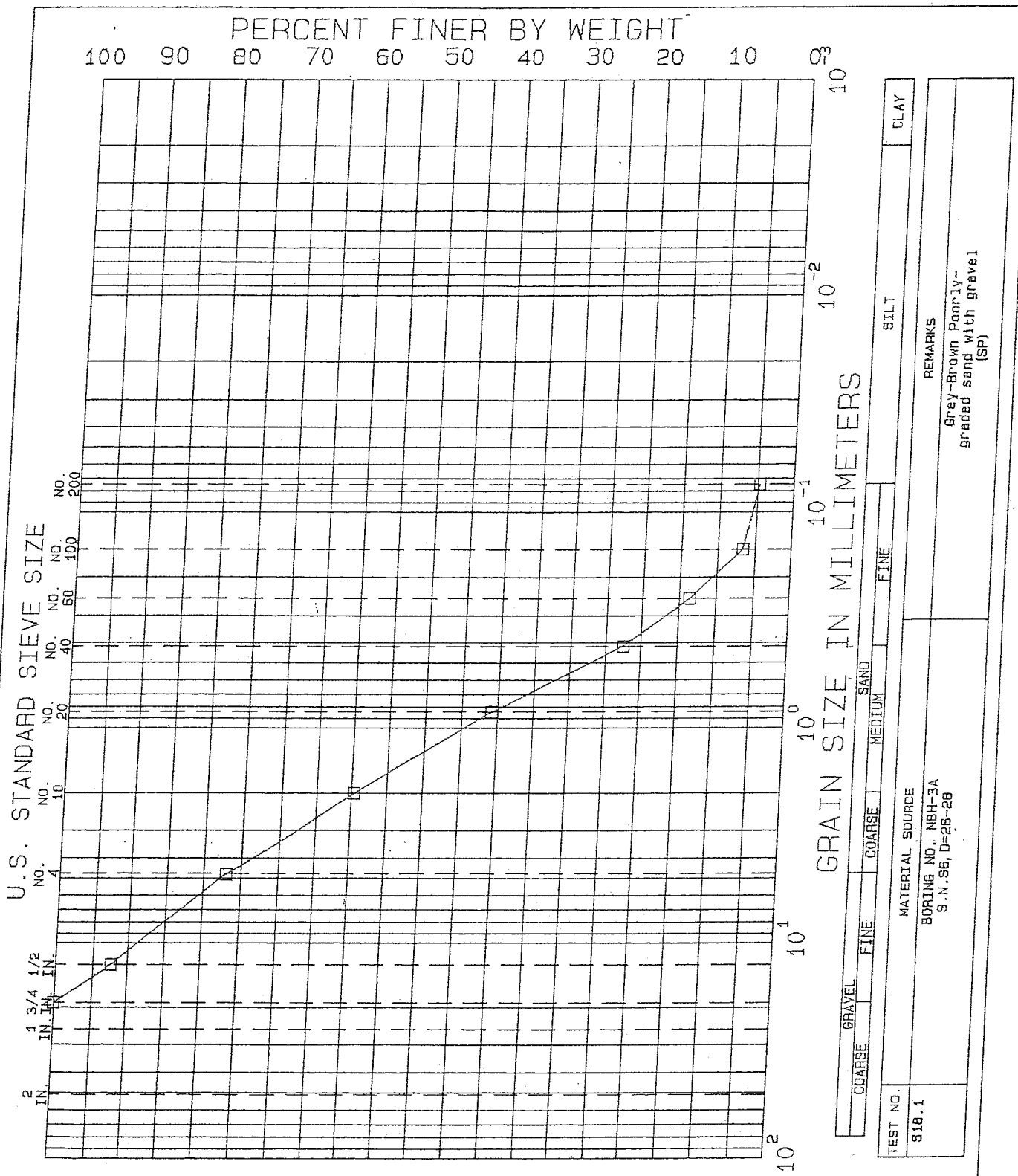
GRADATION TESTS

BORING NO. NBH-3A
SAMPLE S4-S5
DEPTH 16.5-23.5'
TECH. mst
REVIEWER MCM

TEST SERIES NO. 17
DATE SEPT. 01

FILE L16928

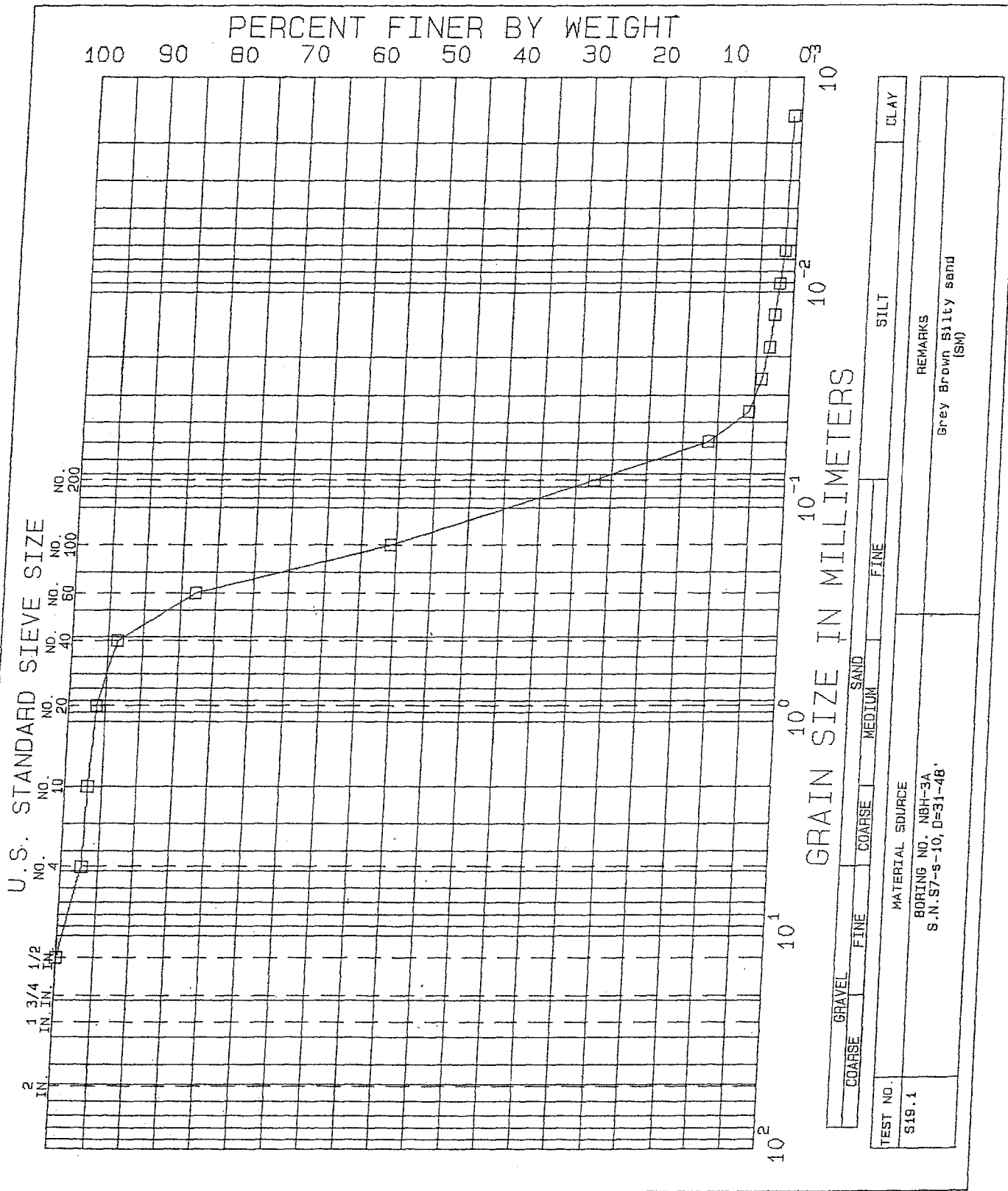
GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS



NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

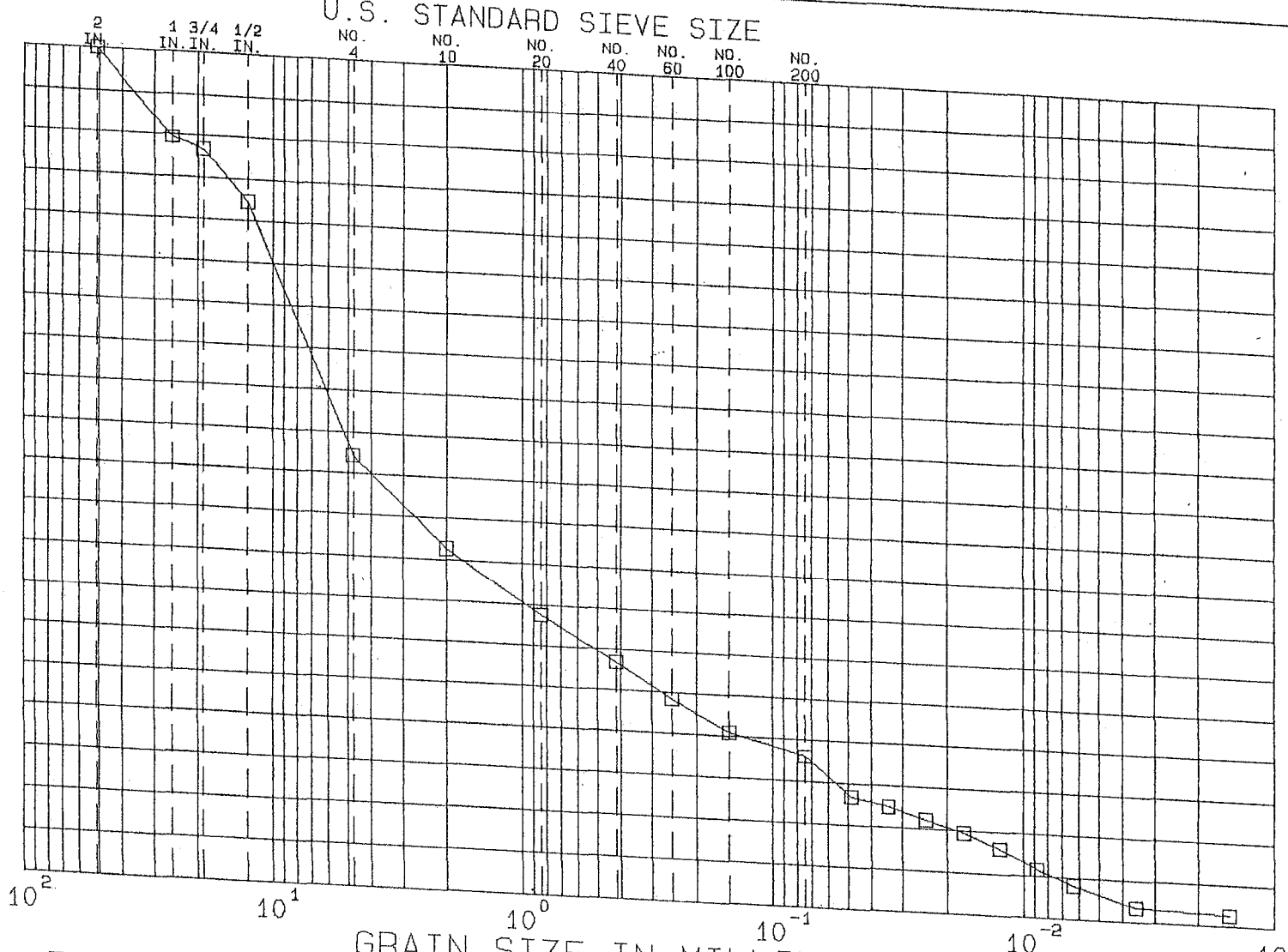
BORING NO.	NBH-3A	TEST SERIES	
SAMPLE	S6	NO.	18
DEPTH	26-28'	DATE	SEPT. 01
TECH.	mst		
REVIEWER	MCM	FILE	L16928



NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO.	NBH-3A	TEST SERIES	
SAMPLE	S7-S10	NO.	19
DEPTH	31-48'	DATE	SEPT. 01
TECH.	mst		
REVIEWER	MCM	FILE	L16928



TEST NO.	MATERIAL SOURCE	REMARKS
S20.1	BORING NO. NBH-3A S.N.S11&S12, D=50-56'	Grey-Brown Silty, clayey gravel with sand (GC-GM)

NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-3A
SAMPLE S11,12
DEPTH 50-56'
TECH. mst
REVIEWER MCM

TEST SERIES NO. 20
DATE SEPT. 01
FILE L16928

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS

LABORATORY TESTING DATA SHEET

Project Name: NEW BEDFORD HARBOR
NEW BEDFORD, MASS.
Project No.: L17571 — Assigned By: D. NACCI — Reviewed By:
Project Engineer: D. SCHULZE — Date: DEC.02 — Date Reviewed:

Boring/ Test Pit No.	Sample No.	Depth ft.	Lab No.	Identification Tests: Water Content %	LL %	PL %	Sieve -200 %	Hyd -2μ %	ORG. %	G_s	Dry unit wt. pcf	Density: γ_d MAX (pcf) / W_{opt} (%)	Permeability cm/sec	Strength Tests: Torvane or Type Test	$\bar{\sigma}_c$ psf	Failure Criteria	$\sigma_1 - \sigma_3$ or τ psf	Strain %	Consol: $\frac{G_s}{1+e_0}$	Laboratory Log and Soil Description
NBH-8	UP-1	5-7	21		Average Total Unit Weight (5.0-6.8') = 127.7 Pcf															
		5.1		20.4																Brown fine SAND, little (-) Silt
		5.1-5.6		21.5							105.3									
		5.6		17.3																
		5.6-5.9		18.4	non-plastic		11	<1	0.4											
		5.9-6.4		21.1							105.9									
		6.4		20.1																

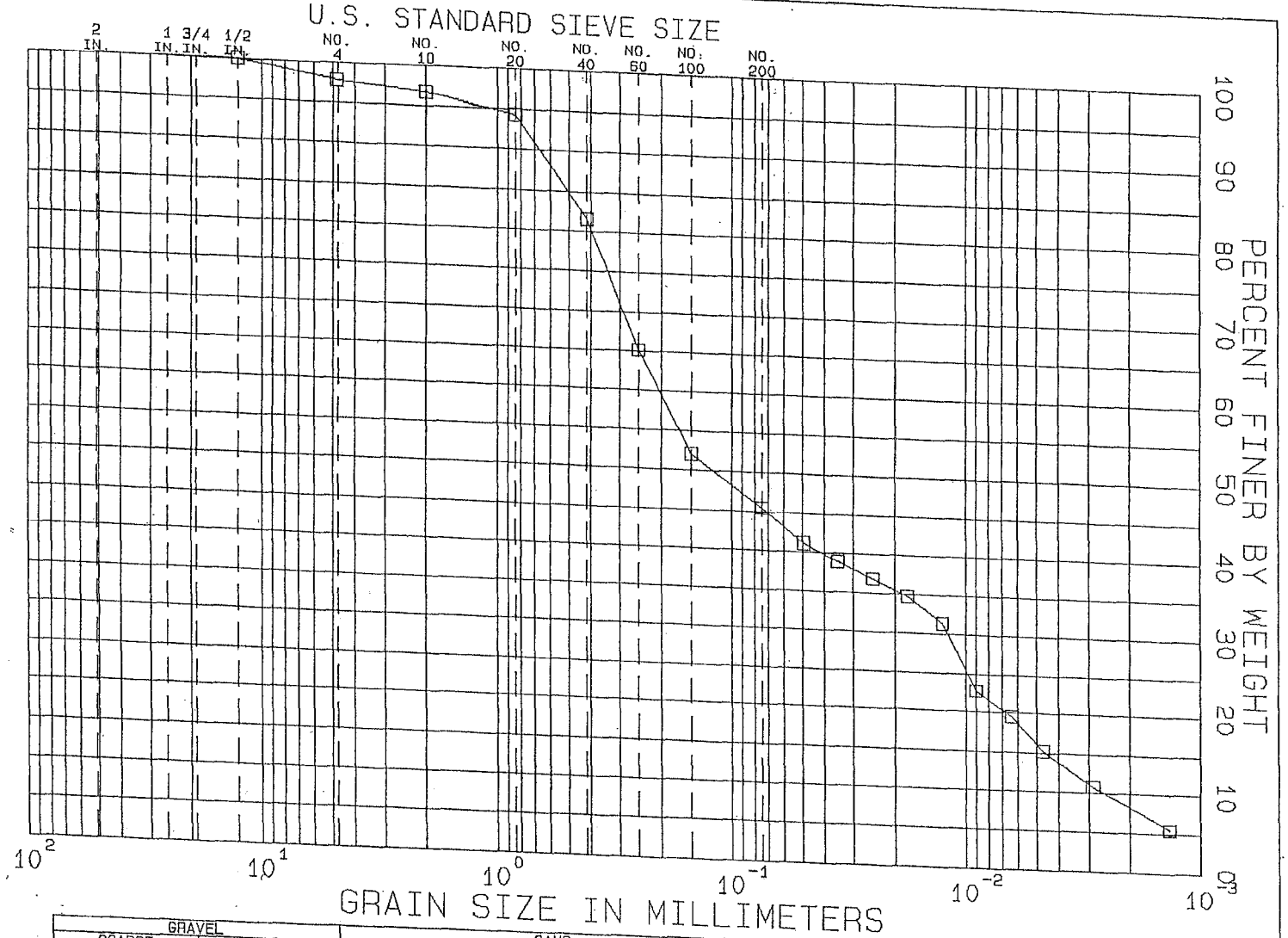
GZA GeoEnvironmental, Inc.
Q:\NEWTON\LAB\LABFORM7.XLS

labform1.xls

LABORATORY TESTING DATA SHEET

Project Name: NEW BEDFORD HARBOR
NEW BEDFORD, MA.
Project No.: L17571
Project Engineer: D. SCHULZE
Assigned By: D. NACCI
Date: DEC.02
Reviewed By:
Date Reviewed:

Boring/ Test Pit No.	Sample No.	Depth ft.	Lab No.	Identification Tests: Water Content %	LL %	PL %	Sieve -200 %	Hyd -2μ %	ORG %	G_s	Dry unit wt. pcf	Density: γ_d MAX (pcf) / W_{opt} (%)	Permeability cm/sec	Strength Tests: Torvane or Type Test	$\bar{\sigma}_c$ psf	Failure Criteria	$\sigma_1 - \sigma_3$ or τ psf	Strain %	Consol.: $\frac{G_s}{1+e_0}$	Laboratory Log and Soil Description
NBH-8	S-1	0-2	1	47.5	38	19	46	8	2.6											Grey f-m SAND and Organic SILT
	S-2	7-9	2				11													Brown f-c SAND, little (+) Gravel, little (-) Silt
	S-3-S-6	10-27	3				6													Brown f-c GRAVEL and m-c SAND trace Silt
	S-8 S-9	41.5-49.5	4				3													Grey-Brown f-c SAND, little (-) Gravel, trace Silt
	S-10	52.5-54.5	5				3													Brown fine SAND, trace Silt
	S-11 S-12	57.5-64.5	6				4													Grey-f-c SAND and f-c GRAVEL, trace Silt
	S-14	75.5-77.5	7				6													Grey f-m SAND, little Gravel, trace Silt
	S-15 S-16	80.5-87.5	8				9													Grey-Brown f-c SAND, little (-) Gravel, trace (+) Silt
NBH-9	S-1	0-2	9	114	100	47	86	14	10.4											Grey Organic SILT, little Sand
	S-2	12-14	10				11	1												Brown f-c GRAVEL and f-m SAND, little (-) Silt
	S-3	18-20	11				15	1												Brown f-m SAND and f-c GRAVEL, little Silt



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

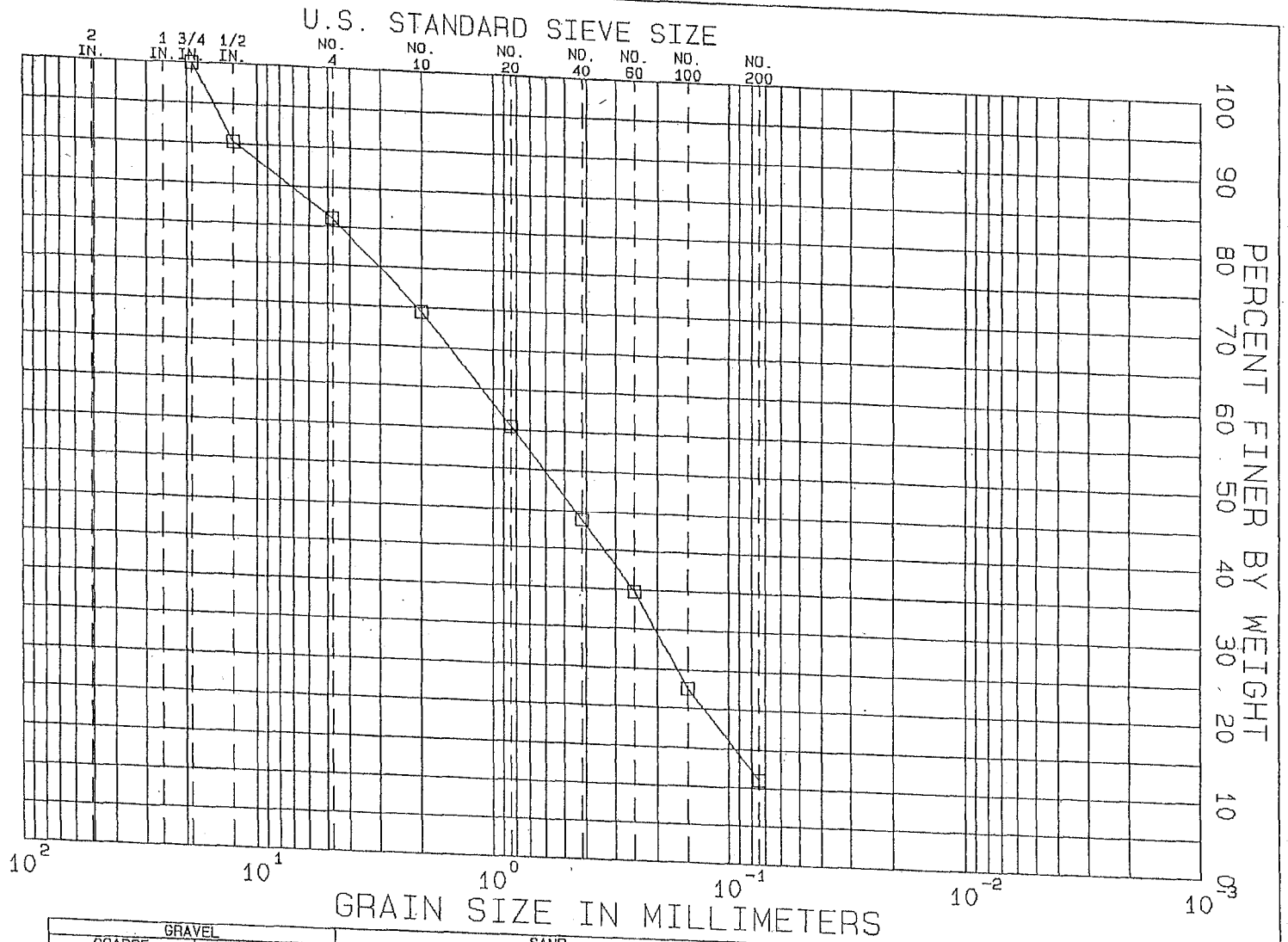
TEST NO.	MATERIAL SOURCE	REMARKS
S1.1	BORING NO. NBH-8 SAM.NO.S1, D=0-2'	Grey f-m SAND and Organic SILT

NEW BEDFORD HARBOR
NEW BEDFORD, MA.
GRADATION TESTS

BORING NO. NBH-8
SAMPLE S-1
DEPTH 0-2'
TECH. MST
REVIEWER MCM

TEST SERIES NO. 1
DATE Jan.03
FILE L17571

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

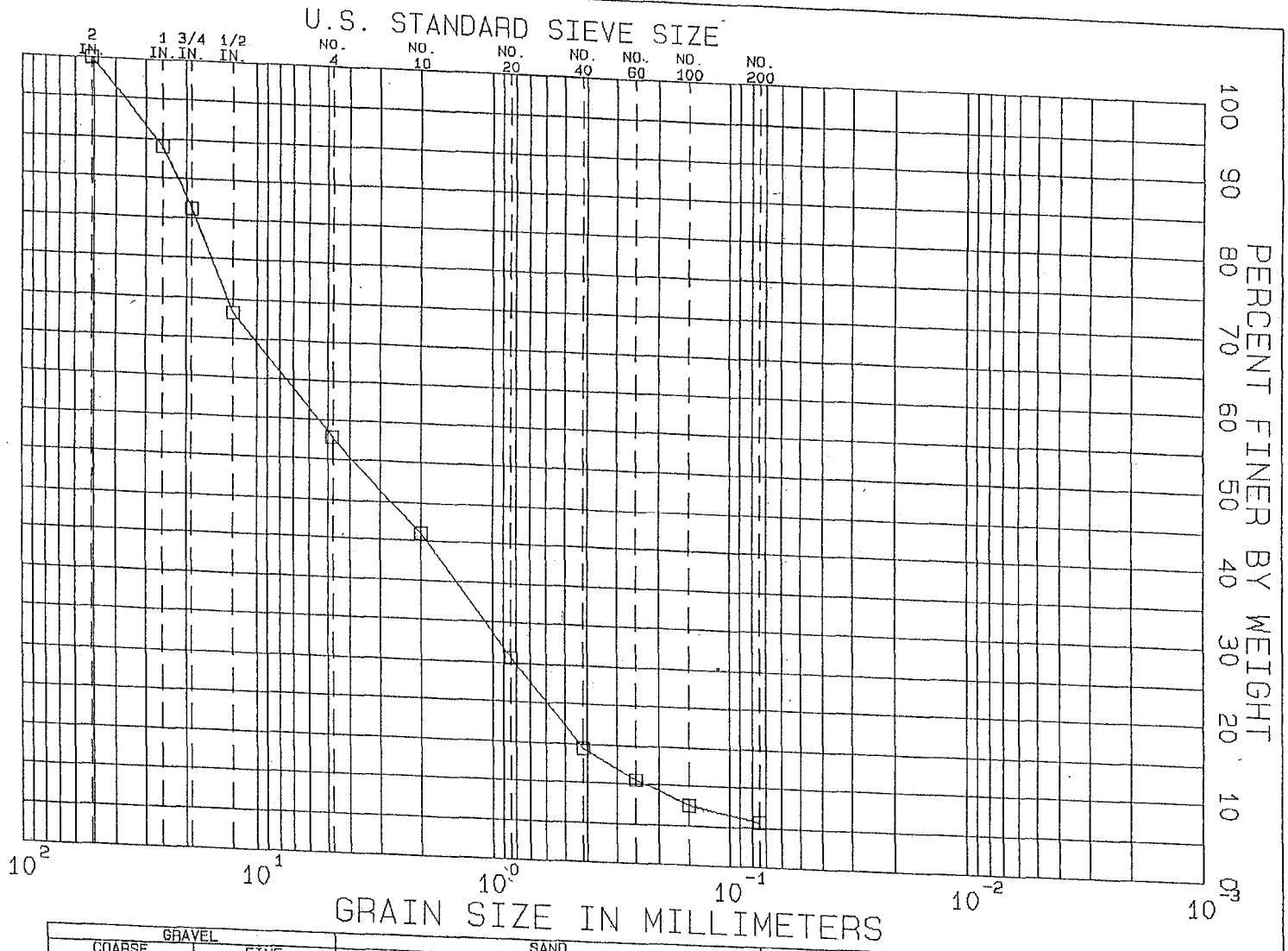
TEST NO.	MATERIAL SOURCE	REMARKS
S2.1	BORING NO. NBH-8 SAM.NO.S2, D=7-9'	Brown f-c SAND, little (+) Gravel, little (-) Silt

NEW BEDFORD HARBOR
NEW BEDFORD, MA.
GRADATION TESTS

BORING NO. NBH-8
SAMPLE S-2
DEPTH 7-9'
TECH. MST
REVIEWER MCM

TEST SERIES NO. 2
DATE Jan.03
FILE L17571

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS



TEST NO.	MATERIAL SOURCE	REMARKS
S3.1	BORING NO. NBH-8 S.NO.S3-S6, D=10-27'	Brown f-c GRAVEL and m-c SAND, trace Silt

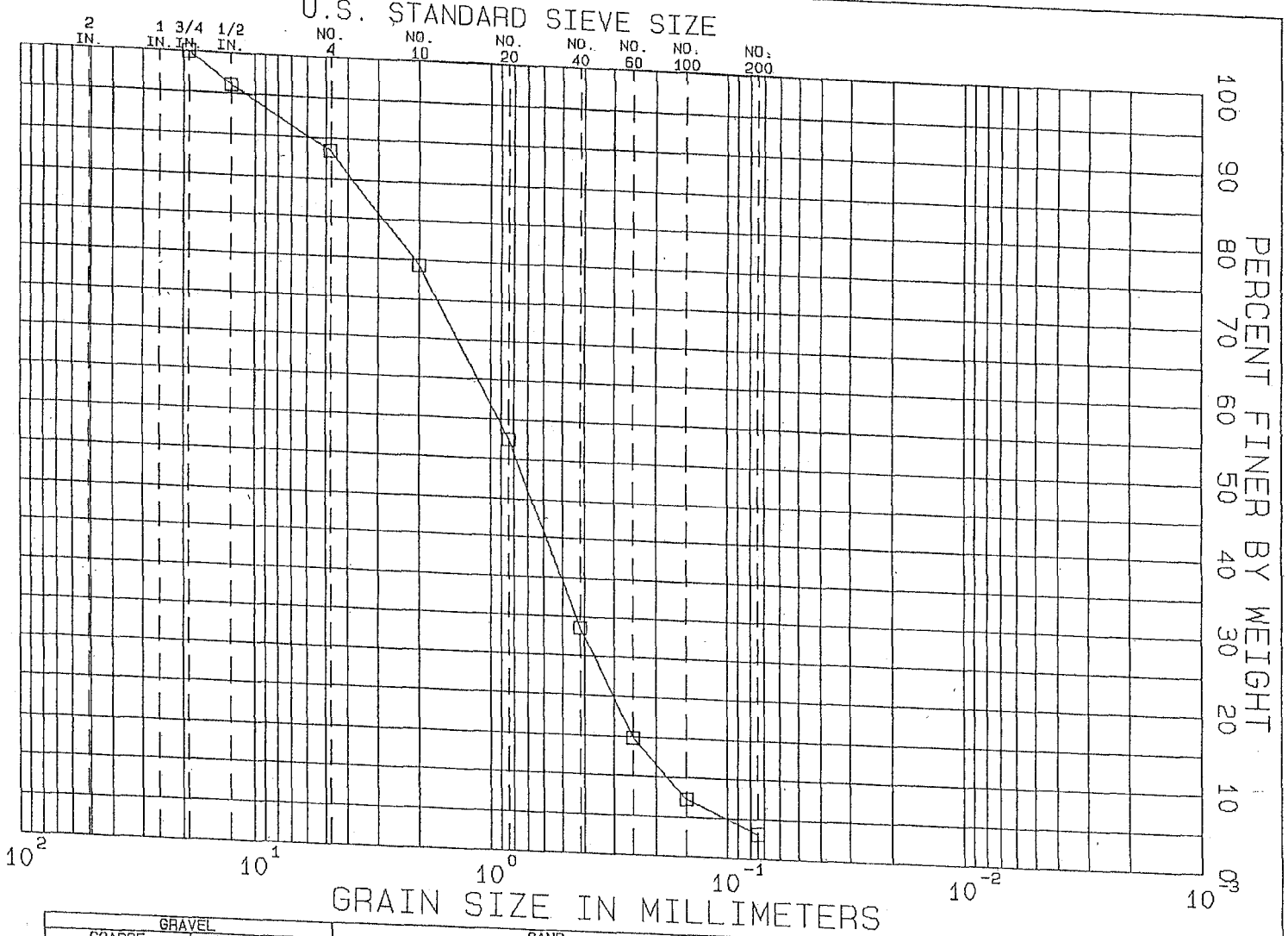
NEW BEDFORD HARBOR
NEW BEDFORD, MA.
GRADATION TESTS

BORING NO. NBH-8
SAMPLE S3-S6
DEPTH 10-27'
TECH. MST
REVIEWER MCM

TEST SERIES
NO. 3
DATE Jan.03

FILE L17571

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

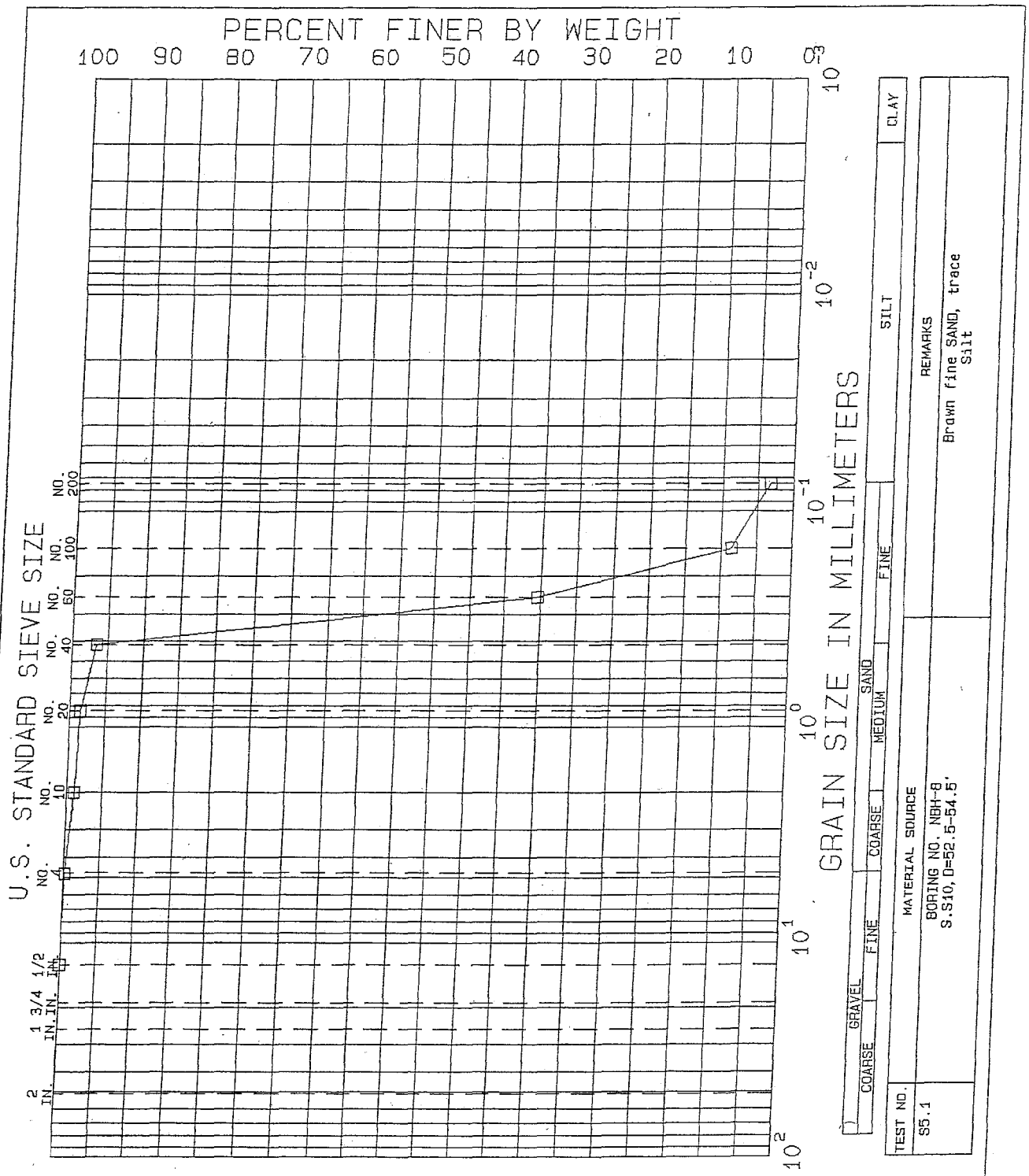
TEST NO.	MATERIAL SOURCE	REMARKS
S4.1	BORING NO. NBH-8 S.S8-S9, D=41.5-49.5'	Grey-Brown f-c SAND, little (-) Gravel, trace Silt

NEW BEDFORD HARBOR
NEW BEDFORD, MA.
GRADATION TESTS

BORING NO. NBH-8
SAMPLE S8-S9
DEPTH 41.5-49.5'
TECH. MST
REVIEWER MCM

TEST SERIES NO. 4
DATE Jan.03
FILE L17571

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS

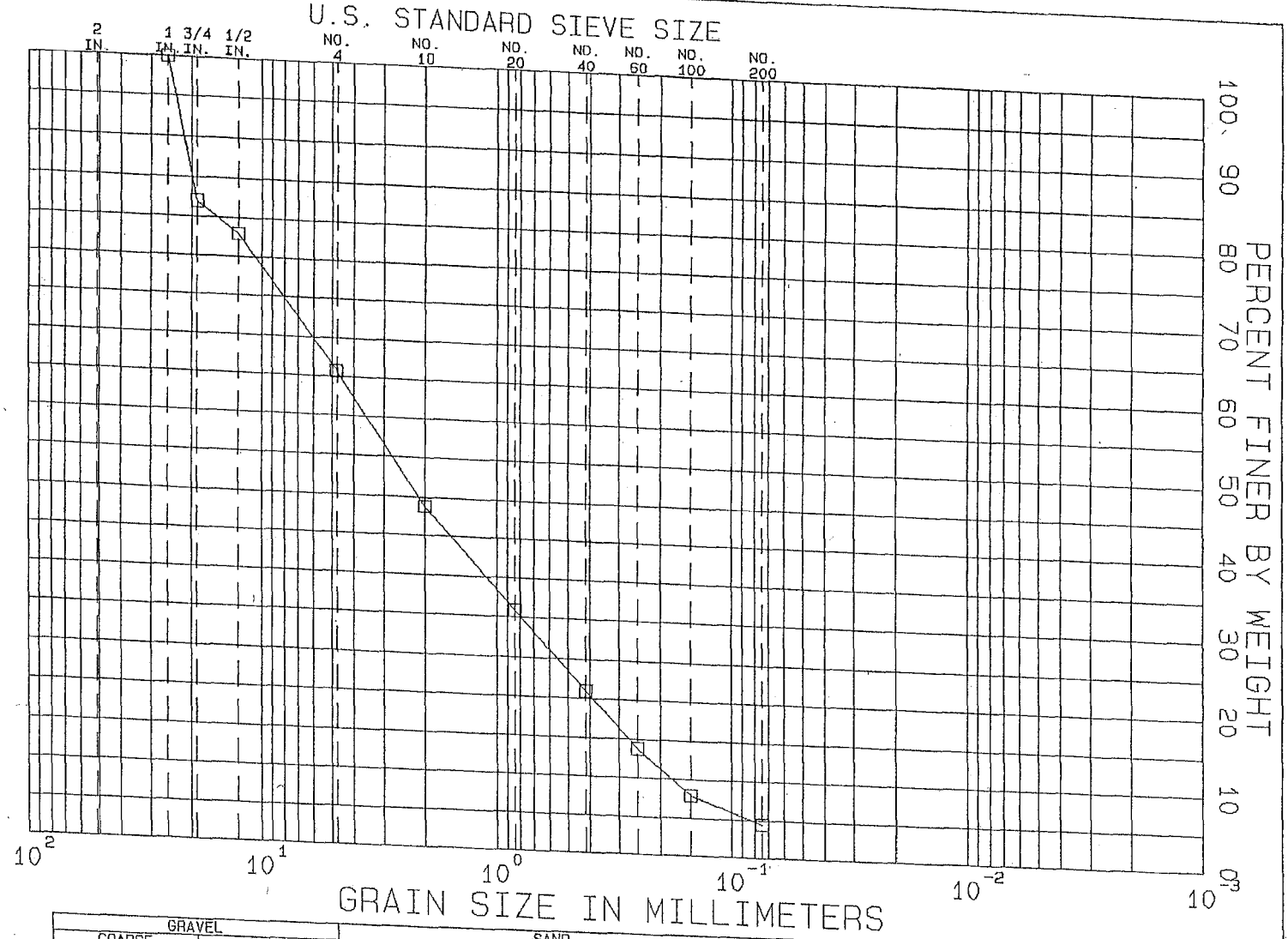


NEW BEDFORD HARBOR

NEW BEDFORD, MA.

GRADATION TESTS

BORING NO.	NBH-8	TEST SERIES	
SAMPLE	S10	NO.	5
DEPTH	52.5-54.5'	DATE	Jan.03
TECH.	MST		
REVIEWER	MCM	FILE	L17571



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

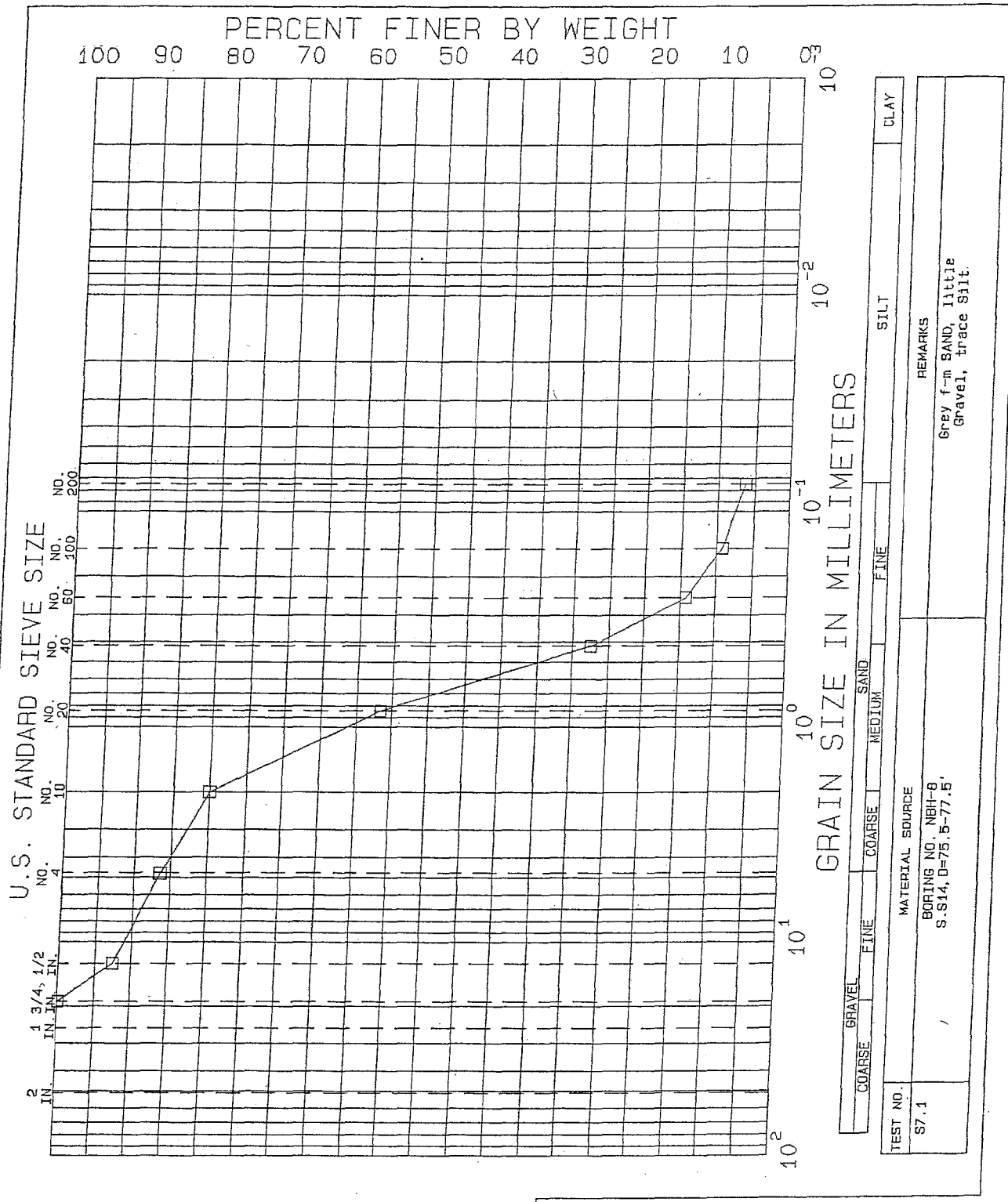
TEST NO.	MATERIAL SOURCE	REMARKS
S6.1	BORING NO. NBH-8 S.S11&12, D=57.5-69.5'	Grey f-c SAND and f-c GRAVEL, trace Silt

NEW BEDFORD HARBOR
NEW BEDFORD, MA.
GRADATION TESTS

BORING NO. NBH-8
SAMPLE S11&12
DEPTH 57.5-69.5'
TECH. MST
REVIEWER MCM

TEST SERIES NO. 6
DATE Jan.03
FILE L17571

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS

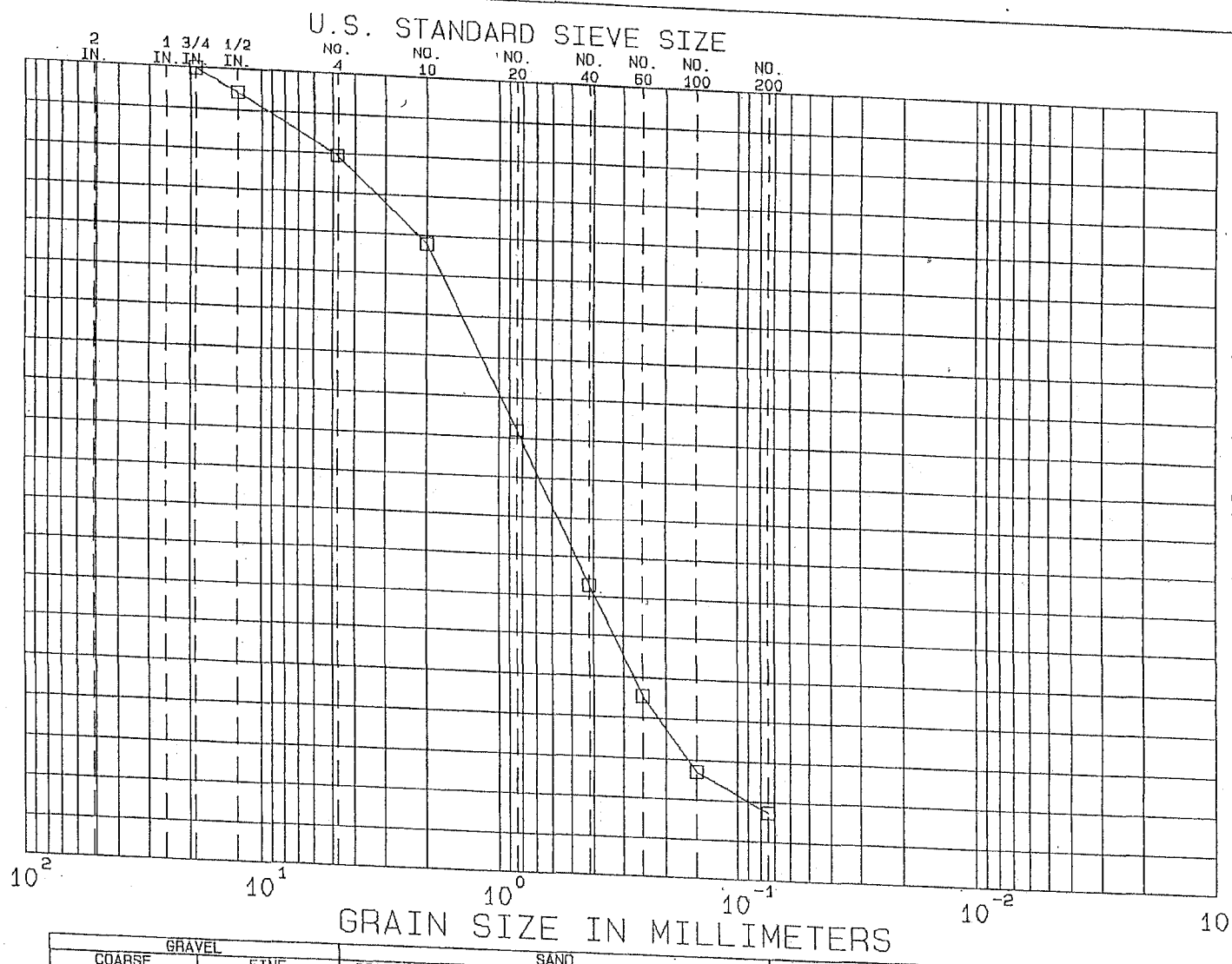


NEW BEDFORD HARBOR

NEW BEDFORD, MA.

GRADATION TESTS

BORING NO.	NBH-8	TEST SERIES	
SAMPLE	S14	NO.	7
DEPTH	75.5-77.5'	DATE	Jan.03
TECH.	MST		
REVIEWER	MCM	FILE	L17571



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

TEST NO.	MATERIAL SOURCE	REMARKS
S8:1	BORING NO. NBH-8 S.S15&16, D=80.5-87.5'	Grey-Brown f-c SAND, little (-) Gravel, trace (+) Silt

NEW BEDFORD HARBOR
NEW BEDFORD, MA.
GRADATION TESTS

BORING NO. NBH-8
SAMPLE S15&16
DEPTH 80.5-87.5'
TECH. MST
REVIEWER MCM

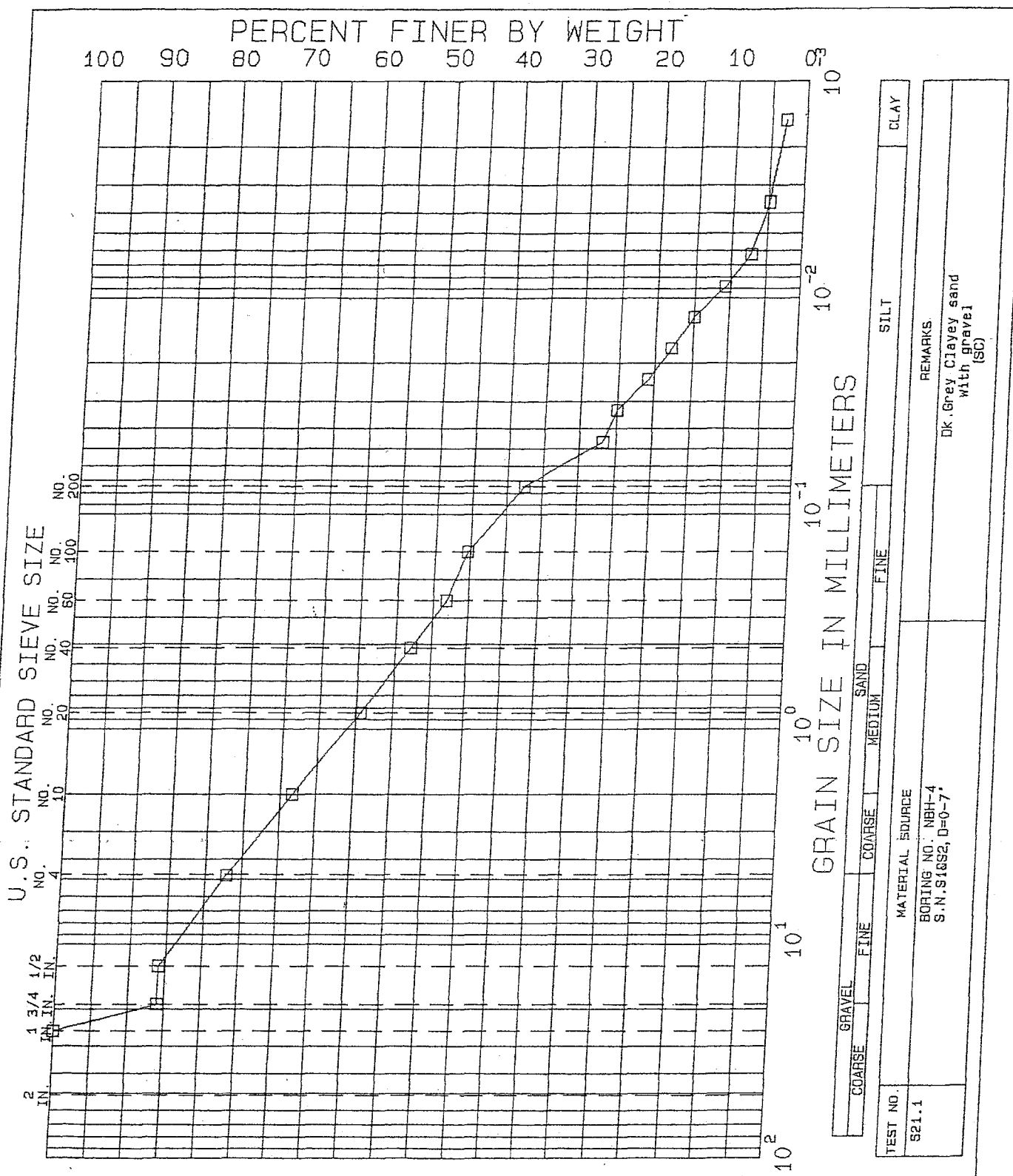
TEST SERIES NO. 8
DATE Jan.03
FILE L17571

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS

Appendix V

Channel Inner Laboratory Testing Data

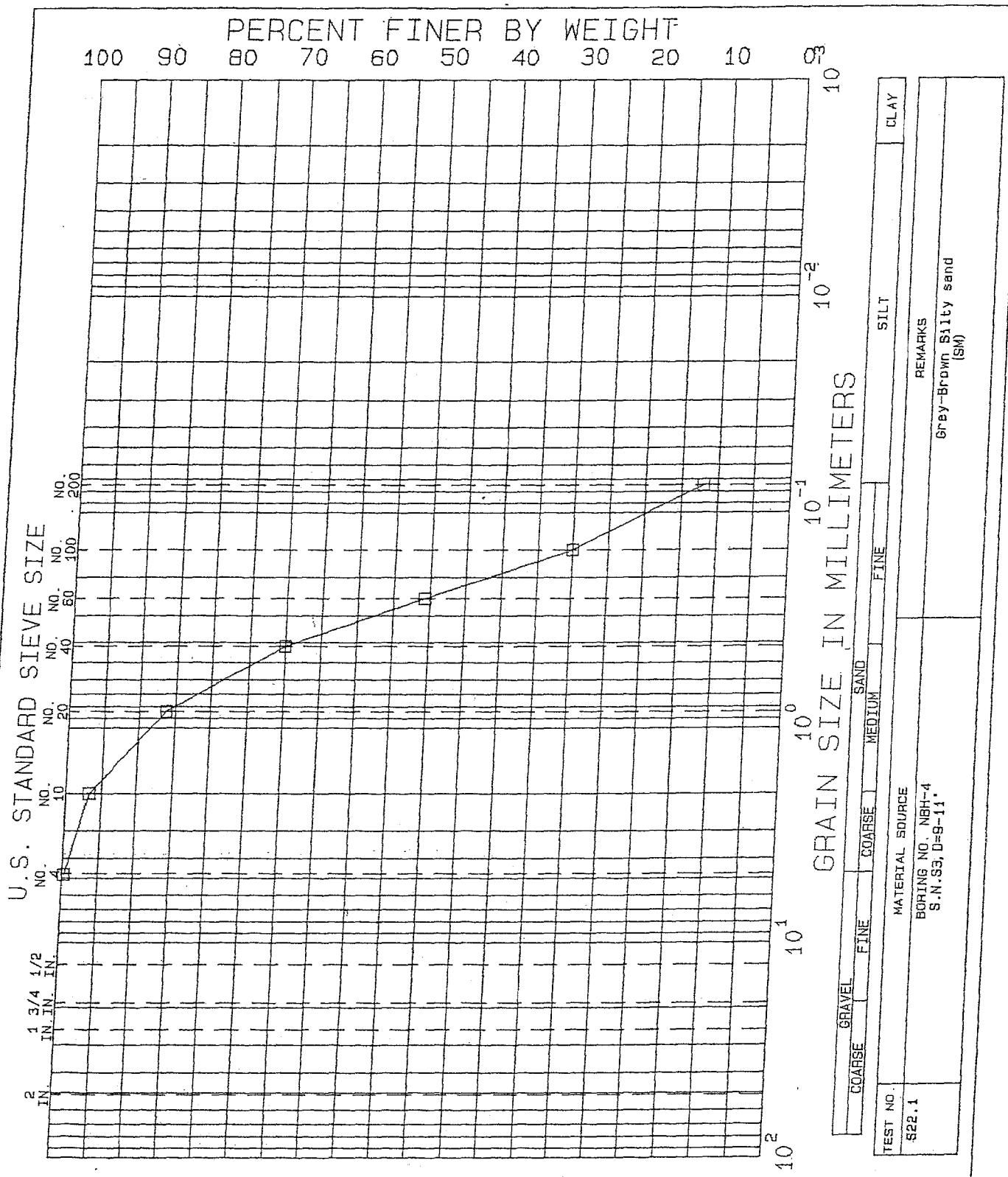
Phase I, NBH – 4, 5, 6 and 7
Phase II, NBH – 9, 10 and 11



NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

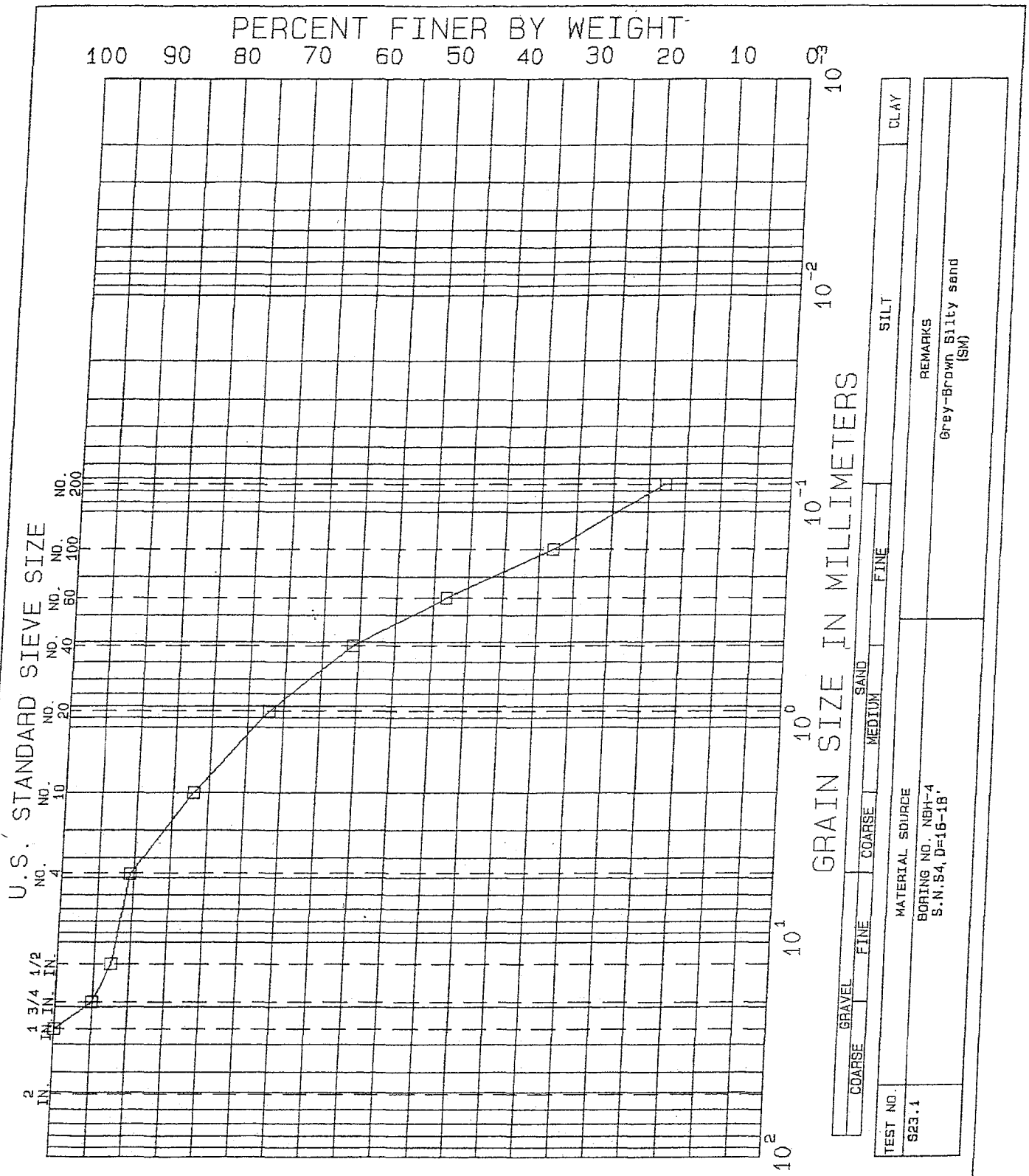
BORING NO.	NBH-4	TEST SERIES	
SAMPLE	S1&S2	NO.	21
DEPTH	0-7'	DATE	SEPT. 01
TECH.	mst		
REVIEWER	MCM	FILE	L16S28



NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

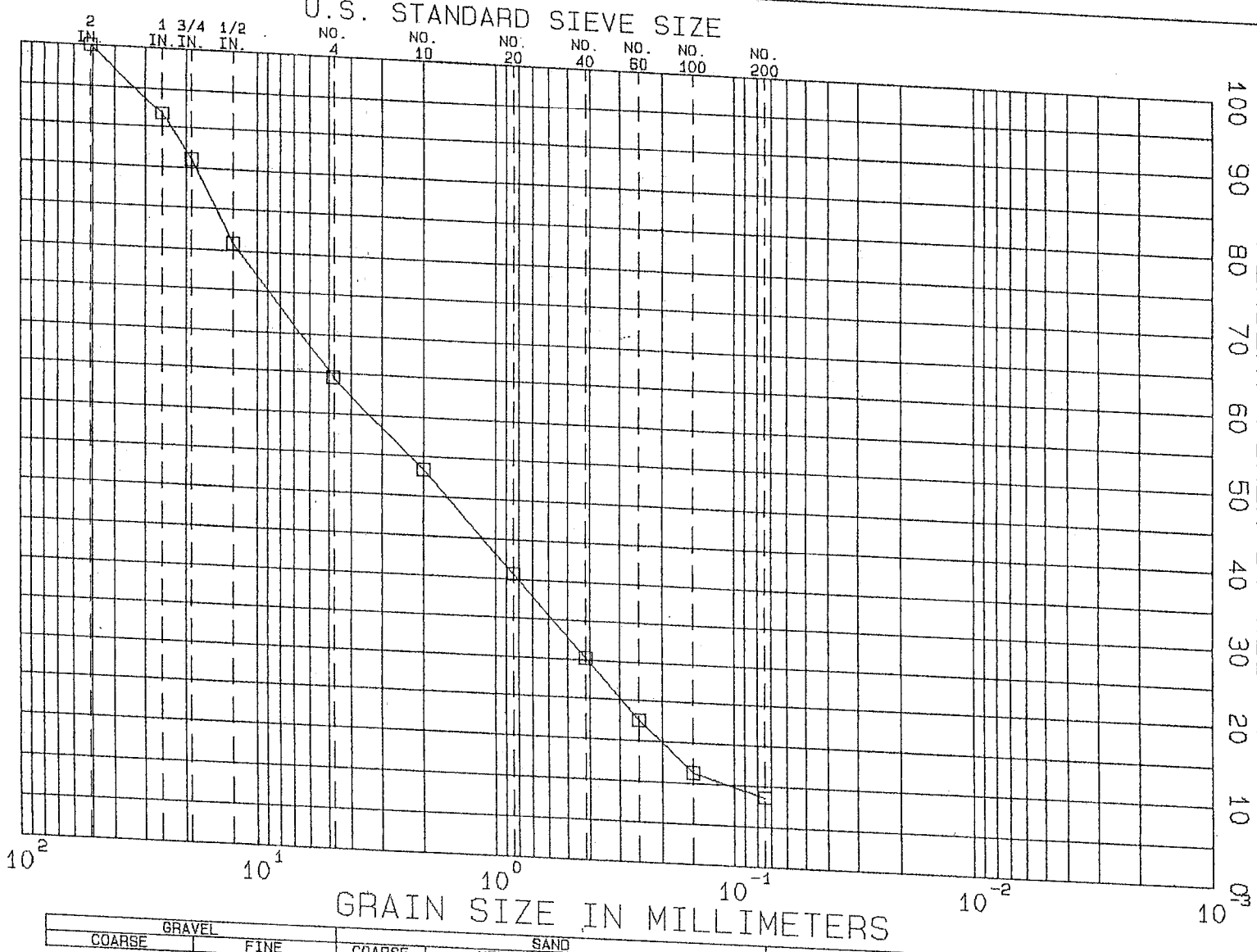
BORING NO.	NBH-4	TEST SERIES	
SAMPLE	S3	NO.	22
DEPTH	9-11'	DATE	SEPT. 01
TECH.	mst		
REVIEWER	MCM	FILE	L16928



NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO.	NBH-4	TEST SERIES	
SAMPLE	S4	NO.	23
DEPTH	16-18'	DATE	SEPT. 01
TECH.	mst		
REVIEWER	MCM	FILE	L16928



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

TEST NO.	MATERIAL SOURCE	REMARKS
S24.1	BORING NO. NBH-4 S.N.S5&S6, D=21-29'	Brown Poorly-graded sand with silt and gravel (SP-SM)

NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-4
SAMPLE S5&S6
DEPTH 21-29'
TECH. mst
REVIEWER MCM

TEST SERIES NO. 24
DATE SEPT. 01

FILE L16928

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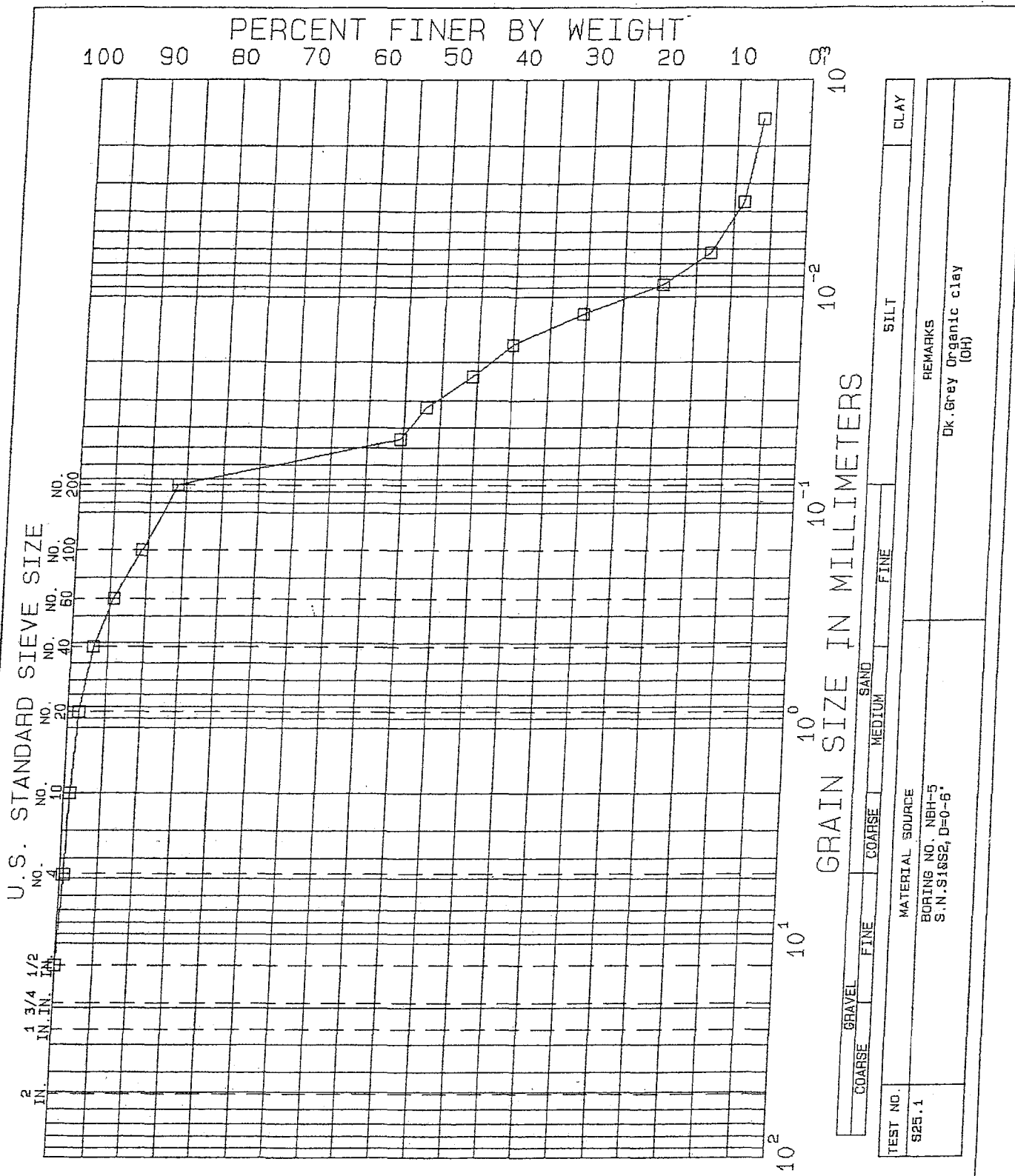

NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO.	NBH-5	TEST SERIES NO.	25
SAMPLE	S1&S2	DATE	SEPT. 01
DEPTH	0-6'		
TECH.	mst		
REVIEWER	MCM	FILE	L16928

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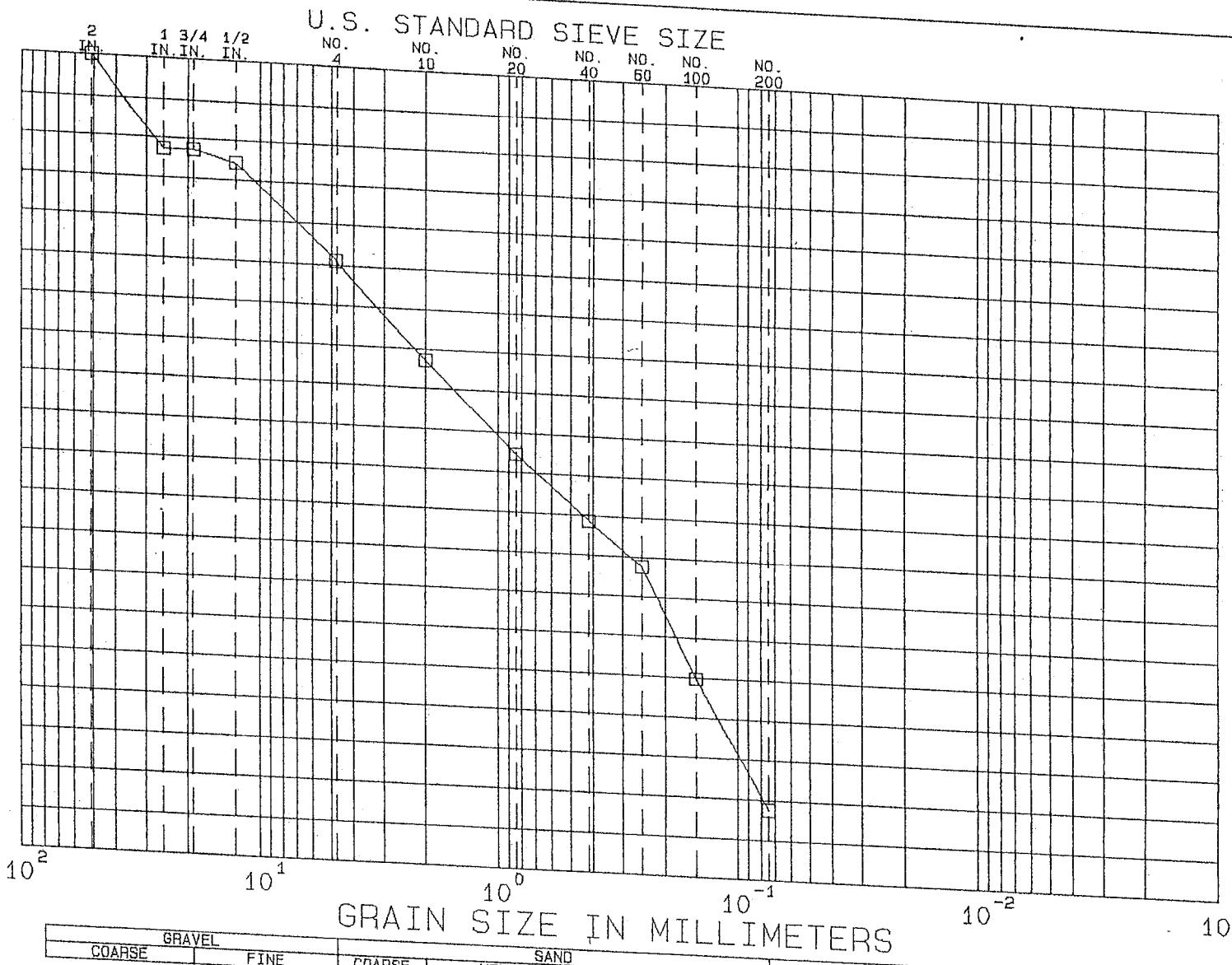

TEST NO.	MATERIAL SOURCE	REMARKS
S26.1	BORING NO. NBH-5 S.N.S3, D=9-11'	Grey-Brown Well-graded sand with silt and gravel (SW-SM)

NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-5
SAMPLE S3
DEPTH 9-11'
TECH. mst
REVIEWER MCM

TEST SERIES NO. 26
DATE SEPT. 01

FILE L16928

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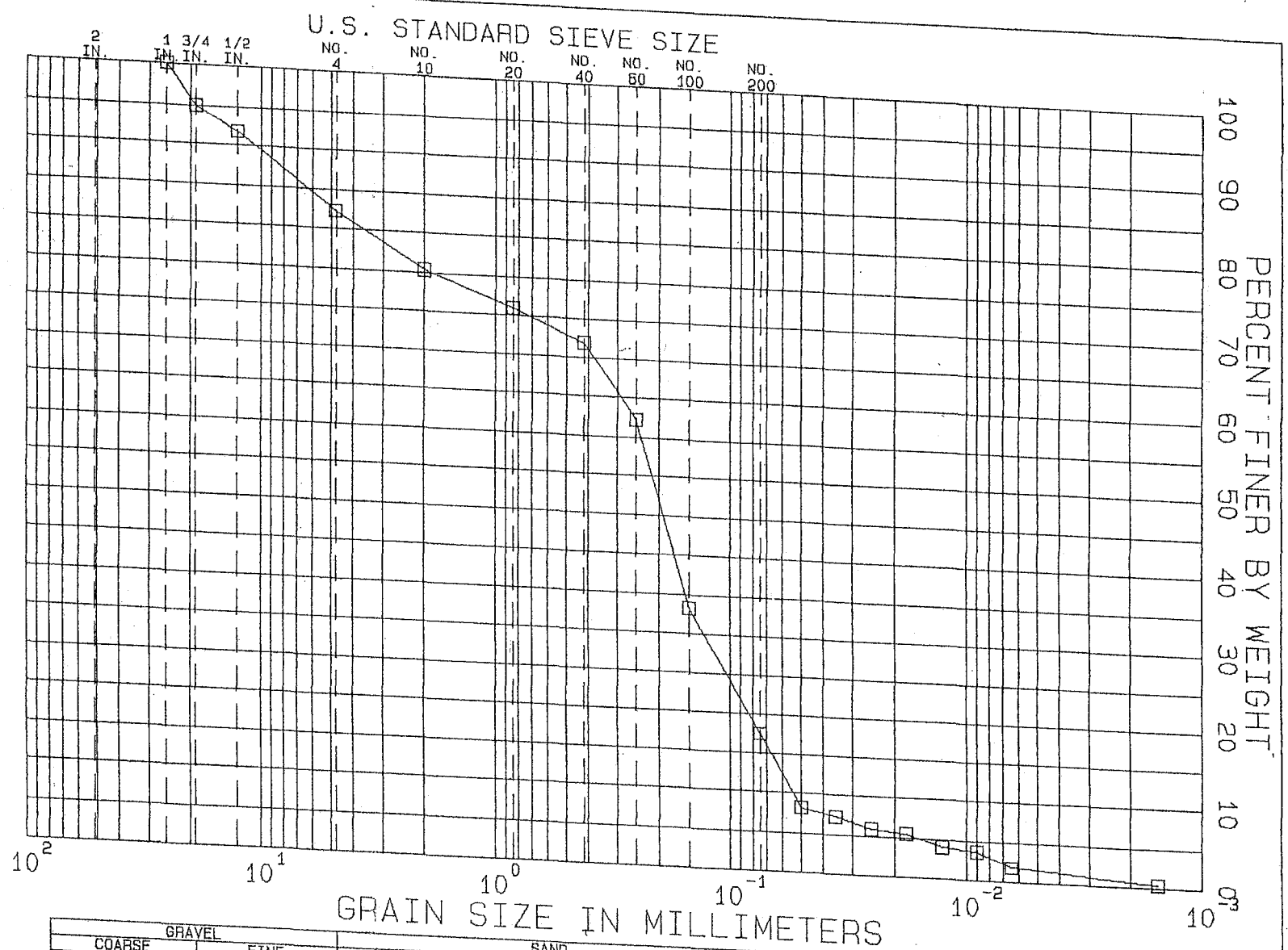

GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

TEST NO.	MATERIAL SOURCE	REMARKS
S27.1	BORING NO. NBH-5 S.N.S4QS5, D=14-21'	Grey-Brown Silty sand with gravel (SM)

NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-5
SAMPLE S4QS5
DEPTH 14-21'
TECH. mst
REVIEWER MCM

TEST SERIES NO. 27
DATE SEPT. 01
FILE L16928

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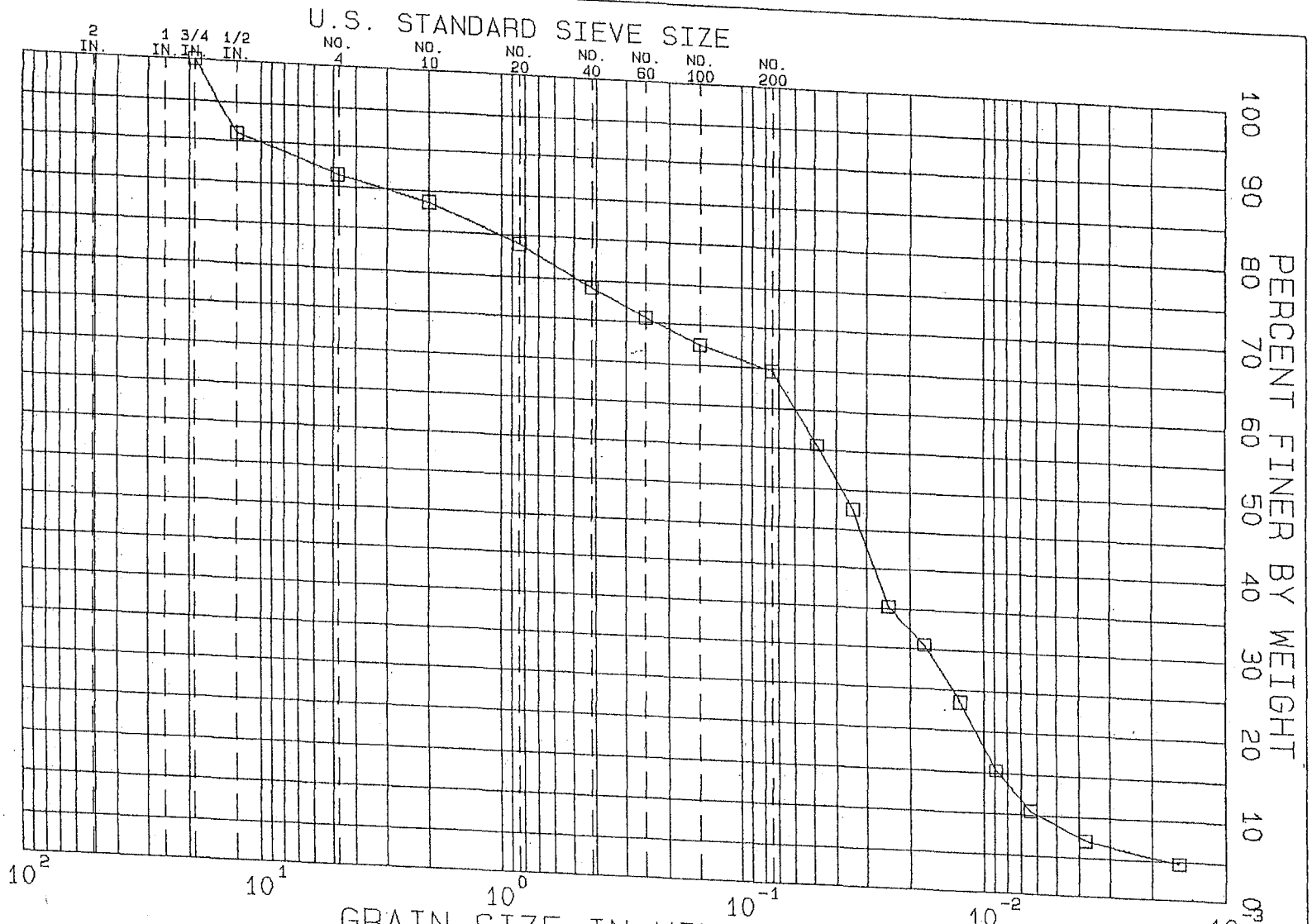

GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

TEST NO.	MATERIAL SOURCE	REMARKS
S28.1	BORING NO. NBH-6 S.N.S1&S2, D=0-6'	Dk.Grey Organic silt with sand and gravel (OL)

NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-6
SAMPLE S1-S2
DEPTH 0-6'
TECH. mst
REVIEWER MCM

TEST SERIES NO. 28
DATE SEPT. 01
FILE L16928

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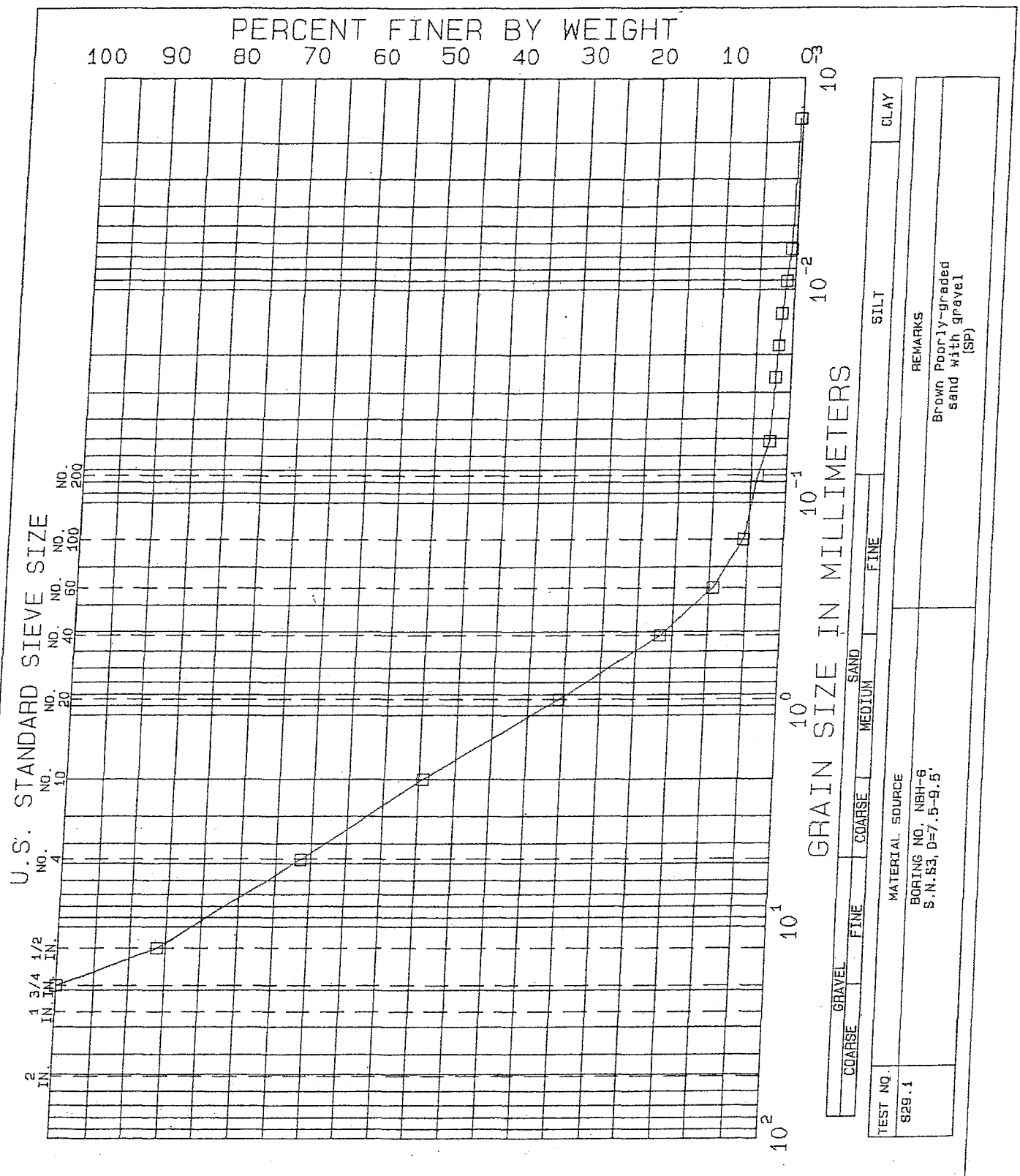
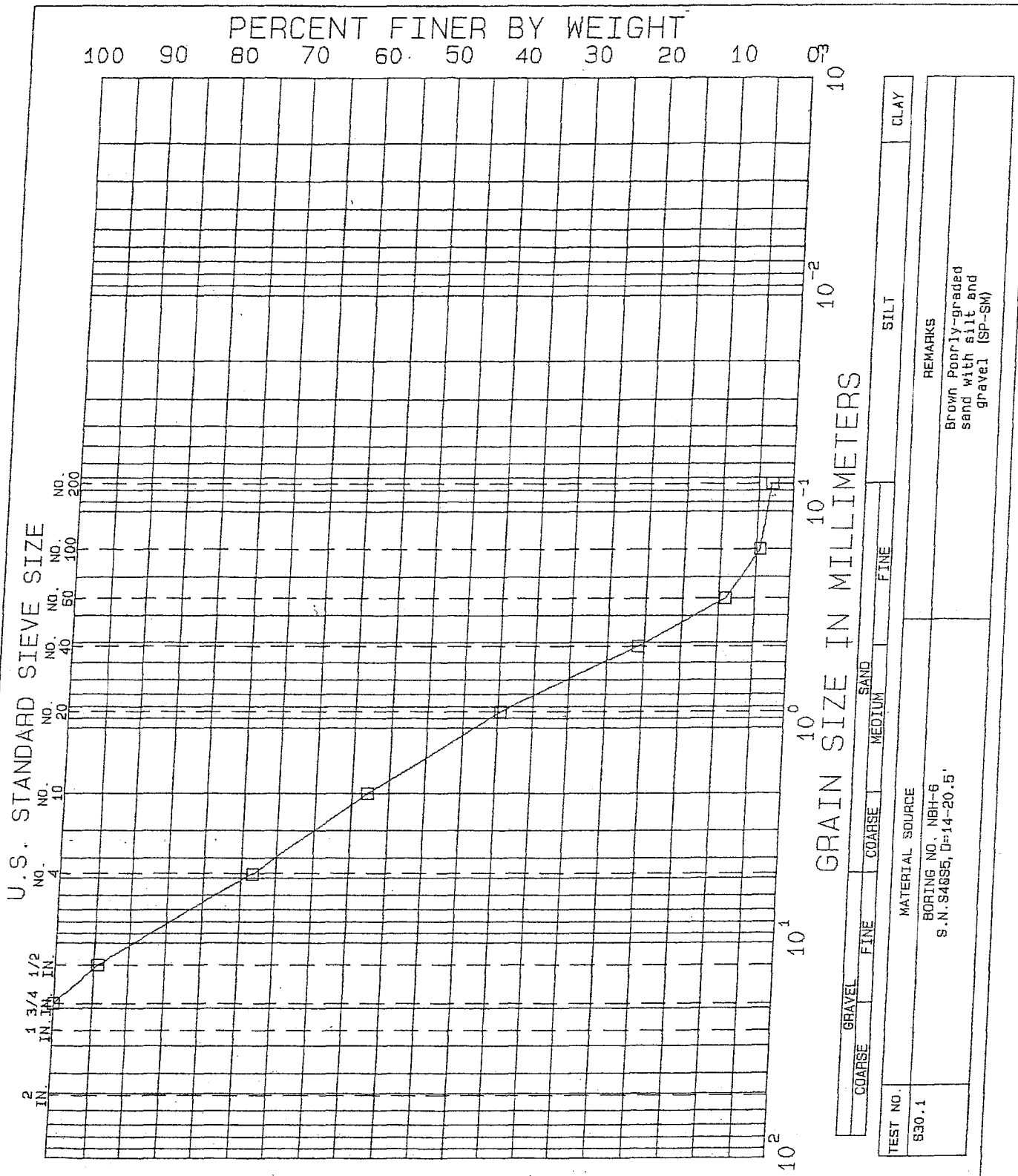


NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

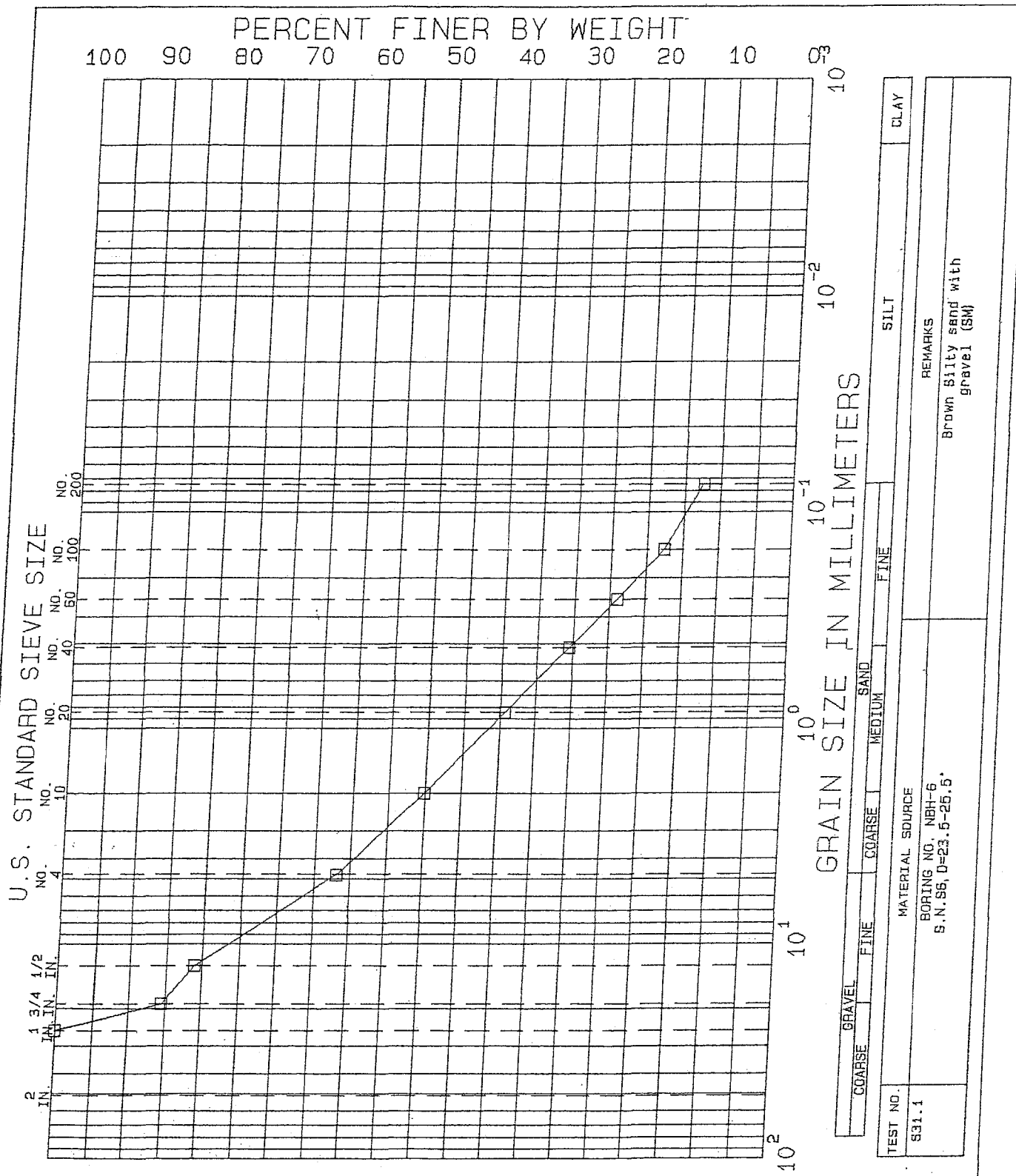
BORING NO.	NBH-6	TEST SERIES	
SAMPLE	S3	NO.	29
DEPTH	7.5-9.5'	DATE	SEPT. 01
TECH.	mst		
REVIEWER	MCM	FILE	L16928



NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

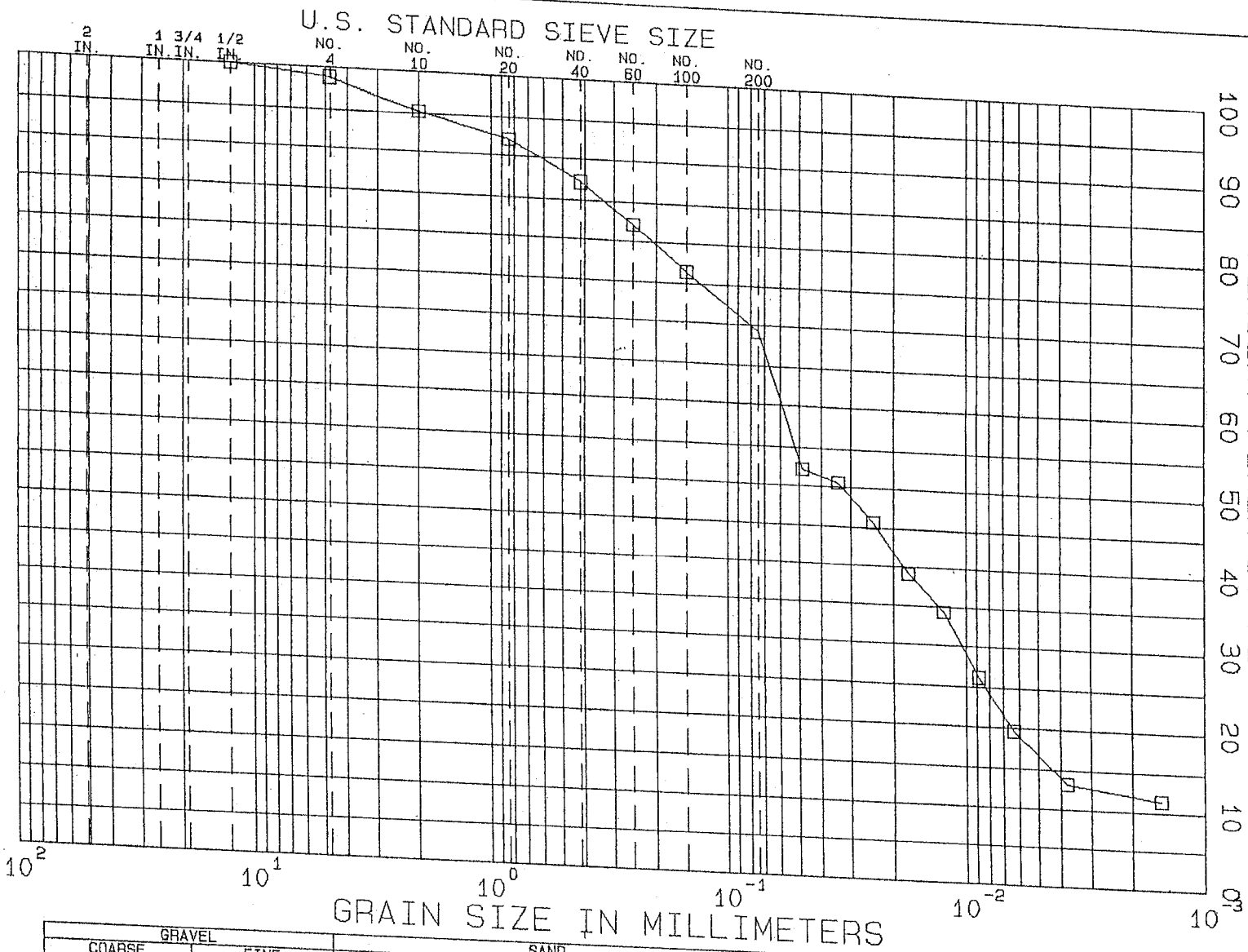
BORING NO.	NBH-6	TEST SERIES	
SAMPLE	S4&S5	NO.	30
DEPTH	14-20.5'	DATE	SEPT. 01
TECH.	mst		
REVIEWER	MCM	FILE	L16928



NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO.	NBH-6	TEST SERIES	
SAMPLE	S6	NO.	31
DEPTH	23.5-25.5'	DATE	SEPT. 01
TECH.	mst		
REVIEWER	MCM	FILE	L16928



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

TEST NO.	MATERIAL SOURCE	REMARKS
S32.1	BORING NO. NBH-7 S.N.S1, D=0-2'	Dk.Grey Sandy fat clay (CH)

NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-7
SAMPLE S1
DEPTH 0-2'
TECH. mst
REVIEWER MCM

TEST SERIES NO. 32
DATE SEPT. 01
FILE L16928

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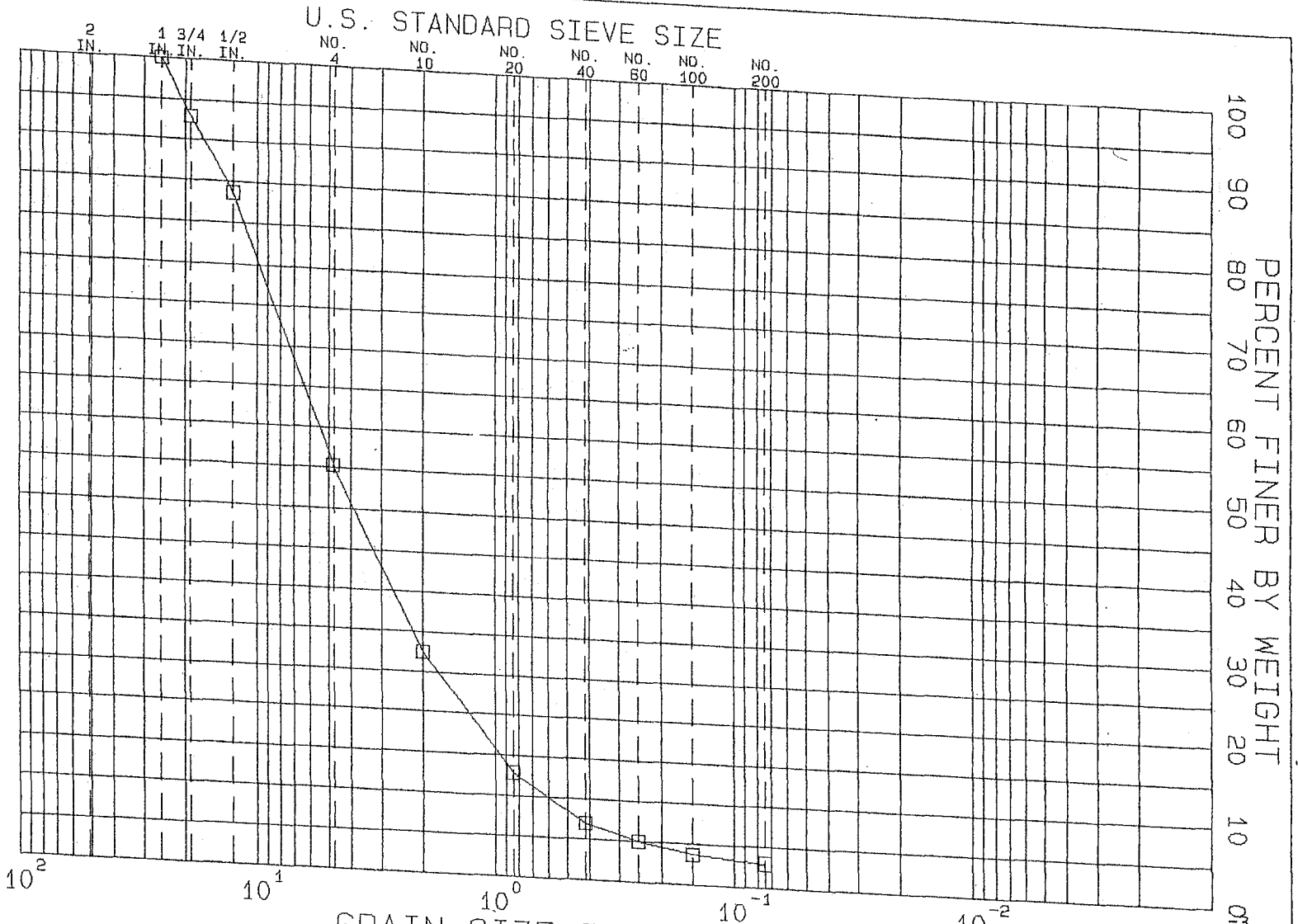

GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

TEST NO.	MATERIAL SOURCE	REMARKS
S33.1	BORING NO. NBH-7 S.N.S2, D=4-6'	Brown Poorly-graded gravel with sand (GP)

NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-7
SAMPLE S2
DEPTH 4-6'
TECH. mst
REVIEWER MCM

TEST SERIES NO. 33
DATE SEPT. 01
FILE L16928

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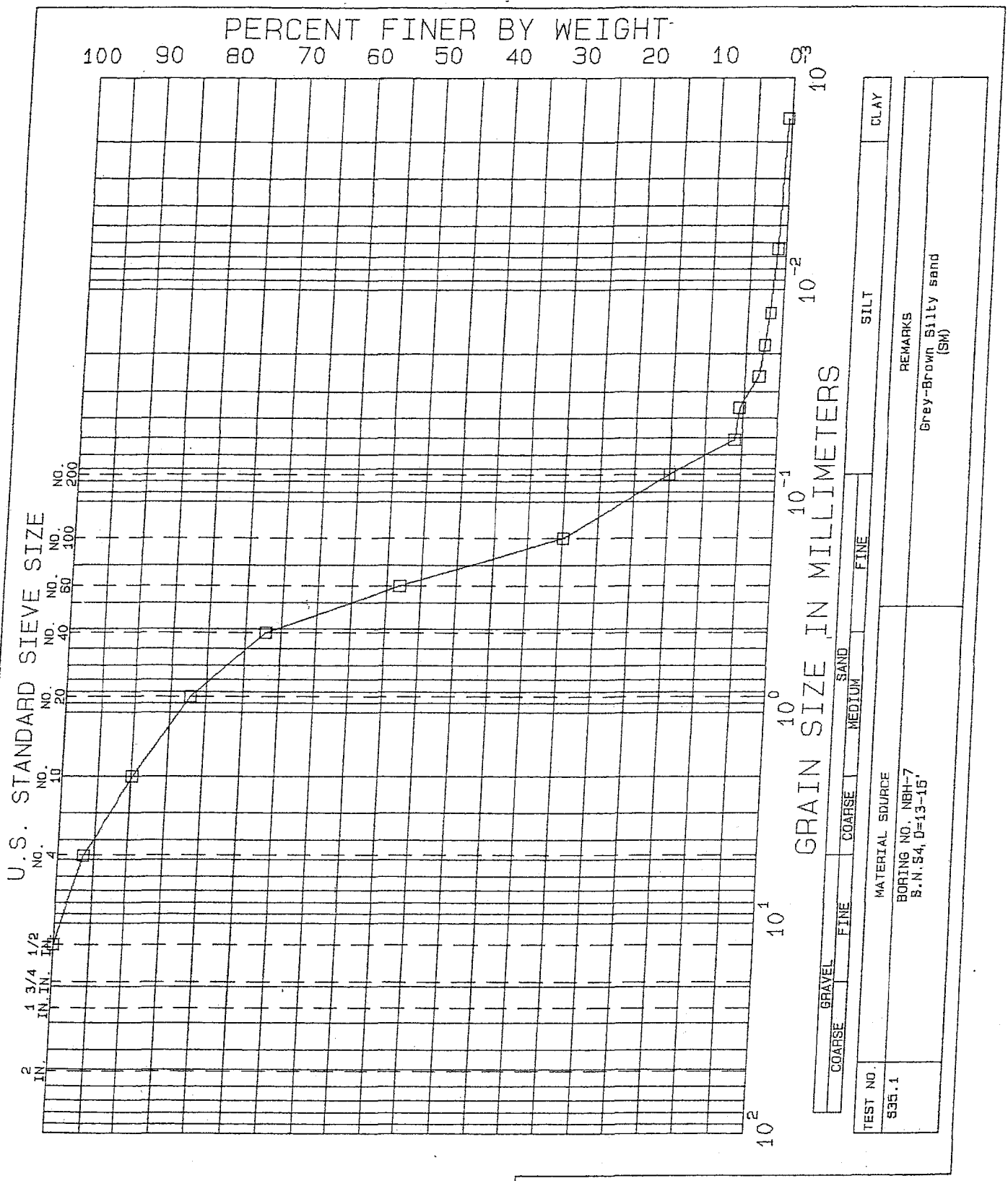
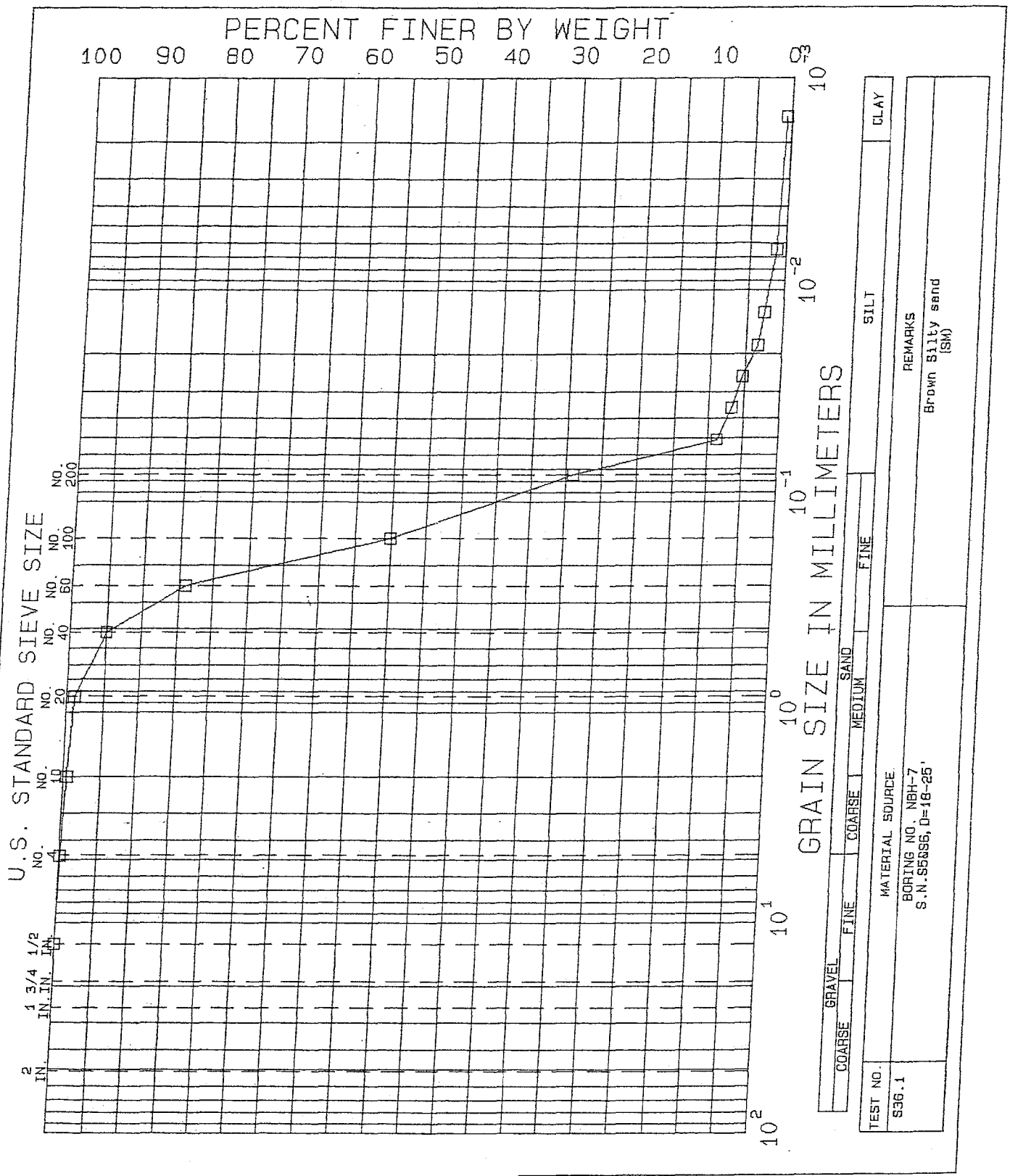


NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO.	NBH-7	TEST SERIES	
SAMPLE	S4	NO.	35
DEPTH	13-15'	DATE	SEPT. 01
TECH.	mst		
REVIEWER	MCM	FILE	L16928



NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO.	NBH-7	TEST SERIES	
SAMPLE	S5&S6	NO.	36
DEPTH	18-25'	DATE	SEPT. 01
TECH.	mst		
REVIEWER	MCM	FILE	L16928

Project Name: NEW BEDFORD HARBOR
NEW BEDFORD, MASS.

Project No.: L17571

Project Engineer: D. SCHULZE

Assigned By: D. NACCI

Date: DEC.02

Reviewed By

Date Reviewed

LABORATORY TESTING DATA SHEET

Boring/ Test Pit No.	Sample No.	Depth ft.	Lab No.	Identification Tests: Water Content %	LL %	PL %	Sieve -200 %	Hyd -2μ %	ORG %	G_s	Dry unit wt. pcf	Density: γ_d MAX (pcf) W_{opt} (%)	Permeability cm/sec	Strength Tests: Torvane or Type Test	$\bar{\sigma}_c$ psf	Failure Criteria	$\sigma_1 - \sigma_3$ or τ psf	Strain %	Consol. $\frac{\Delta e}{1 + e_0}$	Laboratory Log and Soil Description
NBH-9	UP-1	5-7	22																	
				Average Total Unit Weight (5.0-6.5') = 121.6 Pcf																
		5.1		31.3																Grey-f-m SAND and Organic SILT, trace (+) Gravel
		5.2-5.7		29.9							93.1									
		5.7		29.4																
		5.7-6.2		25.5							99.4									
		6.2		27.5																
		6.2-6.4		36.6	32	19	38	4	2.5											

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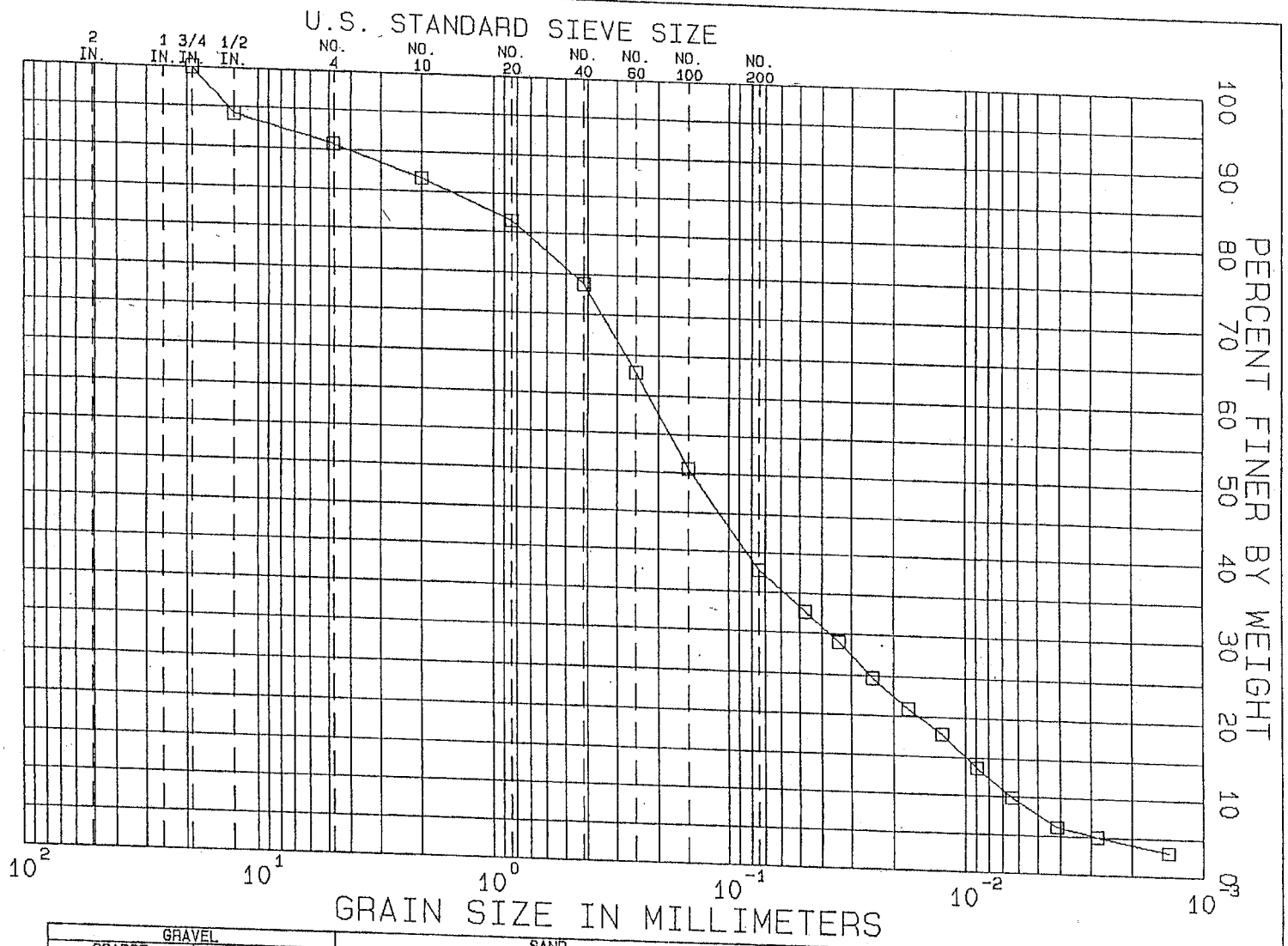
labform1.xls



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

TEST NO.	MATERIAL SOURCE	REMARKS
S22.1	Boring No. NBH-9 S.No.UP-1, D=6.2-6.4'	Grey f-m SAND and Organic SILT, trace (+) Gravel

NEW BEDFORD HARBOR
NEW BEDFORD, MA.
GRADATION TESTS

BORING NO. NBH-9
SAMPLE UP-1
DEPTH 6.2-6.4'
TECH. mst
REVIEWER DAS

TEST SERIES NO. 22
DATE DEC. 02
FILE L17571

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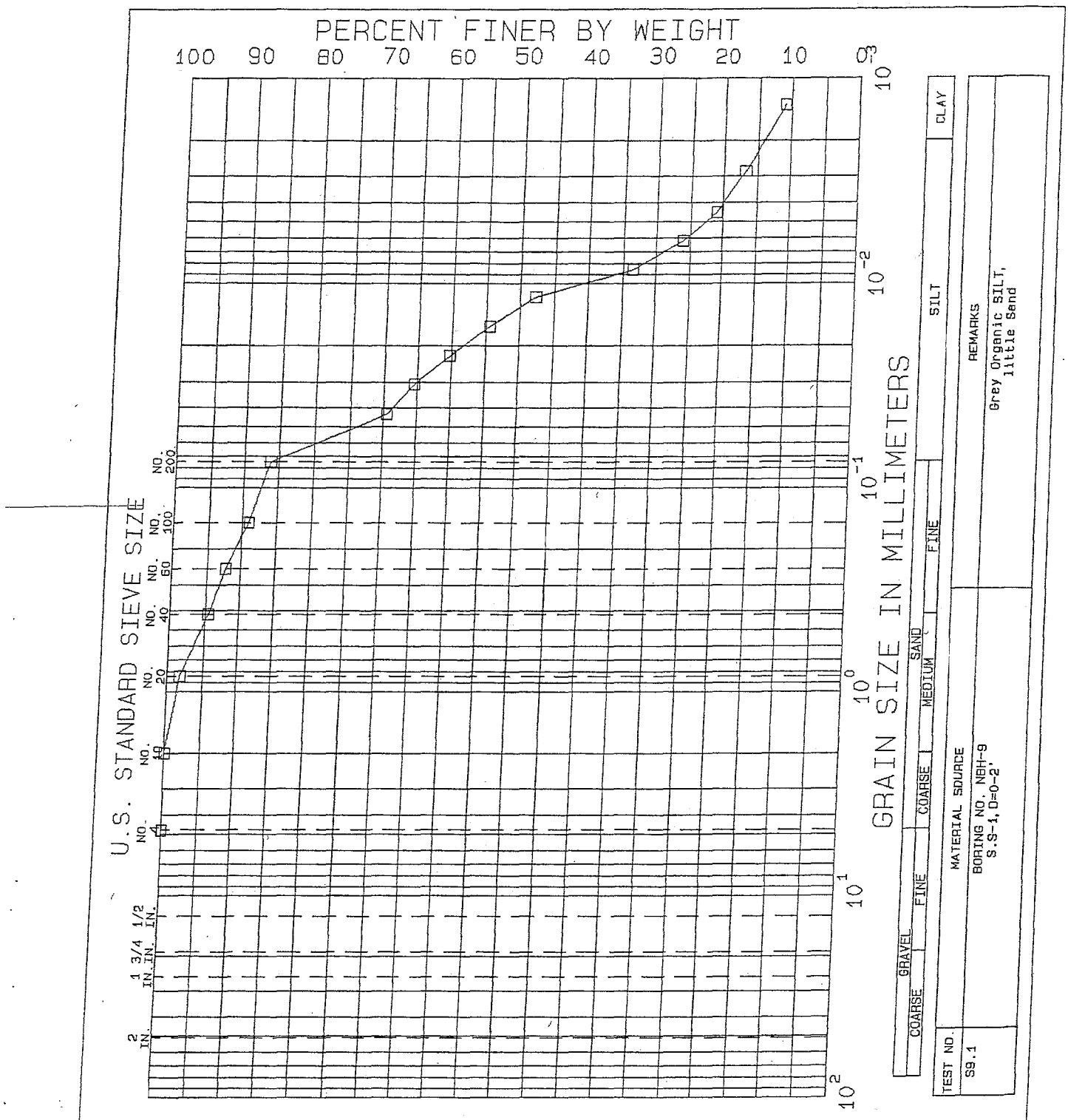
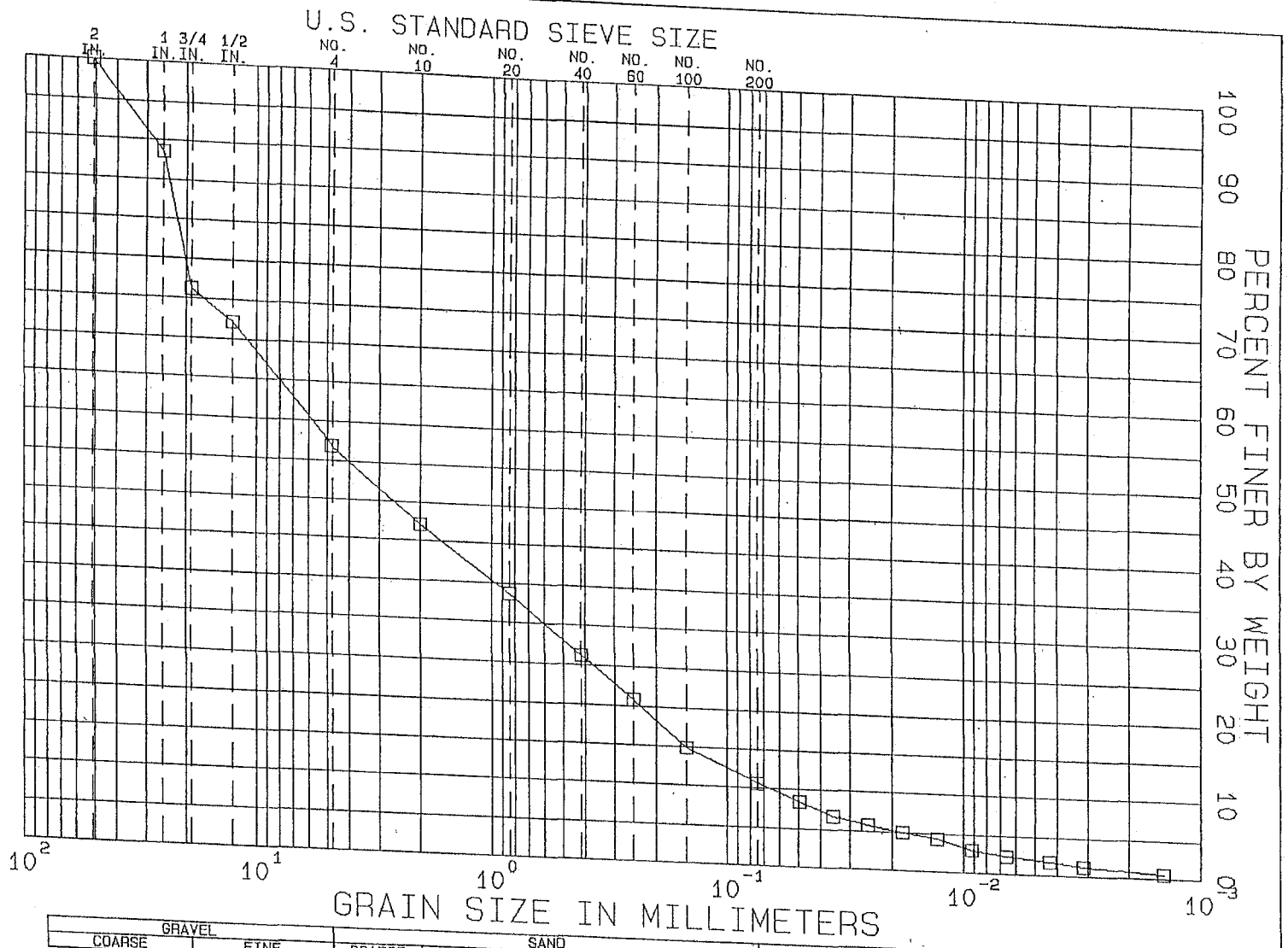


NEW BEDFORD HARBOR

NEW BEDFORD, MA.

GRADATION TESTS

BORING NO.	NBH-9	TEST SERIES	
SAMPLE	S-1	NO.	9
DEPTH	0-2'	DATE	Jan.03
TECH.	MST		
REVIEWER	MCM	FILE	L17571



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

TEST NO.	MATERIAL SOURCE	REMARKS
S10.1	BORING NO. NBH-9 S.S-2, D=12-14'	Brown f-c Gravel and f-m SAND, little (-) Silt

NEW BEDFORD HARBOR
NEW BEDFORD, MA.
GRADATION TESTS

BORING NO. NBH-9
SAMPLE S-2
DEPTH 12-14'
TECH. MST
REVIEWER MCM

TEST SERIES NO. 10
DATE Jan.03
FILE L17571

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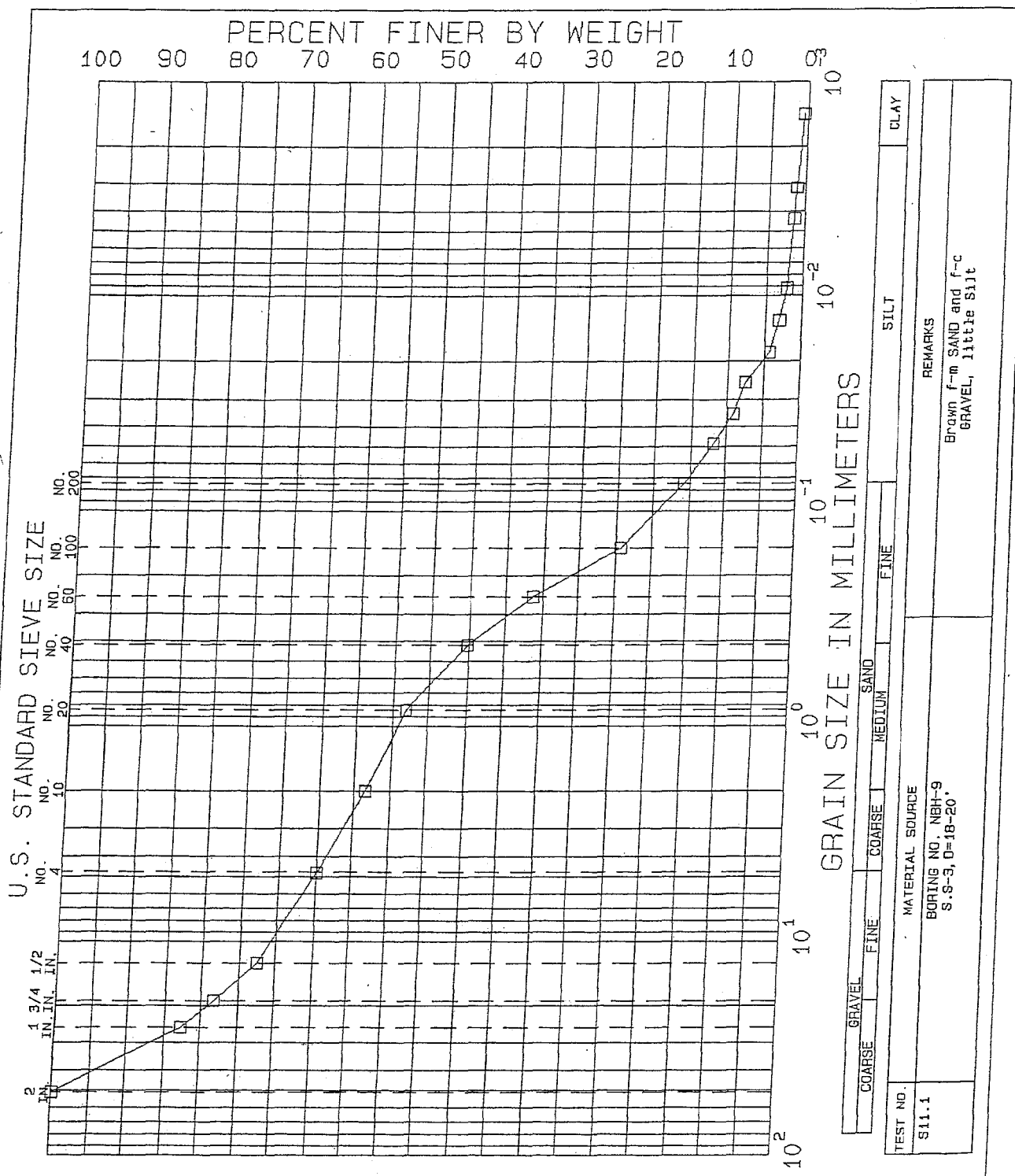

NEW BEDFORD HARBOR

NEW BEDFORD, MA.

GRADATION TESTS

BORING NO.	NBH-9	TEST SERIES	
SAMPLE	S-3	NO.	11
DEPTH	18-20'	DATE	Jan.03
TECH.	MST		
REVIEWER	MCM	FILE	L17571

Project Name: NEW BEDFORD HARBOR
NEW BEDFORD, MA.
Project No.: L17571
Project Engineer: D. SCHULZE
Assigned By: D. NACCI
Date: DEC.02
Reviewed By:
Date Reviewed:

LABORATORY TESTING DATA SHEET

Boring/ Test Pit No.	Sample No.	Depth ft.	Lab No.	Identification Tests: Water Content %	LL %	PL %	Sieve -200 %	Hyd -2μ %	ORG %	G_s	Dry unit wt. pcf	Density: γ_d MAX (pcf) / W_{opt} (%)	Permeability cm/sec	Strength Tests: Torvane or Type Test	$\bar{\sigma}_c$ psf	Failure Criteria	$\sigma_1 - \sigma_3$ or τ psf	Strain %	Consol. $\frac{C_c}{1+e_0}$	Laboratory Log and Soil Description
NBH-10	S-1	0-2	12	29.3	27	19	34	7	1.6											Grey f-m SAND, some (+) Organic Silt, little (+) f-c Gravel
	S-2 S-3	5-12	13				3													Brown f-c SAND and GRAVEL, trace Silt
	S-4	15-17	14				19	2												Brown f-m SAND, some f-c Gravel, little (+) Silt
NBH-11	S-1	0-2	15	55.9	53	28	56	4	3.0											Grey Organic SILT and f-m SAND
	S-2	5-7	16				6	1												Grey-Brown f-m SAND, trace Silt
	S-3	9.5-11.5	17				31	2												Brown fine SAND, some (+) Silt
	S-4	14.5-16.5	18				11													Grey-Brown f-c SAND, some Gravel, little (-) Silt
	S-5-S-7	18.5-31	19				2													Grey-Brown f-c GRAVEL and f-c SAND, trace (-) Silt
	S-8	34-36	20				20	<1												Brown f-m SAND, some (-) Silt, little (+) Gravel

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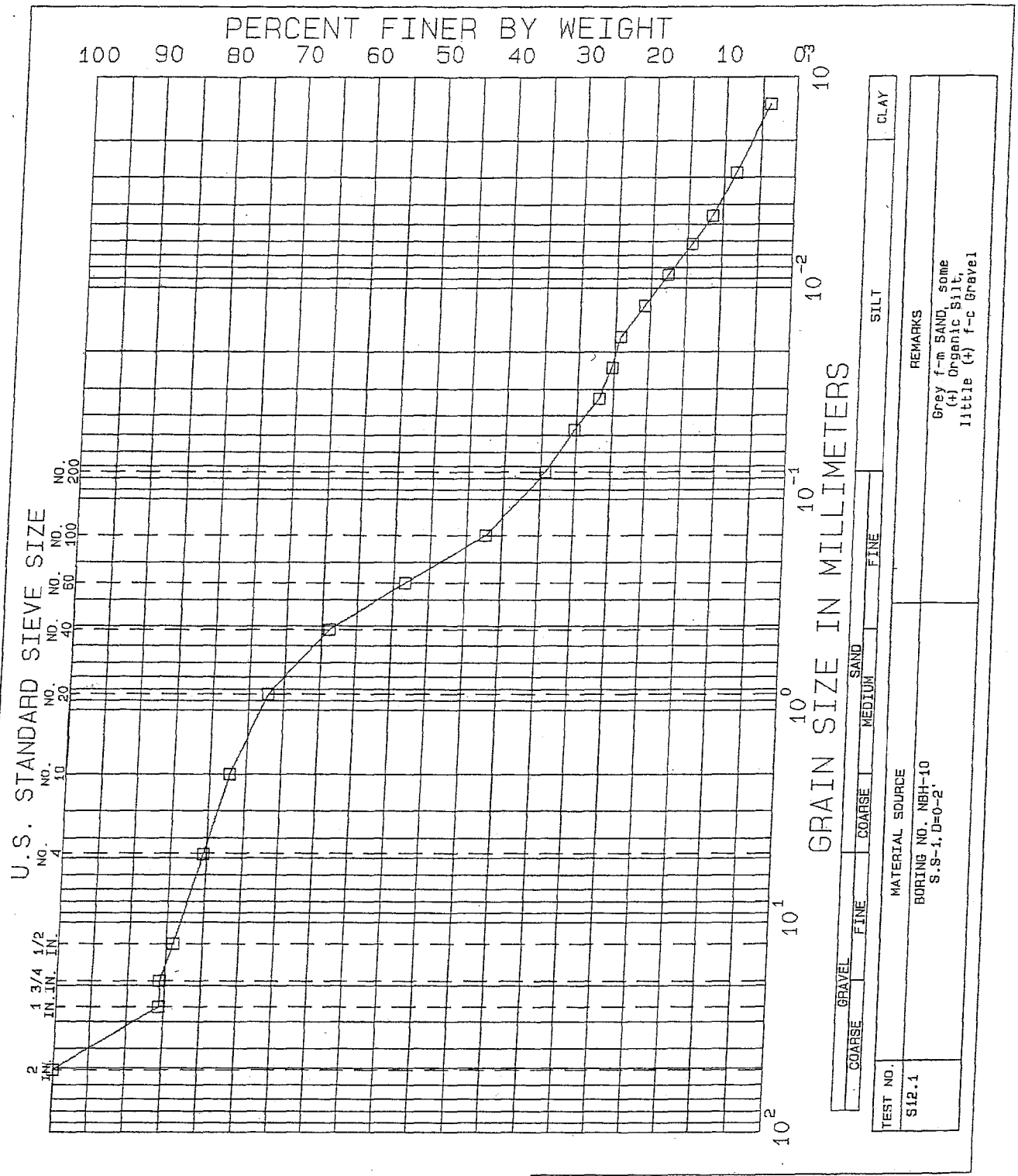
labform1.xls

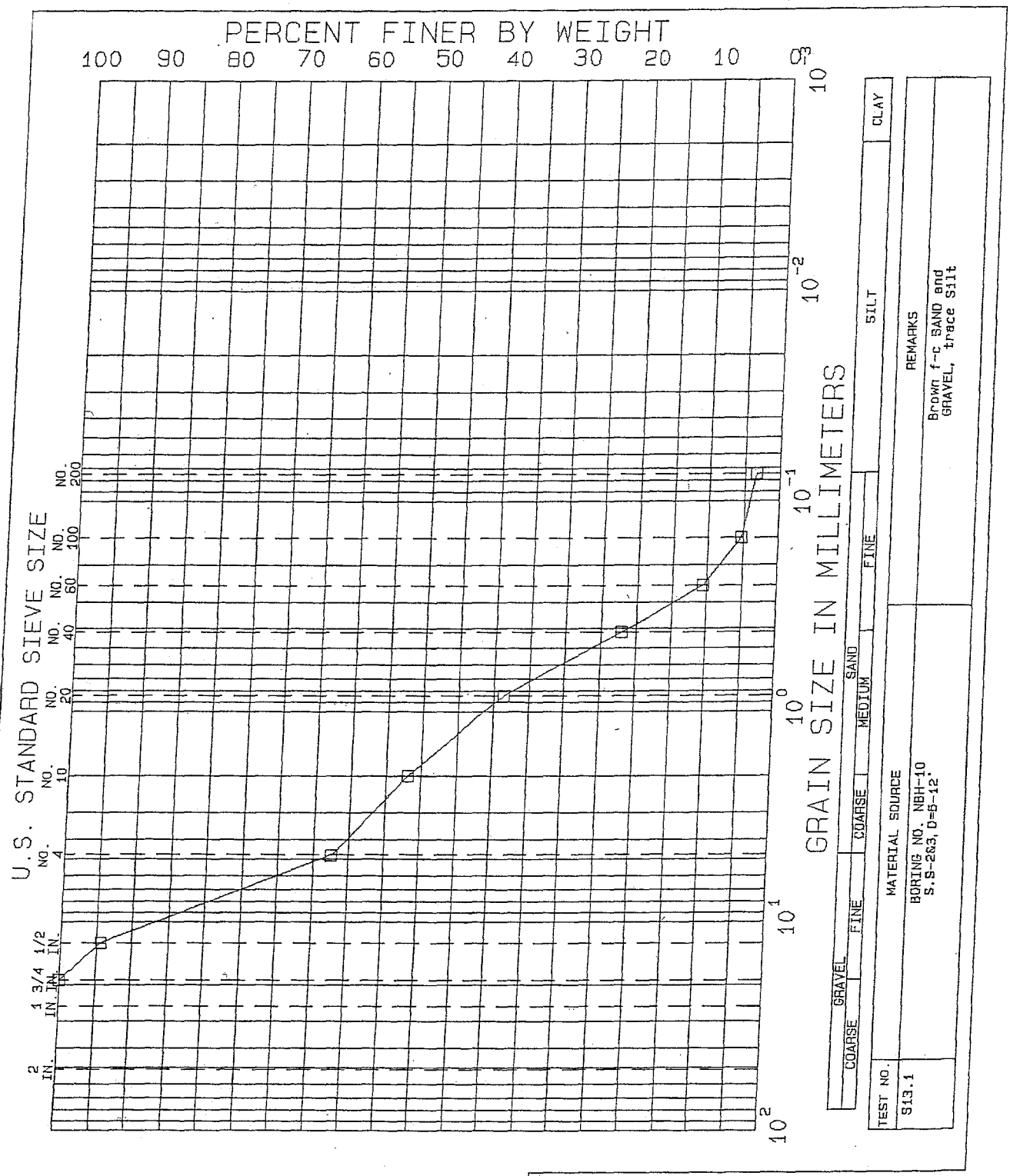


NEW BEDFORD HARBOR

NEW BEDFORD, MA.

GRADATION TESTS

BORING NO.	NBH-10	TEST SERIES	
SAMPLE	S-1	NO.	12
DEPTH	0-2'	DATE	Jan.03
TECH.	MST		
REVIEWER	MCM	FILE	L17571

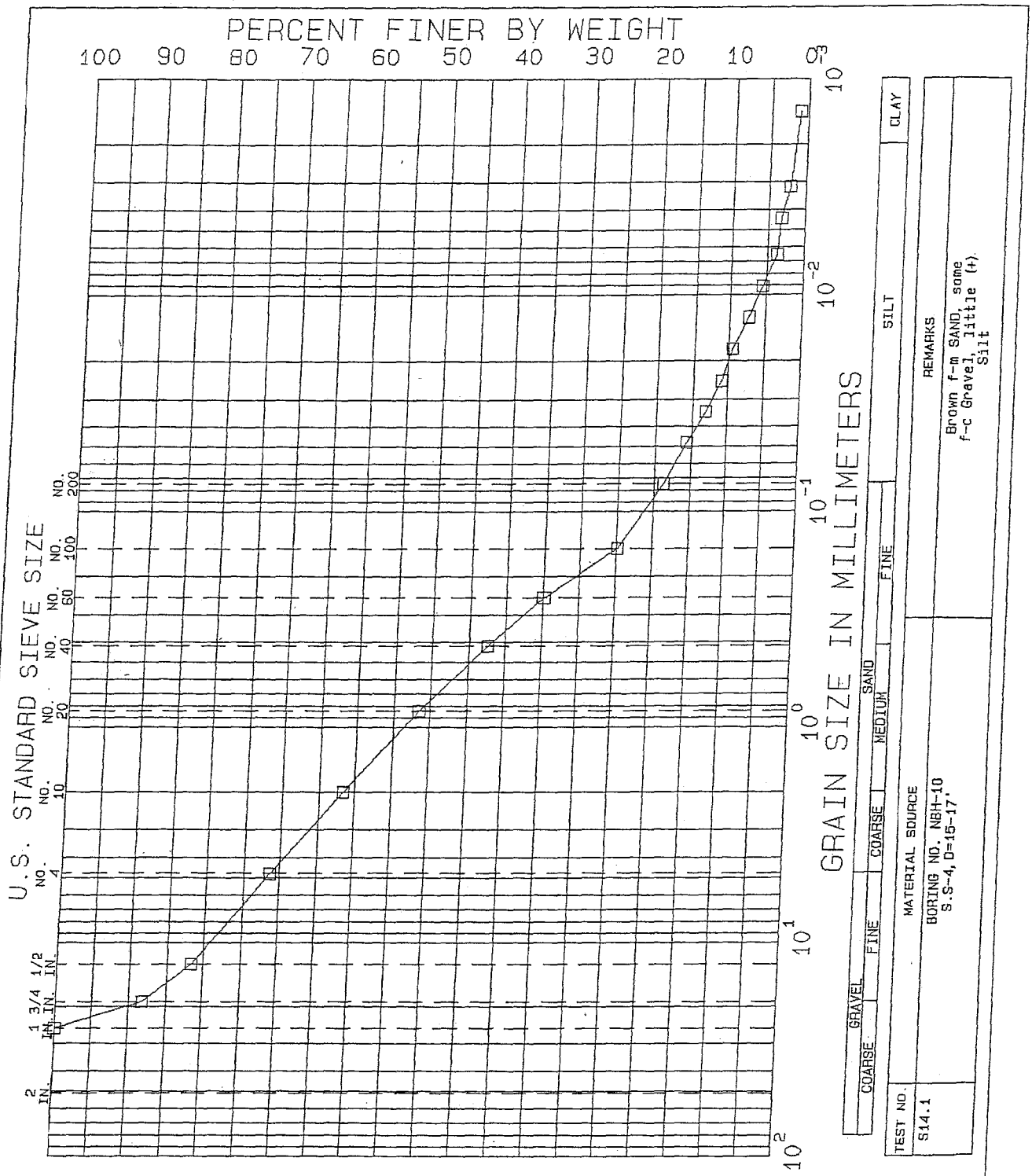


NEW BEDFORD HARBOR

NEW BEDFORD, MA.

GRADATION TESTS

BORING NO.	NBH-10	TEST SERIES	
SAMPLE	S-2&3	NO.	13
DEPTH	5-12'	DATE	Jan.03
TECH.	MST		
REVIEWER	MCM	FILE	L17571



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NEW BEDFORD, MA.

GRADATION TESTS

BORING NO.	NBH-10	TEST SERIES	
SAMPLE	S-4	NO.	14
DEPTH	15-17'	DATE	Jan.03
TECH.	MST		
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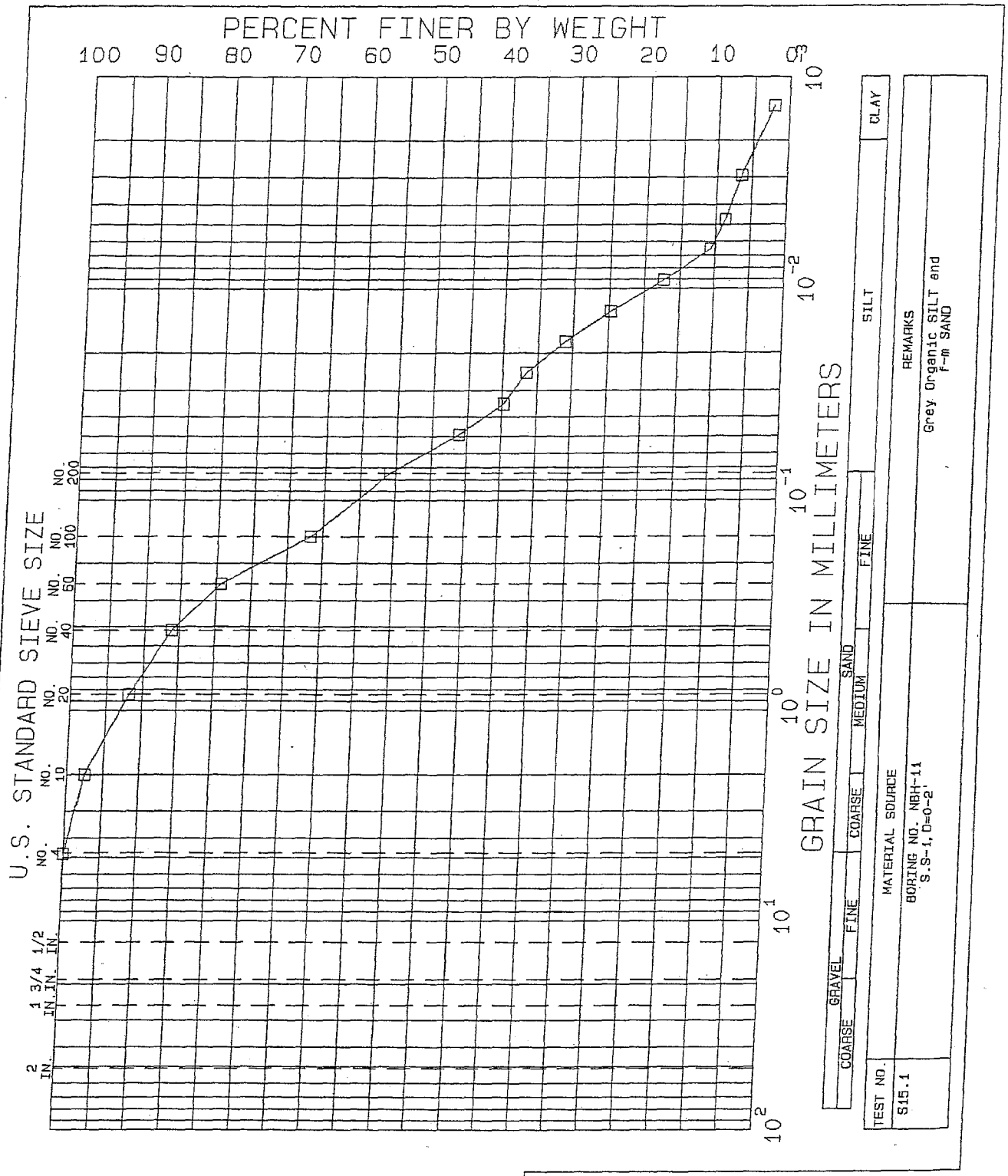

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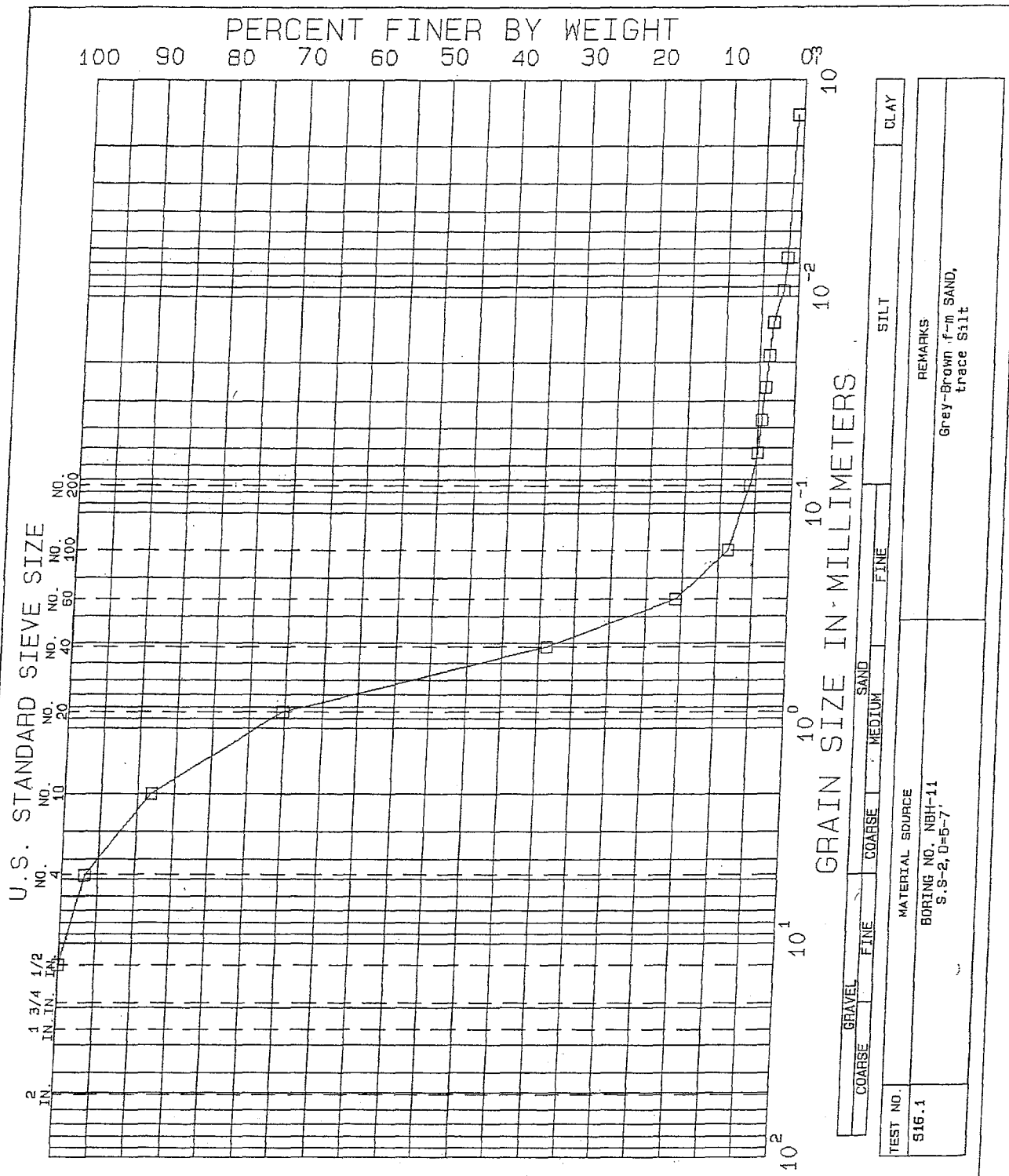
NEW BEDFORD, MA.

GRADATION TESTS

BORING NO.	NBH-11	TEST SERIES	
SAMPLE	S-1	NO.	15
DEPTH	0-2'	DATE	Jan.03
TECH.	MST		
REVIEWER	MCM	FILE	L17571



NEW BEDFORD HARBOR

NEW BEDFORD, MA.

GRADATION TESTS

BORING NO.	NBH-11	TEST SERIES	
SAMPLE	S-2	NO.	16
DEPTH	5-7'	DATE	Jan.03
TECH.	MST		
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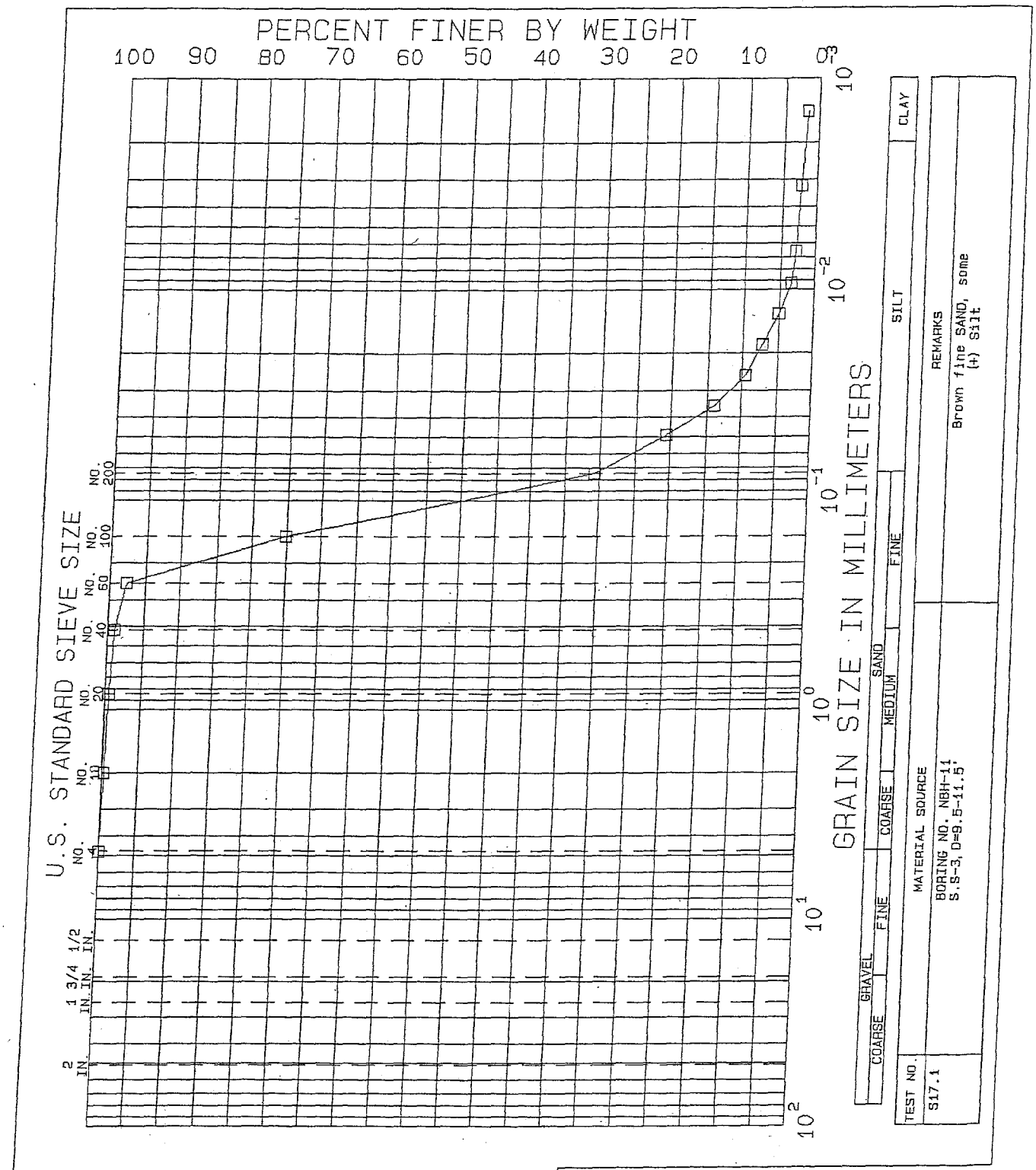

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NEW BEDFORD, MA.

GRADATION TESTS

BORING NO.	NBH-11	TEST SERIES	
SAMPLE	S-3	NO.	17
DEPTH	9.5-11.5'	DATE	Jan.03
TECH.	MST		
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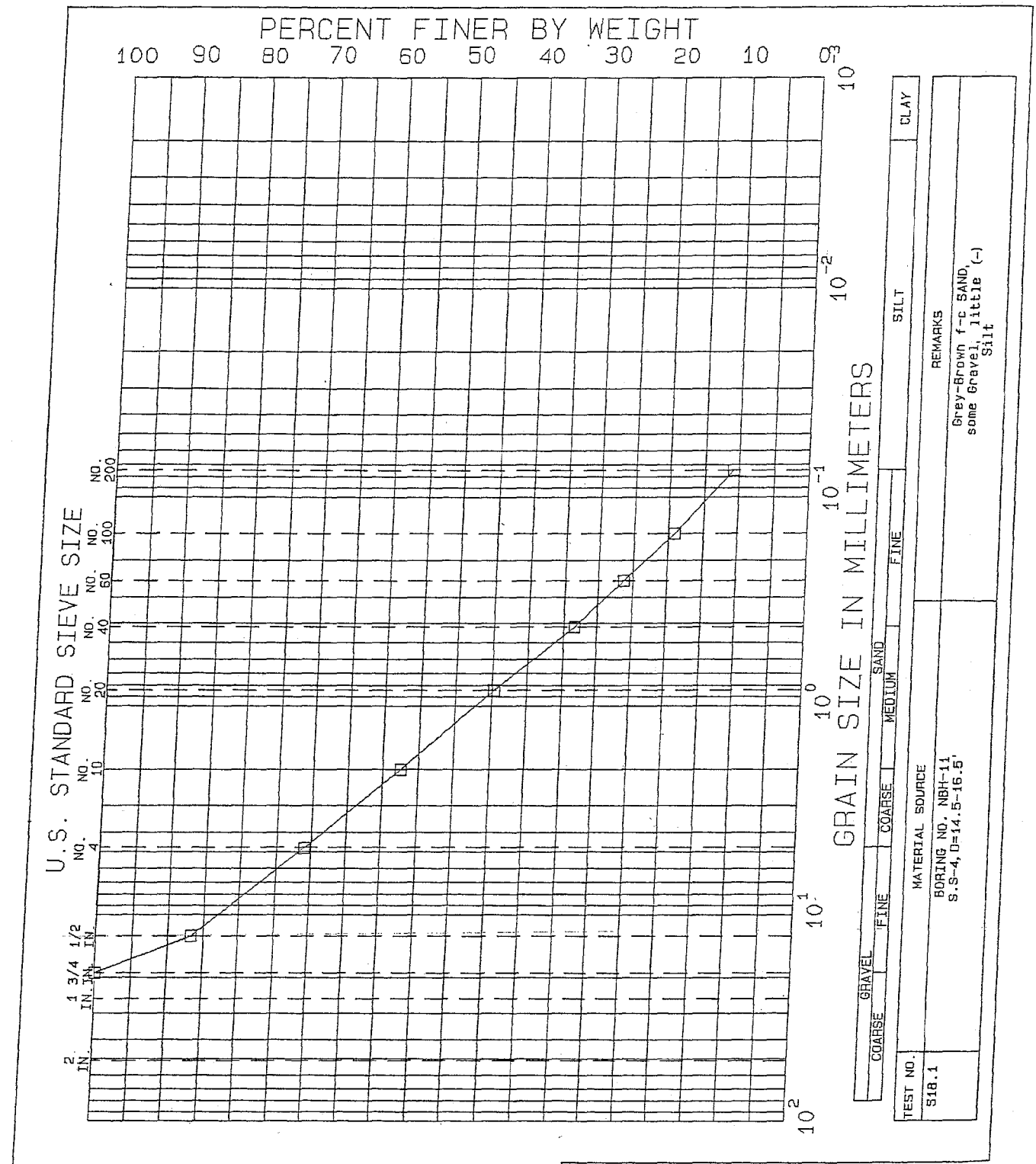
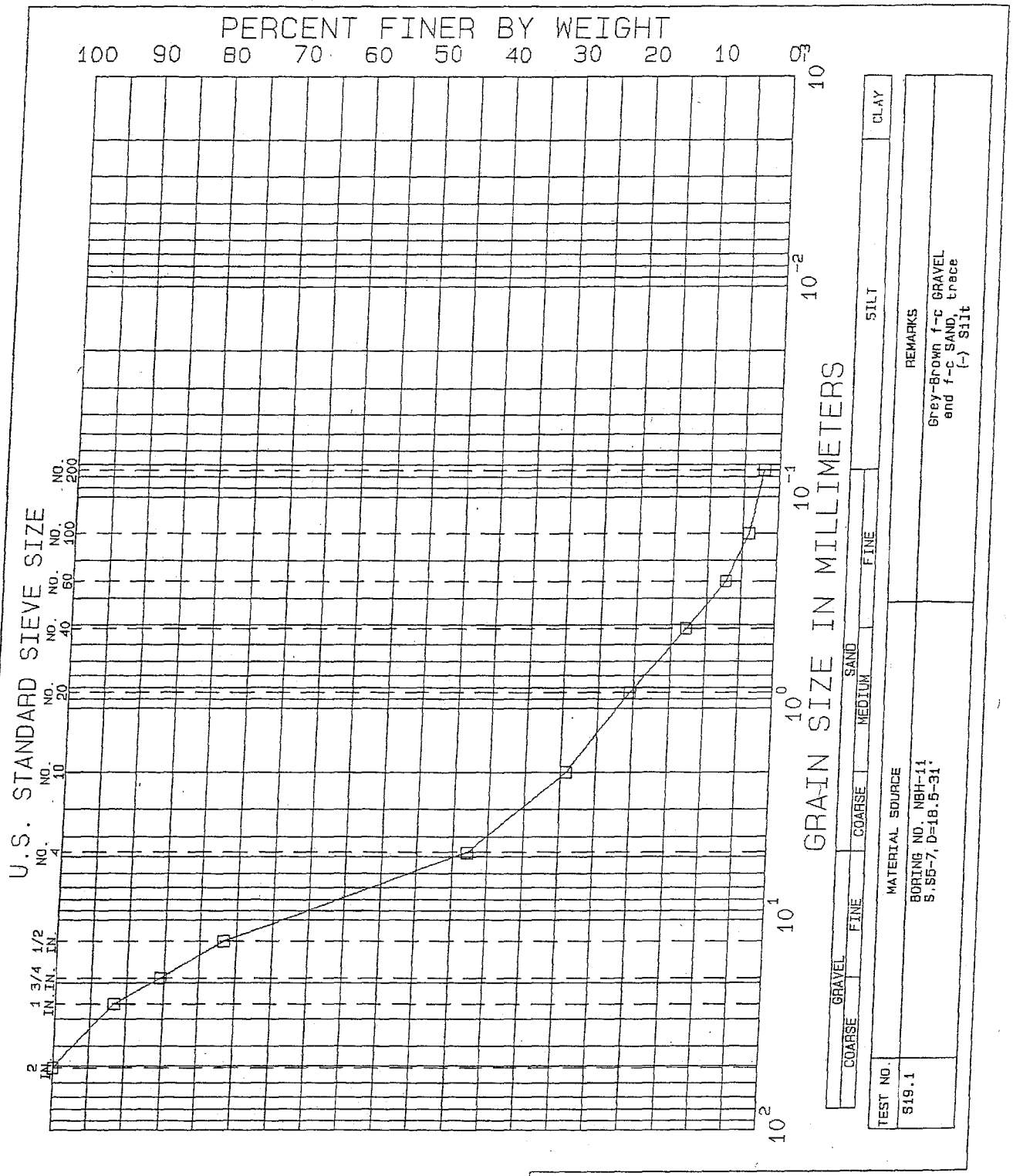


NEW BEDFORD HARBOR

NEW BEDFORD, MA.

GRADATION TESTS

BORING NO.	NBH-11	TEST SERIES	
SAMPLE	S-4	NO.	18
DEPTH	14.5-16.5'	DATE	Jan.03
TECH.	MST		
REVIEWER	MCM	FILE	L17571



NEW BEDFORD HARBOR

NEW BEDFORD, MA.

GRADATION TESTS

BORING NO.	NBH-11	TEST SERIES	
SAMPLE	S5-7	NO.	19
DEPTH	18.5-31'	DATE	Jan.03
TECH.	MST		
REVIEWER	MCM	FILE	L17571

APPENDIX B

MARINE GEOPHYSICAL SURVEYS: SEISMIC REFRACTION, SUB- AQUEOUS DISPOSAL

ADDENDUM TO MARINE GEOPHYSICAL SURVEYS: SEISMIC REFRACTION, SUB-AQUEOUS DISPOSAL CELL FEASIBILITY STUDIES, UPDATED DATA AND MODEL REVISION

NEW BEDFORD HARBOR
New Bedford, Massachusetts

Prepared for:

Massachusetts Coastal Zone Management Agency
251 Causeway Street, Suite 900
Boston, MA 02202

CZM

Submitted by:

Maguire Group Inc.

MAGUIRE GROUP

July 2003

ADDENDUM TO MARINE GEOPHYSICAL SURVEYS: SEISMIC REFRACTION, SUB-AQUEOUS DISPOSAL CELL FEASIBILITY STUDIES, UPDATED DATA AND MODEL REVISION

NEW BEDFORD HARBOR
New Bedford, Massachusetts

Prepared for:

Maguire Group Inc.

Prepared by:

Apex Environmental, Inc.
Boston, Massachusetts

July 2003

Revision	Date	Prepared By	Approved By	Pages Affected
1	8/25/03	T. Mannering	J. Borkland	All

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INTRODUCTION

This "Addendum to Marine Geophysical Surveys: Seismic Refraction, Sub-aqueous Disposal Cells Feasibility Studies – Updated Data and Model Revision, New Bedford Harbor" was prepared by Apex Environmental, Inc. (Apex) for The Maguire Group, Inc. (Maguire). Apex is supporting Maguire in its completion of feasibility studies concerning proposed Confined Aquatic Disposal (CAD) cells in New Bedford Harbor for The Massachusetts Coastal Zone Management (MACZM). MACZM is assessing the feasibility of locating a CAD cell or cells in New Bedford Harbor in order to alleviate the shortage of permanent dredge spoils disposal sites in the area under a comprehensive Dredged Material Management Plan (DMMP). Two discrete areas of interest within New Bedford Harbor are being evaluated as potential CAD sites: the Popes Island North Area, located northeast of Popes Island in New Bedford Harbor; and the Channel Inner Area, located north of Palmer Island in the lower portion of New Bedford Harbor (See Figure 1).

The initial geophysical investigation entitled "Marine Geophysical Surveys: Seismic Refraction, Sub-aqueous Disposal Cells Feasibility Studies, New Bedford Harbor-2001", was undertaken to provide information and data on the topography and character of the bedrock surface within the survey area. This report is an addendum to the 2001 investigation, and describes the methodology of merging additional geotechnical boring information into updated bedrock models, and the re-calculation of the capacity of the proposed CAD cells.

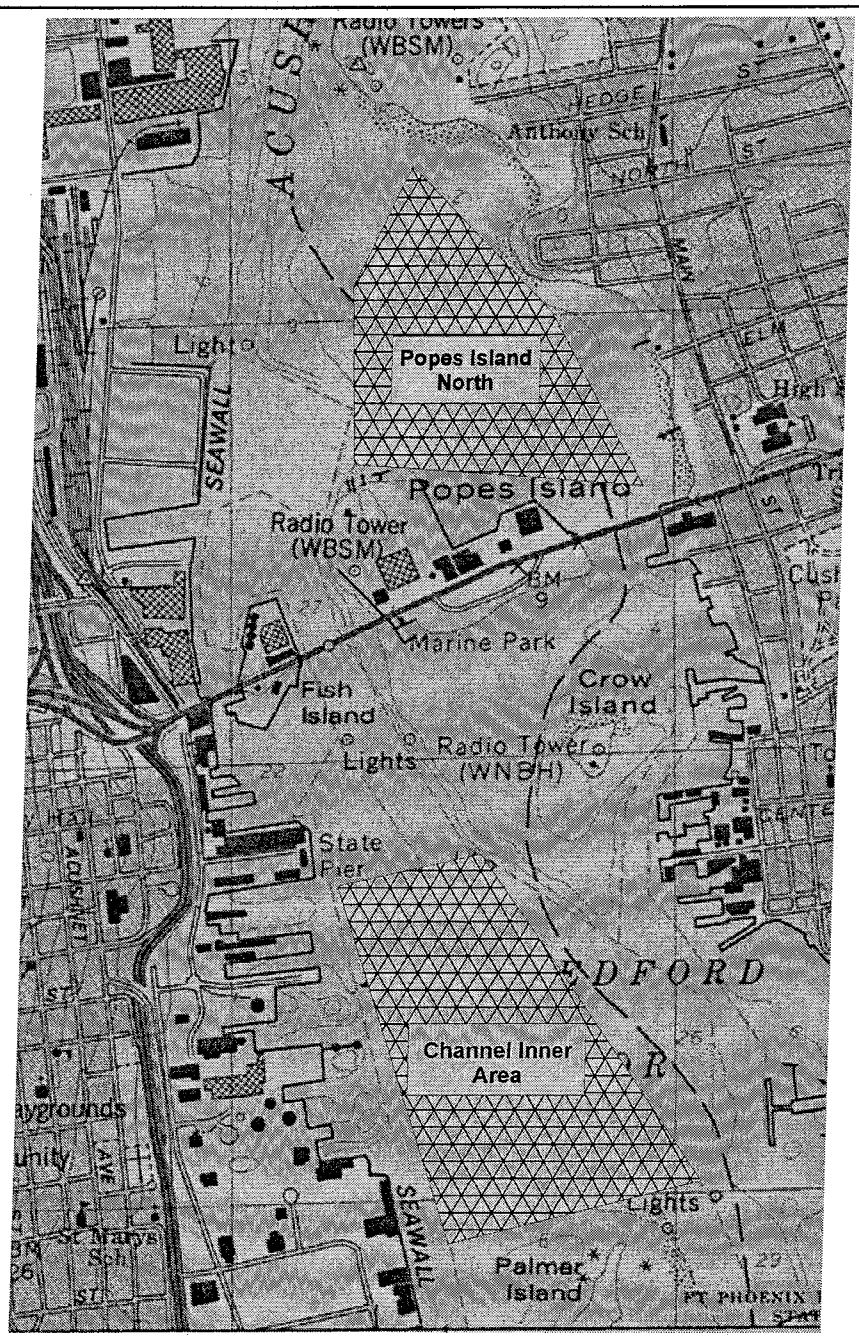
Seismic Refraction Background

Marine geophysical data was collected in two separate areas: Popes Island North Area, located north of Popes Island in the middle portion of New Bedford Harbor; and the Channel Inner Area, located northwest of the hurricane dike within the lower portion of New Bedford Harbor. These two areas represent the potential locations of the Confined Aquatic Disposal (CAD) cells proposed under MACZM's DMMP. Apex collected the initial seismic refraction data over the proposed CAD cell locations from April 19th through May 11th, 2001. Data was collected across a total of 23 seismic refraction spreads (or lines) in the two areas. Ten refraction spreads were collected in the Popes Island North Area, and thirteen spreads in the Channel Inner Area. Each refraction spread was collected utilizing a 48-channel seismograph (data was collected from 48 hydrophones deployed on the harbor bottom simultaneously), with a nominal hydrophone spacing of 30 feet, such that each spread measured approximately 1,410 feet in length. (Details of the data collection and processing techniques utilized for the 2001 investigation can be found in section 2 of Apex's initial report entitled *"Marine Geophysical Surveys: Seismic Refraction, Sub-aqueous Disposal Cell Feasibility Studies, New Bedford Harbor, 2001."*

Small seismic charges were emplaced into the sediment of the harbor bottom to provide seismic energy. The charges were set off, and a digital seismograph recorded the resulting voltage generated by each hydrophone on the harbor bottom. The voltage is displayed as a "wiggle trace" (or waveform) for each channel. The "wiggle trace" voltage fluctuations were recorded with respect to the time (in milliseconds) after the seismic shot was initiated. Selected example seismograph records are included in Appendix A. The computer program "SIP2" (Seismic Interpretation Program - Version 2) was utilized to enhance and filter the raw seismogram records.

Time vs. Distance plots (See Illustration 1) were created using the SIP program. These graphs are a plot of the time taken for energy to reach each hydrophone along the "seismic array" and are used to determine the number of layers (apparent in the data). Layer numbers were then assigned to the various layer segments interpreted from the "Time vs. Distance" plots - these layer numbers form the basis on which the model calculates the seismic velocities that it uses in the production of the resultant "depth

models". The Time vs. Distance plot is a graphical means of displaying seismic data, allowing an interpreter the ability to identify the correct number of distinct geologic layers to be incorporated into the computer models used to compute layer depth estimates. Layers are identified on the Time vs. Distance graphs by "inflection points" in the straight line trends, where a segment of points change slope from longer-time-per-relative-distance to shorter-time-per-relative-distance (see Illustration 1).



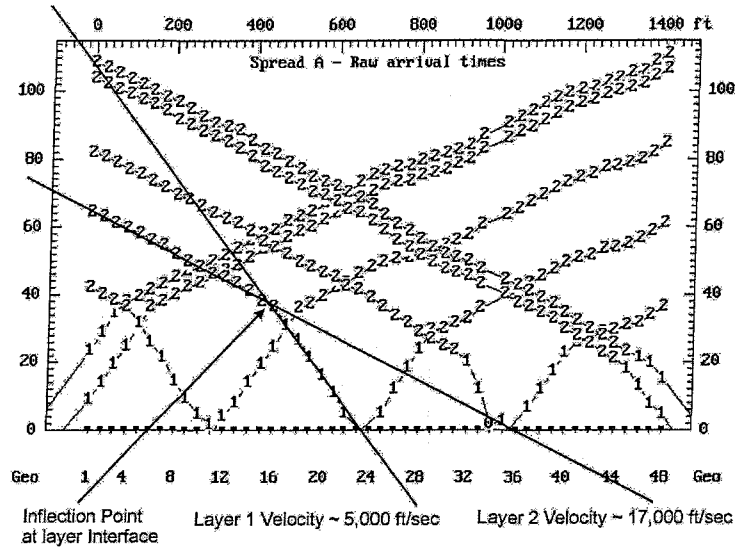


Illustration 1
Time-Distance Plot Example

Structure of the Report Presentation

This report summarizes the information obtained during this additional phase of the geophysical model preparation. This phase involved the merging of additional Phase II geotechnical boring information with the original (2001) seismic refraction data in order to update the bedrock models and calculate the potential capacity of the proposed CAD cells. The revised models for both Popes Island North and Channel Inner Areas are presented in this report.

This report is organized by sections that provide a functional framework for the presentation of additional boring information and model refinements. The following provides an outline of the approach to the presentation of the information.

Section 1.0 (Introduction) Describes the contractual framework for the program and background information and a brief description of the means and methods by which the initial seismic refraction data was collected.

Section 2.0 (Methods) Describes the means and methods by which the Phase II geotechnical information was incorporated into the previously generated seismic refraction models.

Section 3.0 (Results) Describes the revised findings of the Seismic Refraction investigation and also includes a discussion of the maps generated as part of the additional seismic data reduction process.

Section 4.0 (Conclusions) presents the conclusions of the investigation, including an assessment of the potential volumes of the proposed CAD cells.

Section 5.0 presents the limitations of the program.

Section 6.0 provides a list of references cited throughout this report.

RE-INTERPRETATION AND ADDITION OF NEW INFORMATION

Calibration Data

The depth to bedrock information collected from two phases of geotechnical borings drilled in the harbor was used to calibrate the parameters utilized as inputs to the seismic models. The calibration of the Seismic Interpretation Program (SIP) models was an iterative process that involved changing the input parameters of layer velocities and "first pick" layer assignments until there was agreement with existing information (boring logs, other seismic model lines at crossing points, and other geophysical information). The calibration took as many as several dozen iterations to resolve all discrepancies, depending on the data particulars and the line location. The initial 2001 models were used to select the Phase II boring locations in order to provide the most beneficial bedrock elevation calibration data. The additional calibration points were selected based upon locations where seismic lines crossed within areas of low model confidence in order to take advantage of higher data density in those areas. Coincident line boring selection also allows the boring information to be used to calibrate more than one line. Calibration borings were also performed in areas that had the greatest change in elevation over a short distance in order to minimize the discrepancies within the models.

The Phase I geotechnical-drilling program was conducted between June 20 and July 13, 2001 and provided seven calibration points (NBH-1 through 7). These boring locations were used in the calibration of the initial model. The Phase II drilling program was conducted between October 15 – 23, 2002, providing an additional four calibration points (NBH-8 thru NBH-11), which were used for this re-interpretation.

Both Phase I & II geotechnical drilling programs were conducted with a barge mounted drill rig in the harbor. Samples of soil were collected during the drilling program using a split-spoon sampler. Rock-core samples were collected from the borings using a diamond-bit rock core barrel.

Data Re-Processing

Initial re-processing of the data was performed using the United States Geological Survey (USGS) seismic interpretation software "SIP" ('Seismic Interpretation Program'). This software is a standard processing software package recognized by the industry and has been used by the USGS for many of the seismic refraction applications completed by the government.

Data processing began as additional depth to bedrock information was made available. Initial depth-to-bedrock information was re-run using the final models from 2001 as a starting point. Based on the comparisons between the existing models and the new depth to bedrock elevation information gained through the 2002 drilling program, various lines were re-analyzed using the following steps:

1. From the bedrock elevation corrected data, "Time vs. Distance" (see Illustration 1) plots were created, allowing the interpreter to determine the number of layer responses (apparent in the data), which are used by the program to create "layer models".
2. Layer numbers were assigned to the various layer segments interpreted from the "Time vs. Distance" plots. These layer numbers form the basis on which the model calculates the seismic velocities that it uses in the production of the resultant "depth models".
3. SIP modeling was conducted using the above as input information, and resultant depth profiles were generated. Models were re-run adjusting the layer velocities until the resulting model was correctly calibrated to specific boring elevations. The velocity issues were studied in further runs of the modeling program, and the inconsistencies were rectified, as were errors

resulting from improper initial "picks" or elevation errors. A more detailed examination of the "Time vs. Distance" plots was completed to refine the models in both areas. Additional velocity calculations were utilized to help correct for (as well as to illustrate) potential fractures, high velocity zones (HVZ) and low velocity zones (LVZ). This information was inserted back in the SIP software in order to re-run partial lines (zeroing out particular phones) at the modified velocities. The resulting information, analyzed using the newly calculated differing velocities, were combined to produce a more accurate final seismic line. The approach utilized was an iterative process that involved the merging and interpretation of all lines into a single model in order to identify potential modeling problems.

Synthesis of Geophysics with Geotechnical Borings

The geophysical data from the Seismic Refraction program was processed and interpreted with historical geotechnical boring information as well as that collected in the Phase II geotechnical program. Where the seismic lines crossed directly over a boring location, the boring data was utilized to calibrate the depth of bedrock models generated as part of the seismic data processing.

Table 1. Geotechnical borings collected as part of this program were utilized in the calibration of the following seismic lines (See Figures 3 and 4 for locations).

Phase	Area	Boring ID	Bedrock Ele (NGVD29)	Line/Positions
I	Popes Island	NBH-1	-90.2 feet	Seismic Line 20 & 3
I	Popes Island	NBH-2	-63.8 feet	Seismic Lines 4 & 5
I	Popes Island	NBH-3	-61.7 feet	Seismic Lines 1, 2 & 7
I	Channel Inner	NBH-4	-58.5 feet	Seismic Line 11
I	Channel Inner	NBH-5	-48.1 feet	Seismic Lines 13 & 15
I	Channel Inner	NBH-6	-54.6 feet	Seismic Lines 16 & 19
I	Channel Inner	NBH-7	-62.7 feet	Seismic Lines 7, 18 & 21
II	Popes Island	NBH-8	-92.5 feet	Seismic Lines 5 & 7
II	Channel Inner	NBH-9	-49.0 feet	Seismic Lines 11 & 18
II	Channel Inner	NBH-10	-51.1 feet	Seismic Lines 14 & 22
II	Channel Inner	NBH-11	-62.2 feet	Seismic Lines 10 &17

Additional historic boring information (Ebasco, 1988) was used in the contouring process to create the bedrock surfaces. However, this data was not used for direct calibration purposes because details of the data collection process were not known. Ebasco borings utilized are listed below.

- Boring BW-103 (-34 feet)
- Boring BW-104 (-39 feet)
- Boring BW-109 (-52 feet)
- Boring BW-110 (-72 feet)
- Boring BW-111 (-79 feet), and
- Boring BW-112 (-49 feet).

The calibrated seismic lines and selected borings were incorporated into a single interpretation of the bedrock surface (see Figures 3 and 4). The bedrock surface was created by integrating lines of bedrock elevation data (along the seismic profiles) with spot elevation data (from the selected borings listed above as well as elevations obtained from the calibration borings noted above), and gridding and contouring the resulting merged data set.

Data Interpretation

Interpretation of the data involved the refining of the models and comparison of the seismic data with calibration data until the most likely model (most reasonable interpretation of data) was found. The computer program Geosoft Oasis Montaj (Montaj) V 5.15, a data processing and analysis (DPA) system for earth science applications, was used to produce color-contoured maps for the project. The Montaj software was used to integrate the revised modeled bedrock elevation surface information and boring elevation into geo-referenced maps.

Data interpretation involved repeating many of the initial data processing steps described previously until the most appropriate best-fit model was generated. For some of the records, the "first breaks" of the seismic records were "re-picked", where the initial "first break" interpretation could be improved in order to achieve a better-fit model.

Another adjustment that was made during data interpretation was the modification of hydrophone layer assignments on the "Time vs. Distance" plots. These layer assignments form the basis upon which the model calculates seismic velocities which are uses in the production of the resultant depth models. Changing the layer assignments revises the morphology of the model, both the shape and depth of interface.

RESULTS

Profiles generated from the data, using the subsurface modeling software package SIP2, indicated that the bedrock character in both areas of interest is irregular, and marked by undulations of the bedrock surface. The results of the re-interpretation of the refraction data are best conveyed as contoured surface maps of the bedrock as determined from the interpreted seismic data. Figures 2 and 3 depict the results of the seismic data interpretation for Popes Island and Channel Inner area respectively. The figures display the inferred top of bedrock surface as determined from the seismic refraction data as a color-coded contour elevation (referenced to NGVD29), in order to aid in the identification of trends in the surface (i.e., blue areas are deeper and red/pink/orange areas are shallower). The location of borings used to "calibrate" the seismic interpretations is also shown on these figures. The bedrock models were calibrated such that the elevation of bedrock, at any given line crossing, is within three feet at line intersection points.

The "highest" bedrock surface elevation noted in the Popes Island North Area is in the range of –28 feet (NGVD29). The "lows" in the bedrock topography, noted from the data within the possible CAD footprint are in the –95 foot range (NGVD29). The mean elevation of the bedrock surface in the Popes Island North area is –66 feet (NGVD29). (See Figure 2). The "highest" bedrock surface elevation noted in the Channel Inner Area is in the range of –35 feet (NGVD29). The "lows" in the bedrock topography, noted from the data within the possible CAD footprint are in the –66 foot range (NGVD29). The mean elevation of the bedrock surface in the Channel Inner area is –52 feet (NGVD29). (See Figure 3).

Model Confidence

Maps showing the seismic model confidence have been generated and are shown in Figures 4 and 5. These maps were constructed based on the quality of the raw data collected in the field and on issues inherent in the data such as LVZ and potential fracturing, which can reduce the accuracy of the velocities and corresponding depths.

Popes Island North Area

Data collected in the Popes Island North Area exhibited low "noise" and was of high quality. As a result, there is a high confidence in the modeled bedrock surface there. Adding to the confidence in this area is supporting seismic data northwest of the survey area (Foster Wheeler, 2001). There is an area on the western edge of the model which has been assessed a "moderate" confidence level, due in part to the deep bedrock and the changing harbor topography.

Channel Inner Area

Data collected in the Channel Inner Area had a large amount of inherent "noise" due to the many shipping and fishing businesses around the harbor front. Background noise was greatest on the western (New Bedford) side of the harbor, and affected the western extents of most seismic lines. Extremely shallow bedrock found in the southern portion of the study area added to the "noisy" or low quality data. Potential faulting or fracturing that trends north-south through the center of the area also affected seismic velocities and the models calculated using these velocities. Every effort was made to filter and compensate for the effects of LVZs on the models, but the amplitude and strength of the raw signal was severely diminished after passing through these zones. The Channel Inner Area confidence map (Figure 5) shows a moderate model confidence level on approximately the western ¼ of the survey area because of the uncertainties discussed above.

Volume Calculations

Utilizing cell configuration parameters provided by Maguire engineers, existing bathymetric information, and the results of the seismic refraction survey, Apex performed preliminary volume calculations for both the Popes Island North and Channel Inner Areas. Calculations were performed using a combination of US Army Corps of Engineers (USACE) (Conditions survey 1996) and Apex Environmental, Inc. (Post dredge survey State Pier Dredge Project, 2002) bathymetry data, and the revised 2002 seismic refraction bedrock surface elevation calculated as part of this program. In calculating the volume of each cell, a slope of 3:1 was assumed.

It should be noted that the bathymetry data obtained from the USACE was supplied to Apex as a subset of the shallowest soundings within a 1"=100' paper plot. As such this data provides only an approximate pre-engineering mudline surface. Possible artifacts or errors may also exist in the Seismic Refraction surface due to the contouring algorithms that extrapolate the data between successive survey lines. In order to account for these uncertainties, contingency volumes have been incorporated into the various volume estimates. The volume calculations completed for this program, along with the relevant contingency volumes, are presented in the subsections below.

Popes Island Area

Volumes were calculated using a proposed configuration of six cells in the Popes Island North Area (See Illustration 2). Cell 1 was designed for a capacity of 1.8 million cubic yards. Cells 2 through 6 were designed to accommodate approximately 50,000 cubic yards of material each. A separation distance of 100 feet was maintained between each of the cells. For the cell volume calculations, a bedrock "buffer" of 10 feet was assumed so that the base of the cells terminate in sediment material. There is an additional loss of cell volume since the upper four (4) feet of sediment in the Popes Island North Area is assumed to be contaminated and should be placed back into the cell taking up volume associated with the top four (4) feet of material. Additionally, a cap of four (4) feet of "clean" material will be placed on top, for a cell total of eight (8) feet of depth subtracted from the calculations for each cell. Table 2 below summarizes the calculations for the Popes Island North Area. Illustration 3 shows a graphical breakdown of the division of available volume and geological types.

Table 2. Volume Calculation summary for the Popes Island North Area CAD configuration shown in Illustration 2.

Cell	Average Bedrock Elevation	Average Bathymetric Elevation	Sediment Thickness	Available Dredge Depth	Total Dredged Volume	Total Storage Capacity
1	-75 ft	-8 ft	**67 ft**	57 ft	**2,275,000 CY**	**1,841,000 CY**
2	-50 ft	-6 ft	**44 ft**	34 ft	**82,375 CY**	**48,100 CY**
3	-54 ft	-8 ft	**46 ft**	36 ft	**83,800 CY**	**49,500 CY**
4	-57 ft	-9 ft	**48 ft**	38 ft	**84,950 CY**	**50,700 CY**
5	-58 ft	-9 ft	**47 ft**	39 ft	**65,450 CY**	**51,200 CY**
6	-57 ft	-8 ft	**49 ft**	39 ft	**85,450 CY**	**51,200 CY**

Average Bedrock Elevation –Average Bathymetric Elevation = Sediment Thickness
Sediment Thickness – Bedrock buffer (10-feet) = Available Dredge Depth
Total Dredged volume = Available Dredge Depth X (length and width of cell) using 3:1 slope
Total Storage Capacity = Total Volume dredge – (top 4-foot contaminated material)

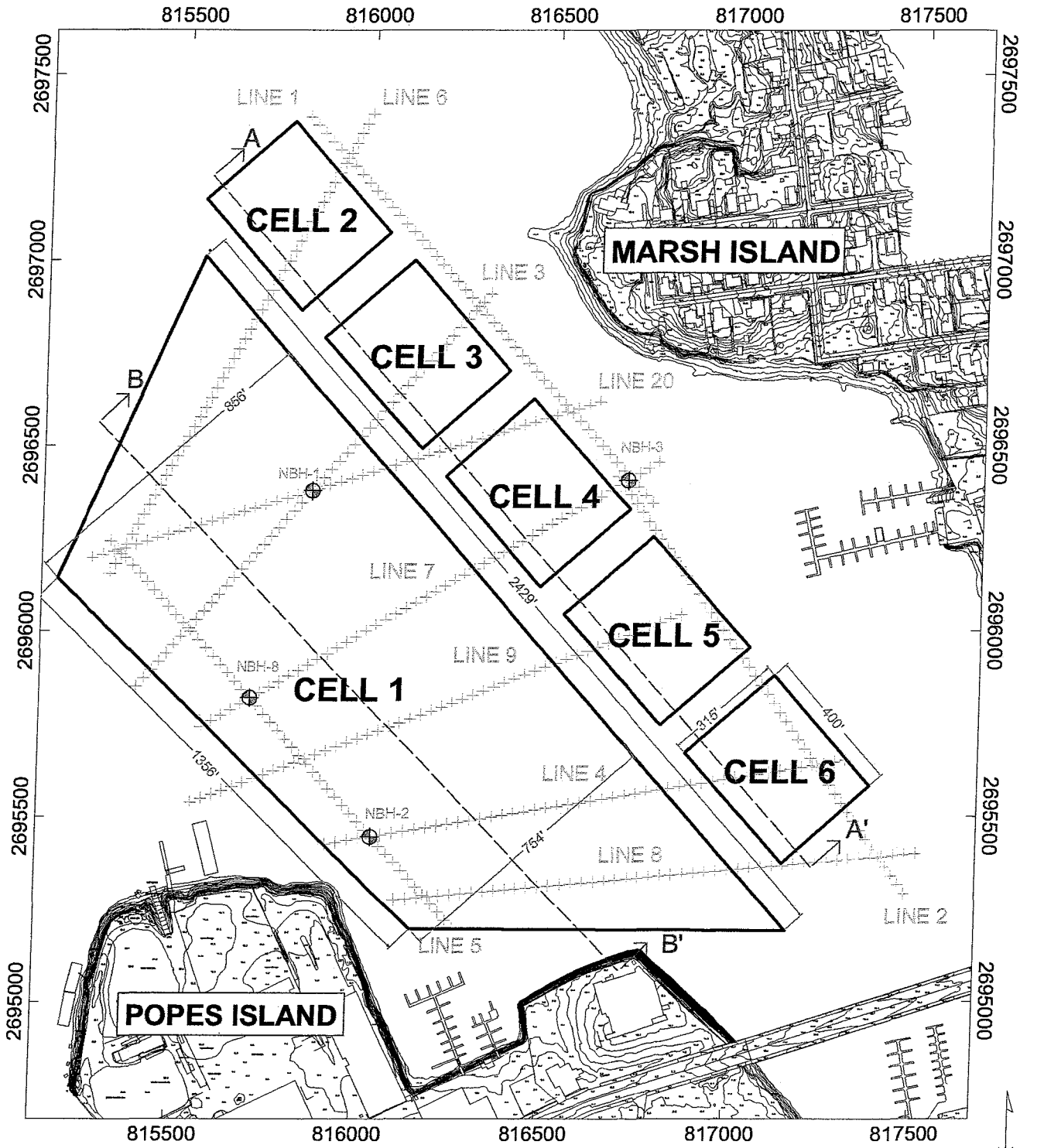
Table Assumptions:

- All volumes were calculated as Volume-Of-the-Void (VOV) and do not take into account sediment properties (i.e. bulking, etc.). The volumes are approximate, and are based on average elevations within each proposed cell.
- **Average Bedrock Elevations** were calculated using Oasis Montaj V5.16 minimum curvature model of the bedrock surfaces within each of the proposed CAD cells. A mathematical modeling cell size of 12 was maintained to construct the minimum curvature model of the bedrock surface.
- **Average Bathymetric Elevations** were calculated in a manner similar to the Average Bedrock Elevations, utilizing the USACE bathymetric data 1997 and a mathematical cell size of 8.
- **Sediment Thickness** was calculated by subtracting Bathymetric/Mud line Elevation from the Bedrock Elevation.
- **Available Dredge Depth** is the depth of material excavated in order to leave a 10-foot buffer so that the proposed CAD cell terminates in sediment material above modeled bedrock. The available dredge depth can also be thought of as the depth of material to the bottom of the proposed CAD cell.
- **Total Volume Dredged** is the amount of material needed to be removed to form the proposed CAD cell given the average dredge depth and assuming a 3:1 (H:V) side slope for each cell.
- **Total Storage Capacity** is the final volume after disposing of the top 4-feet of "contaminated" material back into the cell and allowing for the 4-feet of clean cap material.

Cross Section Profiles –Popes Island North Area

Stratagraphic cross sections were extracted from profile cuts through proposed CAD Cells 2 – 6 (A-A') and CAD Cell 1 (B-B' in the Pope Island North Area). The locations of the cross sections are shown on Illustration 2. The cross sections are presented in Illustrations 4 (A-A') and 5 (B-B'). The cross sections were constructed by digitizing the modeled bedrock surface and the bathymetric surface over the length of the profile. Boring information collected as part of the project was extrapolated to the profile center line to depict the types and thickness of geology encountered.

Illustration 2 Popes Island Area Proposed CAD Cell Configuration



LEGEND

- PROPOSED CELL EXTENT
- HYDROPHONE LOCATION
- BORING LOCATION
- A A' CROSS SECTION LOCATION

Scale 1:4800

250 0 250

US survey foot

NAD83(CSRS98) / Massachusetts CS83 Mainland zone

NOTES:

1. Base Plan of the New Bedford harbor area was obtained from the US Army Corps of Engineers and has not been field verified.
2. Coordinates are shown in the State Plane Coordinate System, Massachusetts Mainland Zone 2001, Referenced to the 1983 North American Datum (NAD83). Vertical Datum referenced to NGVD29.
3. Boring information and position supplied by The Maguire Group.

REV.	DESCRIPTION	BY	DATE

ILLUSTRATION 2

POPES ISLAND NORTH AREA - CELL CONFIGURATION
SEISMIC REFRACTION - 2002 REVISED MODEL

MIDDLE NEW BEDFORD HARBOR
BRISTOL COUNTY, NEW BEDFORD, MASSACHUSETTS

Apex

374 Congress St
Suite 500
Boston MA 02210
617 728-0070

SCALE: 1" = 400'	DRAWN:	DESIGN:	CHECKED:	PROJECT # 6610.201.01
	TDM	TDM	JAB	SHEET 1 OF 1

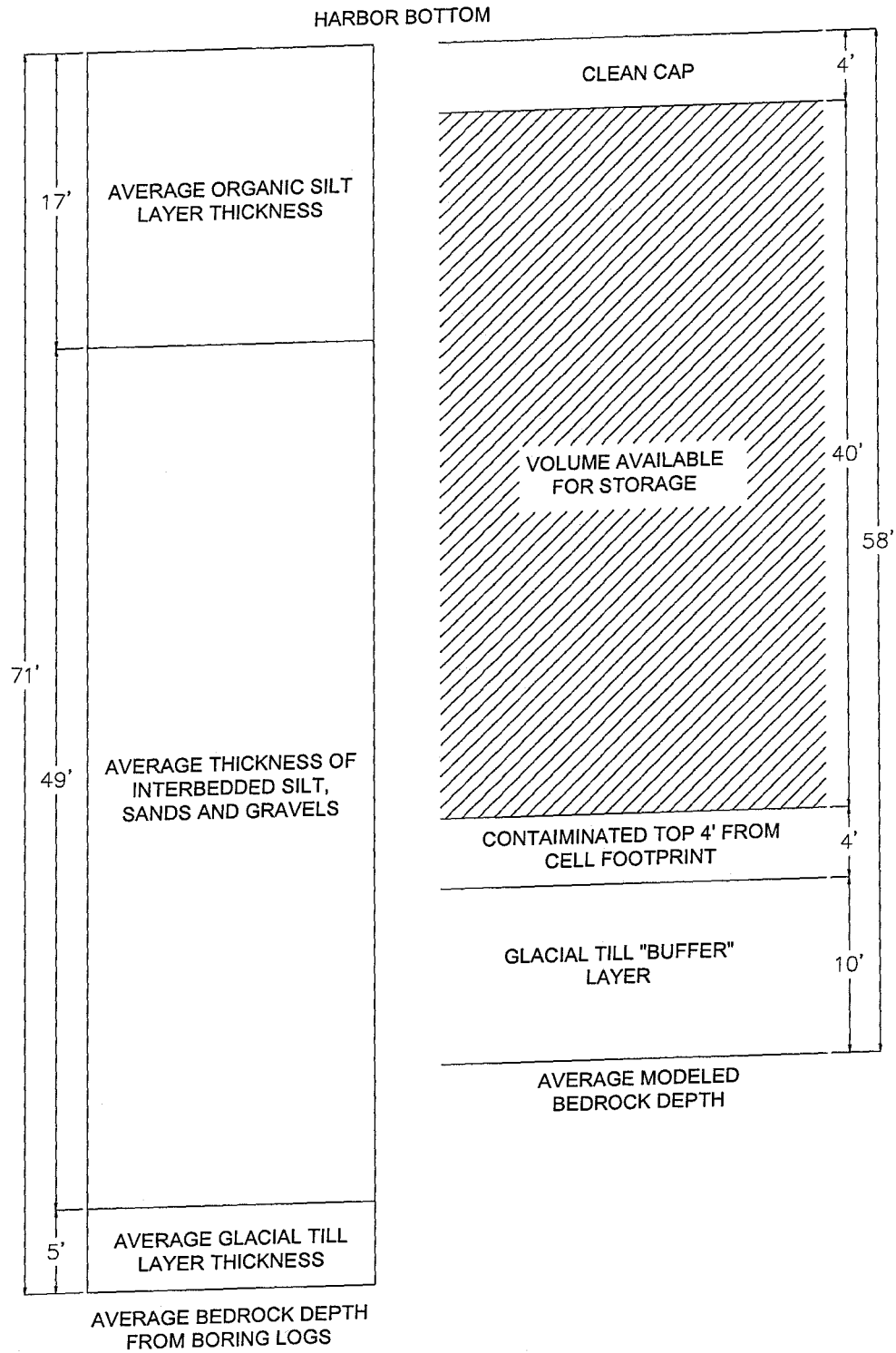


Illustration 3
Breakdown of the division of available storage capacity and an average geological cross section from the borings conducted in the Popes Island Area.

Illustration 4 Popes Island Area Cross Section Profile A-A'

ADDENDUM TO MARINE GEOPHYSICAL SURVEYS: SEISMIC REFRACTION, SUB-AQUEOUS DISPOSAL CELL FEASIBILITY STUDIES, UPDATED DATA AND MODEL REVISION

NEW BEDFORD HARBOR
New Bedford, Massachusetts

Prepared for:

Massachusetts Coastal Zone Management Agency
251 Causeway Street, Suite 900
Boston, MA 02202

CZM

Submitted by:

Maguire Group Inc.

MAGUIRE GROUP

July 2003

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Maguire Group Inc.

Prepared by:

Apex Environmental, Inc.
Boston, Massachusetts

July 2003

Revision	Date	Prepared By	Approved By	Pages Affected
1	8/25/03	T. Mannering	J. Borkland	All

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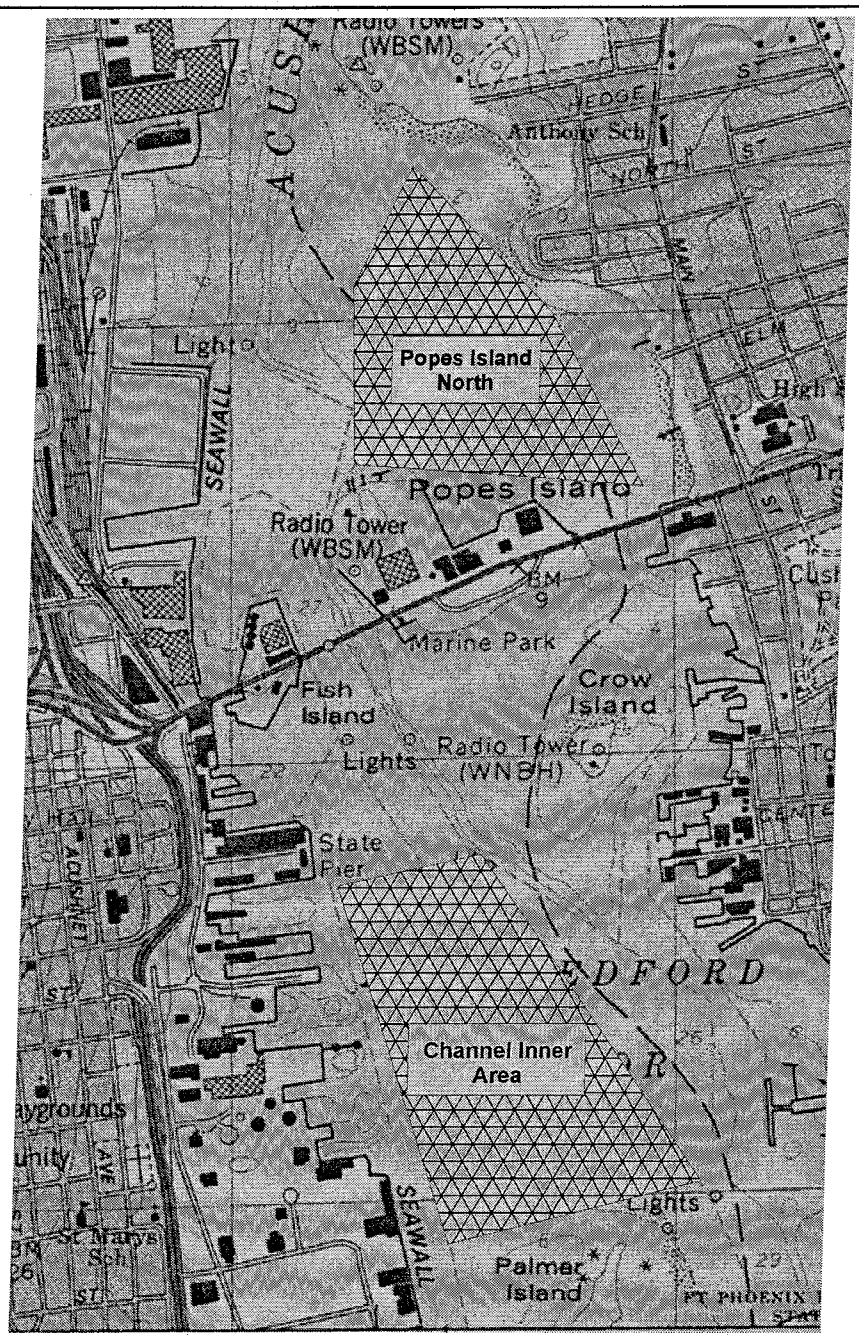
Small seismic charges were emplaced into the sediment of the harbor bottom to provide seismic energy. The charges were set off, and a digital seismograph recorded the resulting voltage generated by each hydrophone on the harbor bottom. The voltage is displayed as a "wiggle trace" (or waveform) for each channel. The "wiggle trace" voltage fluctuations were recorded with respect to the time (in milliseconds) after the seismic shot was initiated. Selected example seismograph records are included in Appendix A. The computer program "SIP2" (Seismic Interpretation Program - Version 2) was utilized to enhance and filter the raw seismogram records.

Time vs. Distance plots (See Illustration 1) were created using the SIP program. These graphs are a plot of the time taken for energy to reach each hydrophone along the "seismic array" and are used to determine the number of layers (apparent in the data). Layer numbers were then assigned to the various layer segments interpreted from the "Time vs. Distance" plots - these layer numbers form the basis on which the model calculates the seismic velocities that it uses in the production of the resultant "depth

models". The Time vs. Distance plot is a graphical means of displaying seismic data, allowing an interpreter the ability to identify the correct number of distinct geologic layers to be incorporated into the computer models used to compute layer depth estimates. Layers are identified on the Time vs. Distance graphs by "inflection points" in the straight line trends, where a segment of points change slope from longer-time-per-relative-distance to shorter-time-per-relative-distance (see Illustration 1).



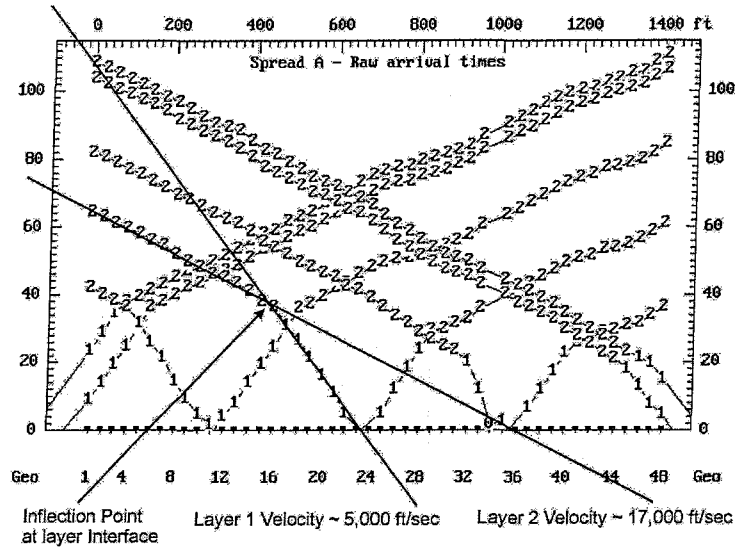


Illustration 1
Time-Distance Plot Example

Structure of the Report Presentation

This report summarizes the information obtained during this additional phase of the geophysical model preparation. This phase involved the merging of additional Phase II geotechnical boring information with the original (2001) seismic refraction data in order to update the bedrock models and calculate the potential capacity of the proposed CAD cells. The revised models for both Popes Island North and Channel Inner Areas are presented in this report.

This report is organized by sections that provide a functional framework for the presentation of additional boring information and model refinements. The following provides an outline of the approach to the presentation of the information.

Section 1.0 (Introduction) Describes the contractual framework for the program and background information and a brief description of the means and methods by which the initial seismic refraction data was collected.

Section 2.0 (Methods) Describes the means and methods by which the Phase II geotechnical information was incorporated into the previously generated seismic refraction models.

Section 3.0 (Results) Describes the revised findings of the Seismic Refraction investigation and also includes a discussion of the maps generated as part of the additional seismic data reduction process.

Section 4.0 (Conclusions) presents the conclusions of the investigation, including an assessment of the potential volumes of the proposed CAD cells.

Section 5.0 presents the limitations of the program.

Section 6.0 provides a list of references cited throughout this report.

RE-INTERPRETATION AND ADDITION OF NEW INFORMATION

Calibration Data

The depth to bedrock information collected from two phases of geotechnical borings drilled in the harbor was used to calibrate the parameters utilized as inputs to the seismic models. The calibration of the Seismic Interpretation Program (SIP) models was an iterative process that involved changing the input parameters of layer velocities and "first pick" layer assignments until there was agreement with existing information (boring logs, other seismic model lines at crossing points, and other geophysical information). The calibration took as many as several dozen iterations to resolve all discrepancies, depending on the data particulars and the line location. The initial 2001 models were used to select the Phase II boring locations in order to provide the most beneficial bedrock elevation calibration data. The additional calibration points were selected based upon locations where seismic lines crossed within areas of low model confidence in order to take advantage of higher data density in those areas. Coincident line boring selection also allows the boring information to be used to calibrate more than one line. Calibration borings were also performed in areas that had the greatest change in elevation over a short distance in order to minimize the discrepancies within the models.

The Phase I geotechnical-drilling program was conducted between June 20 and July 13, 2001 and provided seven calibration points (NBH-1 through 7). These boring locations were used in the calibration of the initial model. The Phase II drilling program was conducted between October 15 – 23, 2002, providing an additional four calibration points (NBH-8 thru NBH-11), which were used for this re-interpretation.

Both Phase I & II geotechnical drilling programs were conducted with a barge mounted drill rig in the harbor. Samples of soil were collected during the drilling program using a split-spoon sampler. Rock-core samples were collected from the borings using a diamond-bit rock core barrel.

Data Re-Processing

Initial re-processing of the data was performed using the United States Geological Survey (USGS) seismic interpretation software "SIP" ('Seismic Interpretation Program'). This software is a standard processing software package recognized by the industry and has been used by the USGS for many of the seismic refraction applications completed by the government.

Data processing began as additional depth to bedrock information was made available. Initial depth-to-bedrock information was re-run using the final models from 2001 as a starting point. Based on the comparisons between the existing models and the new depth to bedrock elevation information gained through the 2002 drilling program, various lines were re-analyzed using the following steps:

1. From the bedrock elevation corrected data, "Time vs. Distance" (see Illustration 1) plots were created, allowing the interpreter to determine the number of layer responses (apparent in the data), which are used by the program to create "layer models".
2. Layer numbers were assigned to the various layer segments interpreted from the "Time vs. Distance" plots. These layer numbers form the basis on which the model calculates the seismic velocities that it uses in the production of the resultant "depth models".
3. SIP modeling was conducted using the above as input information, and resultant depth profiles were generated. Models were re-run adjusting the layer velocities until the resulting model was correctly calibrated to specific boring elevations. The velocity issues were studied in further runs of the modeling program, and the inconsistencies were rectified, as were errors

resulting from improper initial "picks" or elevation errors. A more detailed examination of the "Time vs. Distance" plots was completed to refine the models in both areas. Additional velocity calculations were utilized to help correct for (as well as to illustrate) potential fractures, high velocity zones (HVZ) and low velocity zones (LVZ). This information was inserted back in the SIP software in order to re-run partial lines (zeroing out particular phones) at the modified velocities. The resulting information, analyzed using the newly calculated differing velocities, were combined to produce a more accurate final seismic line. The approach utilized was an iterative process that involved the merging and interpretation of all lines into a single model in order to identify potential modeling problems.

Synthesis of Geophysics with Geotechnical Borings

The geophysical data from the Seismic Refraction program was processed and interpreted with historical geotechnical boring information as well as that collected in the Phase II geotechnical program. Where the seismic lines crossed directly over a boring location, the boring data was utilized to calibrate the depth of bedrock models generated as part of the seismic data processing.

Table 1. Geotechnical borings collected as part of this program were utilized in the calibration of the following seismic lines (See Figures 3 and 4 for locations).

Phase	Area	Boring ID	Bedrock Ele (NGVD29)	Line/Positions
I	Popes Island	NBH-1	-90.2 feet	Seismic Line 20 & 3
I	Popes Island	NBH-2	-63.8 feet	Seismic Lines 4 & 5
I	Popes Island	NBH-3	-61.7 feet	Seismic Lines 1, 2 & 7
I	Channel Inner	NBH-4	-58.5 feet	Seismic Line 11
I	Channel Inner	NBH-5	-48.1 feet	Seismic Lines 13 & 15
I	Channel Inner	NBH-6	-54.6 feet	Seismic Lines 16 & 19
I	Channel Inner	NBH-7	-62.7 feet	Seismic Lines 7, 18 & 21
II	Popes Island	NBH-8	-92.5 feet	Seismic Lines 5 & 7
II	Channel Inner	NBH-9	-49.0 feet	Seismic Lines 11 & 18
II	Channel Inner	NBH-10	-51.1 feet	Seismic Lines 14 & 22
II	Channel Inner	NBH-11	-62.2 feet	Seismic Lines 10 &17

Additional historic boring information (Ebasco, 1988) was used in the contouring process to create the bedrock surfaces. However, this data was not used for direct calibration purposes because details of the data collection process were not known. Ebasco borings utilized are listed below.

- Boring BW-103 (-34 feet)
- Boring BW-104 (-39 feet)
- Boring BW-109 (-52 feet)
- Boring BW-110 (-72 feet)
- Boring BW-111 (-79 feet), and
- Boring BW-112 (-49 feet).

The calibrated seismic lines and selected borings were incorporated into a single interpretation of the bedrock surface (see Figures 3 and 4). The bedrock surface was created by integrating lines of bedrock elevation data (along the seismic profiles) with spot elevation data (from the selected borings listed above as well as elevations obtained from the calibration borings noted above), and gridding and contouring the resulting merged data set.

Data Interpretation

Interpretation of the data involved the refining of the models and comparison of the seismic data with calibration data until the most likely model (most reasonable interpretation of data) was found. The computer program Geosoft Oasis Montaj (Montaj) V 5.15, a data processing and analysis (DPA) system for earth science applications, was used to produce color-contoured maps for the project. The Montaj software was used to integrate the revised modeled bedrock elevation surface information and boring elevation into geo-referenced maps.

Data interpretation involved repeating many of the initial data processing steps described previously until the most appropriate best-fit model was generated. For some of the records, the "first breaks" of the seismic records were "re-picked", where the initial "first break" interpretation could be improved in order to achieve a better-fit model.

Another adjustment that was made during data interpretation was the modification of hydrophone layer assignments on the "Time vs. Distance" plots. These layer assignments form the basis upon which the model calculates seismic velocities which are uses in the production of the resultant depth models. Changing the layer assignments revises the morphology of the model, both the shape and depth of interface.

RESULTS

Profiles generated from the data, using the subsurface modeling software package SIP2, indicated that the bedrock character in both areas of interest is irregular, and marked by undulations of the bedrock surface. The results of the re-interpretation of the refraction data are best conveyed as contoured surface maps of the bedrock as determined from the interpreted seismic data. Figures 2 and 3 depict the results of the seismic data interpretation for Popes Island and Channel Inner area respectively. The figures display the inferred top of bedrock surface as determined from the seismic refraction data as a color-coded contour elevation (referenced to NGVD29), in order to aid in the identification of trends in the surface (i.e., blue areas are deeper and red/pink/orange areas are shallower). The location of borings used to "calibrate" the seismic interpretations is also shown on these figures. The bedrock models were calibrated such that the elevation of bedrock, at any given line crossing, is within three feet at line intersection points.

The "highest" bedrock surface elevation noted in the Popes Island North Area is in the range of –28 feet (NGVD29). The "lows" in the bedrock topography, noted from the data within the possible CAD footprint are in the –95 foot range (NGVD29). The mean elevation of the bedrock surface in the Popes Island North area is –66 feet (NGVD29). (See Figure 2). The "highest" bedrock surface elevation noted in the Channel Inner Area is in the range of –35 feet (NGVD29). The "lows" in the bedrock topography, noted from the data within the possible CAD footprint are in the –66 foot range (NGVD29). The mean elevation of the bedrock surface in the Channel Inner area is –52 feet (NGVD29). (See Figure 3).

Model Confidence

Maps showing the seismic model confidence have been generated and are shown in Figures 4 and 5. These maps were constructed based on the quality of the raw data collected in the field and on issues inherent in the data such as LVZ and potential fracturing, which can reduce the accuracy of the velocities and corresponding depths.

Popes Island North Area

Data collected in the Popes Island North Area exhibited low "noise" and was of high quality. As a result, there is a high confidence in the modeled bedrock surface there. Adding to the confidence in this area is supporting seismic data northwest of the survey area (Foster Wheeler, 2001). There is an area on the western edge of the model which has been assessed a "moderate" confidence level, due in part to the deep bedrock and the changing harbor topography.

Channel Inner Area

Data collected in the Channel Inner Area had a large amount of inherent "noise" due to the many shipping and fishing businesses around the harbor front. Background noise was greatest on the western (New Bedford) side of the harbor, and affected the western extents of most seismic lines. Extremely shallow bedrock found in the southern portion of the study area added to the "noisy" or low quality data. Potential faulting or fracturing that trends north-south through the center of the area also affected seismic velocities and the models calculated using these velocities. Every effort was made to filter and compensate for the effects of LVZs on the models, but the amplitude and strength of the raw signal was severely diminished after passing through these zones. The Channel Inner Area confidence map (Figure 5) shows a moderate model confidence level on approximately the western ¼ of the survey area because of the uncertainties discussed above.

Volume Calculations

Utilizing cell configuration parameters provided by Maguire engineers, existing bathymetric information, and the results of the seismic refraction survey, Apex performed preliminary volume calculations for both the Popes Island North and Channel Inner Areas. Calculations were performed using a combination of US Army Corps of Engineers (USACE) (Conditions survey 1996) and Apex Environmental, Inc. (Post dredge survey State Pier Dredge Project, 2002) bathymetry data, and the revised 2002 seismic refraction bedrock surface elevation calculated as part of this program. In calculating the volume of each cell, a slope of 3:1 was assumed.

It should be noted that the bathymetry data obtained from the USACE was supplied to Apex as a subset of the shallowest soundings within a 1"=100' paper plot. As such this data provides only an approximate pre-engineering mudline surface. Possible artifacts or errors may also exist in the Seismic Refraction surface due to the contouring algorithms that extrapolate the data between successive survey lines. In order to account for these uncertainties, contingency volumes have been incorporated into the various volume estimates. The volume calculations completed for this program, along with the relevant contingency volumes, are presented in the subsections below.

Popes Island Area

Volumes were calculated using a proposed configuration of six cells in the Popes Island North Area (See Illustration 2). Cell 1 was designed for a capacity of 1.8 million cubic yards. Cells 2 through 6 were designed to accommodate approximately 50,000 cubic yards of material each. A separation distance of 100 feet was maintained between each of the cells. For the cell volume calculations, a bedrock "buffer" of 10 feet was assumed so that the base of the cells terminate in sediment material. There is an additional loss of cell volume since the upper four (4) feet of sediment in the Popes Island North Area is assumed to be contaminated and should be placed back into the cell taking up volume associated with the top four (4) feet of material. Additionally, a cap of four (4) feet of "clean" material will be placed on top, for a cell total of eight (8) feet of depth subtracted from the calculations for each cell. Table 2 below summarizes the calculations for the Popes Island North Area. Illustration 3 shows a graphical breakdown of the division of available volume and geological types.

Table 2. Volume Calculation summary for the Popes Island North Area CAD configuration shown in Illustration 2.

Cell	Average Bedrock Elevation	Average Bathymetric Elevation	Sediment Thickness	Available Dredge Depth	Total Dredged Volume	Total Storage Capacity
1	-75 ft	-8 ft	**67 ft**	57 ft	**2,275,000 CY**	**1,841,000 CY**
2	-50 ft	-6 ft	**44 ft**	34 ft	**82,375 CY**	**48,100 CY**
3	-54 ft	-8 ft	**46 ft**	36 ft	**83,800 CY**	**49,500 CY**
4	-57 ft	-9 ft	**48 ft**	38 ft	**84,950 CY**	**50,700 CY**
5	-58 ft	-9 ft	**47 ft**	39 ft	**65,450 CY**	**51,200 CY**
6	-57 ft	-8 ft	**49 ft**	39 ft	**85,450 CY**	**51,200 CY**

Average Bedrock Elevation –Average Bathymetric Elevation = Sediment Thickness
Sediment Thickness – Bedrock buffer (10-feet) = Available Dredge Depth
Total Dredged volume = Available Dredge Depth X (length and width of cell) using 3:1 slope
Total Storage Capacity = Total Volume dredge – (top 4-foot contaminated material)

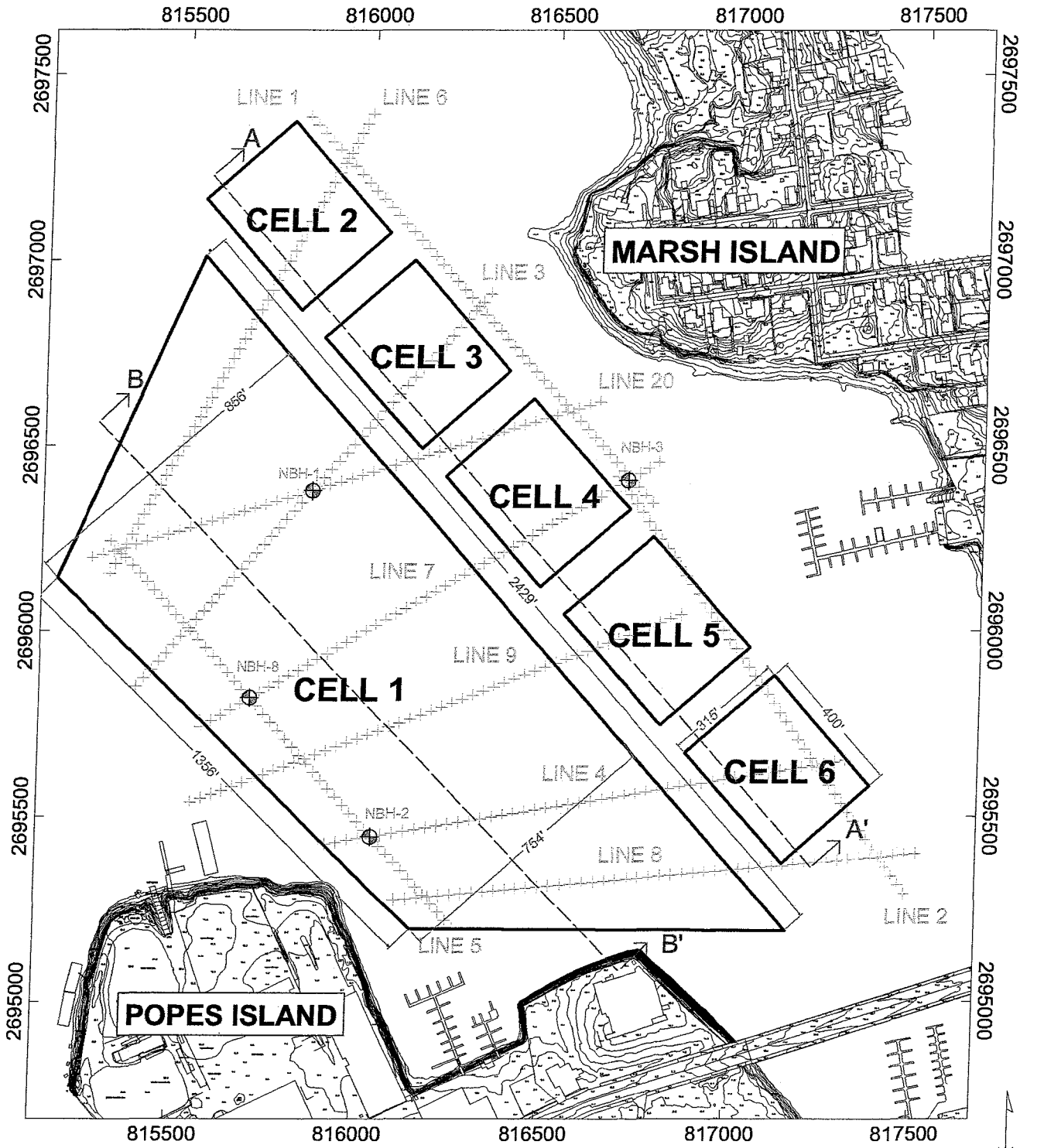
Table Assumptions:

- All volumes were calculated as Volume-Of-the-Void (VOV) and do not take into account sediment properties (i.e. bulking, etc.). The volumes are approximate, and are based on average elevations within each proposed cell.
- **Average Bedrock Elevations** were calculated using Oasis Montaj V5.16 minimum curvature model of the bedrock surfaces within each of the proposed CAD cells. A mathematical modeling cell size of 12 was maintained to construct the minimum curvature model of the bedrock surface.
- **Average Bathymetric Elevations** were calculated in a manner similar to the Average Bedrock Elevations, utilizing the USACE bathymetric data 1997 and a mathematical cell size of 8.
- **Sediment Thickness** was calculated by subtracting Bathymetric/Mud line Elevation from the Bedrock Elevation.
- **Available Dredge Depth** is the depth of material excavated in order to leave a 10-foot buffer so that the proposed CAD cell terminates in sediment material above modeled bedrock. The available dredge depth can also be thought of as the depth of material to the bottom of the proposed CAD cell.
- **Total Volume Dredged** is the amount of material needed to be removed to form the proposed CAD cell given the average dredge depth and assuming a 3:1 (H:V) side slope for each cell.
- **Total Storage Capacity** is the final volume after disposing of the top 4-feet of "contaminated" material back into the cell and allowing for the 4-feet of clean cap material.

Cross Section Profiles –Popes Island North Area

Stratagraphic cross sections were extracted from profile cuts through proposed CAD Cells 2 – 6 (A-A') and CAD Cell 1 (B-B' in the Pope Island North Area). The locations of the cross sections are shown on Illustration 2. The cross sections are presented in Illustrations 4 (A-A') and 5 (B-B'). The cross sections were constructed by digitizing the modeled bedrock surface and the bathymetric surface over the length of the profile. Boring information collected as part of the project was extrapolated to the profile center line to depict the types and thickness of geology encountered.

Illustration 2 Popes Island Area Proposed CAD Cell Configuration



LEGEND

- PROPOSED CELL EXTENT
- HYDROPHONE LOCATION
- BORING LOCATION
- A A' CROSS SECTION LOCATION

Scale 1:4800

250 0 250

US survey foot

NAD83(CSRS98) / Massachusetts CS83 Mainland zone

NOTES:

1. Base Plan of the New Bedford harbor area was obtained from the US Army Corps of Engineers and has not been field verified.
2. Coordinates are shown in the State Plane Coordinate System, Massachusetts Mainland Zone 2001, Referenced to the 1983 North American Datum (NAD83). Vertical Datum referenced to NGVD29.
3. Boring information and position supplied by The Maguire Group.

REV.	DESCRIPTION	BY	DATE

ILLUSTRATION 2

POPES ISLAND NORTH AREA - CELL CONFIGURATION
SEISMIC REFRACTION - 2002 REVISED MODEL

MIDDLE NEW BEDFORD HARBOR
BRISTOL COUNTY, NEW BEDFORD, MASSACHUSETTS

Apex

374 Congress St
Suite 500
Boston MA 02210
617 728-0070

SCALE: 1" = 400'	DRAWN:	DESIGN:	CHECKED:	PROJECT # 6610.201.01
	TDM	TDM	JAB	SHEET 1 OF 1

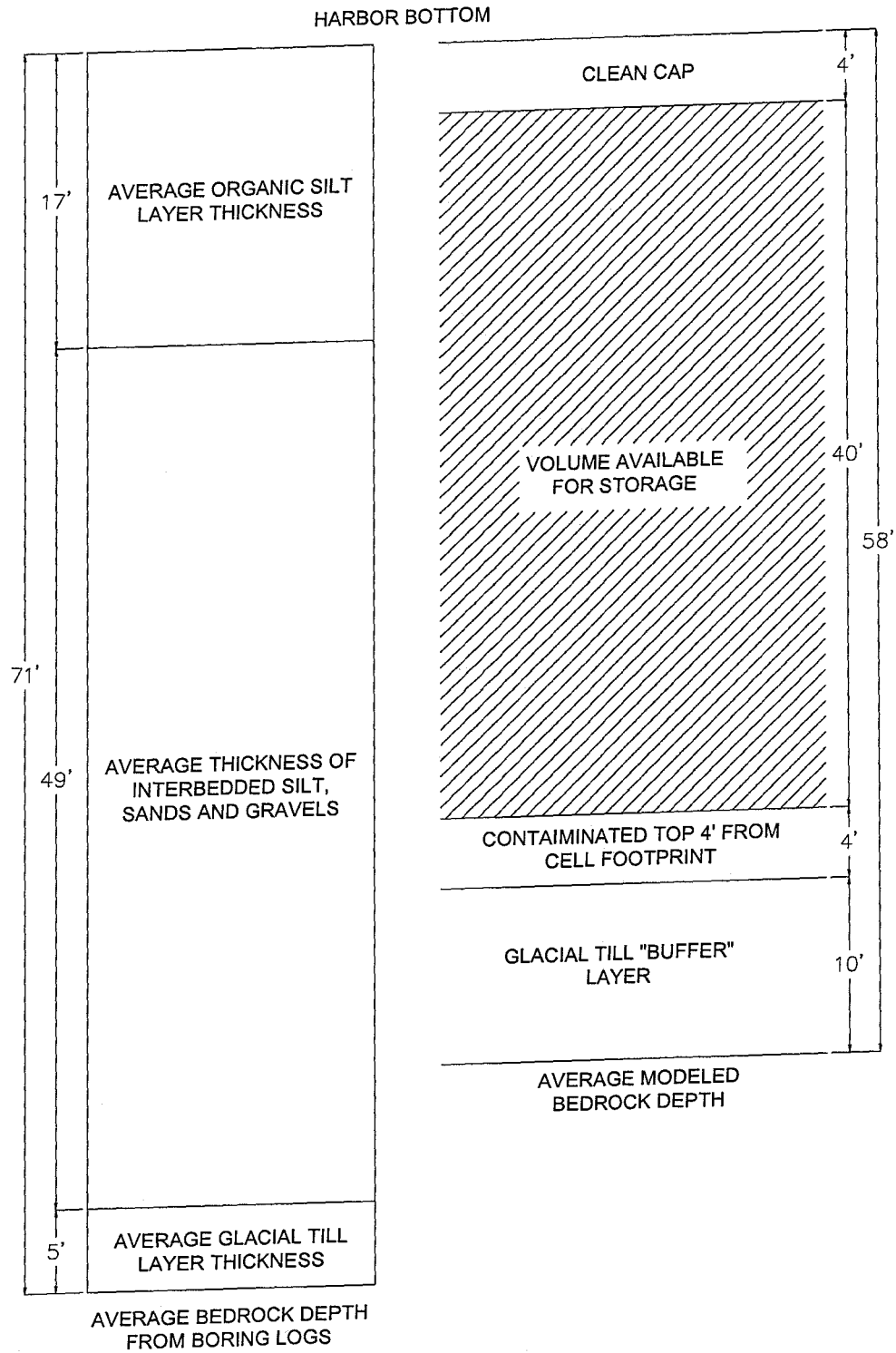
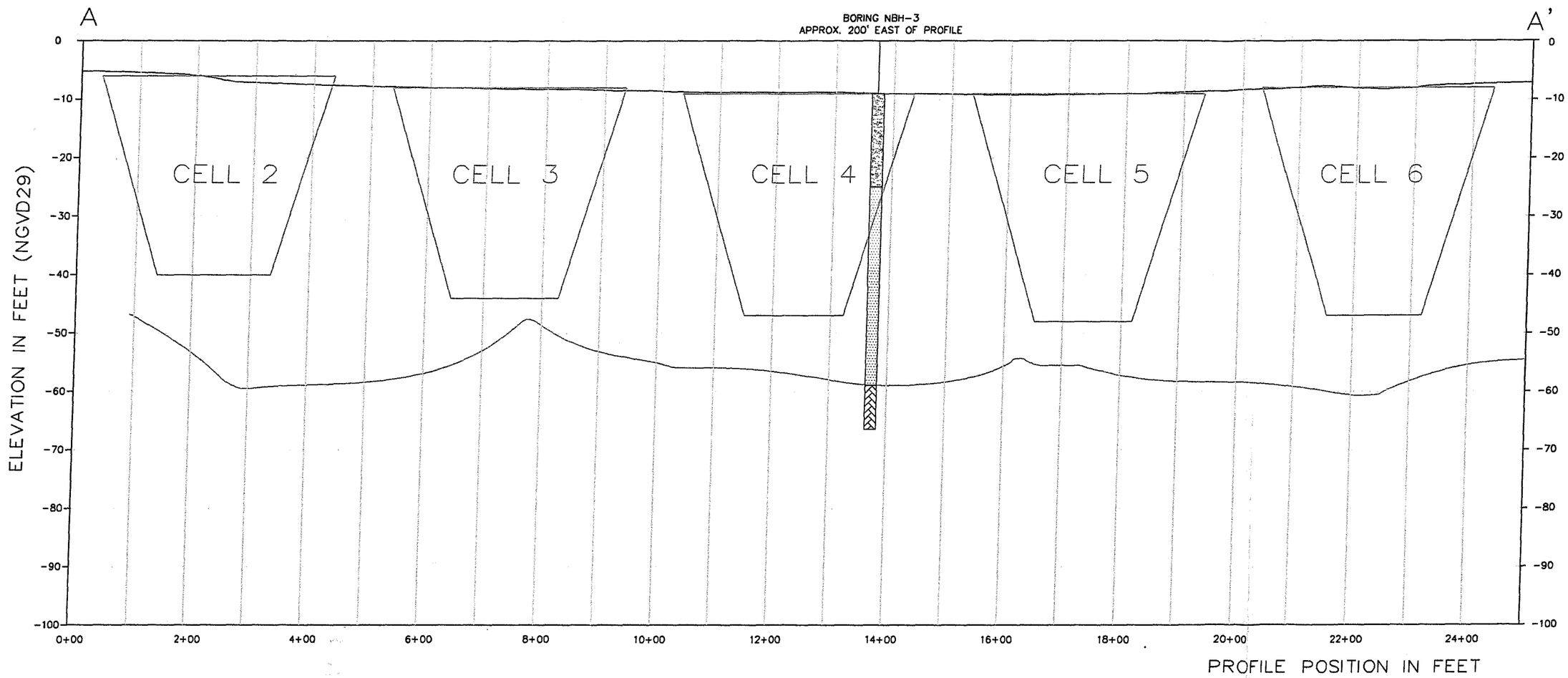


Illustration 3
Breakdown of the division of available storage capacity and an average geological cross section from the borings conducted in the Popes Island Area.

Illustration 4 Popes Island Area Cross Section Profile A-A'

PROFILE – A–A'



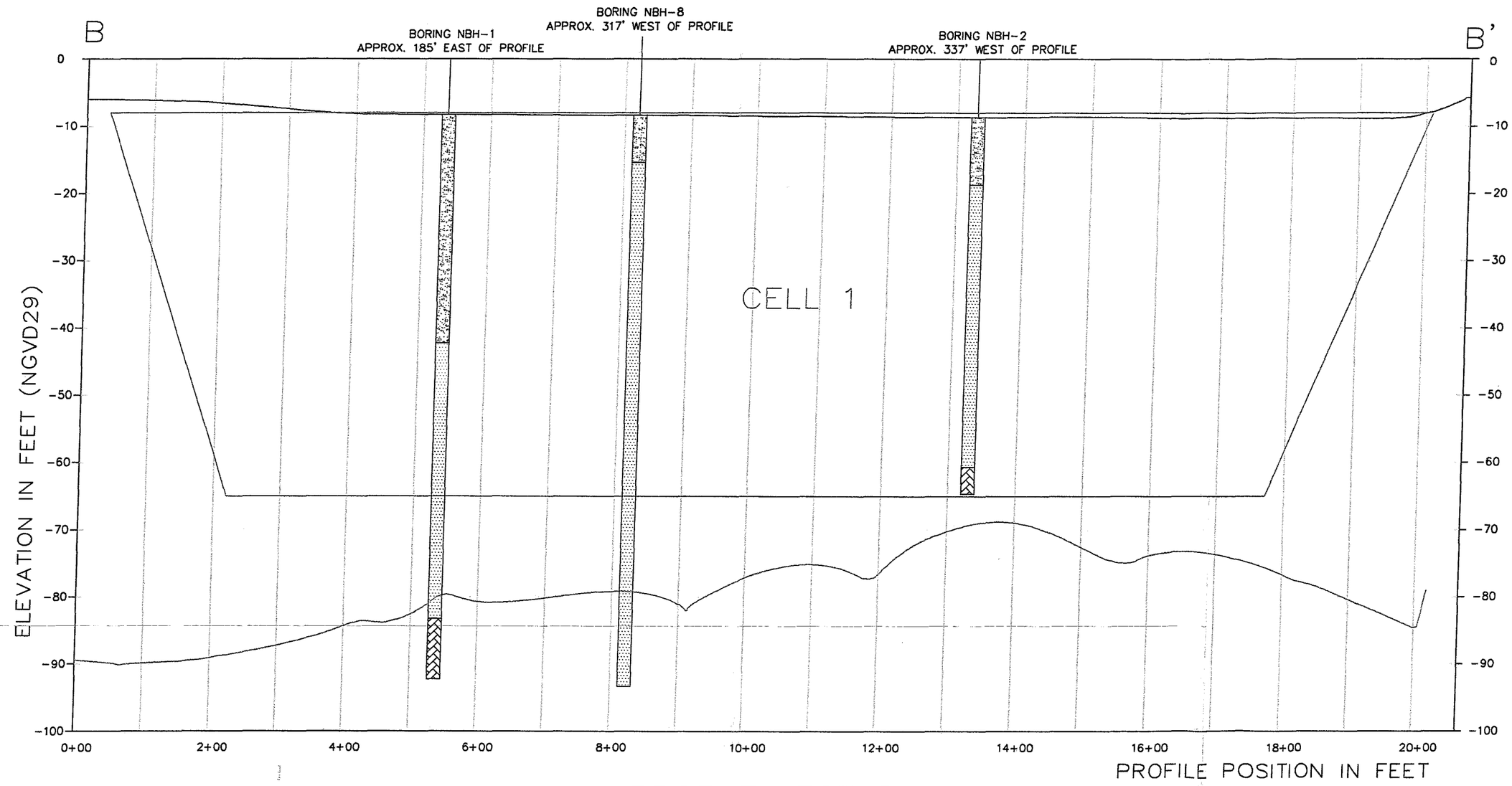
PROFILE LEGEND

- EXISTING MUDLINE ELEVATION
- MODELED BEDROCK SURFACE
- EXTRAPOLATED BORING LOCATION
- PROPOSED CAD CELL EXTENT
- ORGANIC SILT
- INTERBEDDED: SILTS, SAND AND GRAVELS
- GLACIAL TILL

ILLUSTRATION 4 POPES ISLAND PROFILE A-A'.
Stratagraphic cross section was extracted from a profile cut through proposed CAD Cells 2 - 6 (A-A'). The cross section digitizes the modeled bedrock surface and the bathymetric surface over the length of the profile shown on Illustration 2. Proposed CAD cells used in the volume calculations are also shown utilizing the proposed 3:1 side slopes. Boring information collected as part of the project is extrapolated to the profile center line to depict basic geological units encountered.

Illustration 5 Popes Island Area Cross Section Profile B-B'

PROFILE – B–B'



PROFILE LEGEND

- EXISTING MUDLINE ELEVATION
- MODELED BEDROCK SURFACE
- EXTRAPOLATED BORING LOCATION
- PROPOSED CAD CELL EXTENT
- ORGANIC SILT
- INTERBEDDED: SILTS, SAND AND GRAVELS
- GLACIAL TILL

ILLUSTRATION 5 POPES ISLAND PROFILE B-B'.
Stratagraphic cross section was extracted from a profile cut through proposed CAD Cell 1 (B-B'). The cross section digitizes the modeled bedrock surface and the bathymetric surface over the length of the profile shown on Illustration 2. Proposed CAD cells used in the volume calculations are also shown utilizing the proposed 3:1 side slopes. Boring information collected as part of the project is extrapolated to the profile center line to depict basic geological units encountered.

Channel Inner Area

After investigating the potential storage volume within the Channel Inner Area, it is apparent that the shallow bedrock and general location of the proposed cell may severely limit the potential capacity in this area. Volumes were calculated assuming three cells in the Channel Inner Area (See Illustration 7). All Cells were designed to accommodate approximately 50,000 cubic yards of material. A separation distance of 100-feet was maintained between each of the cells. Illustration 6 shows the cell configuration.

For the cell volume calculations, a bedrock "buffer" of 10 feet was assumed so that the base of the cells terminate in sediment material approximately 10-feet higher than modeled bedrock. There is an additional loss of cell volume since the upper four (4) feet of sediment in the Popes Island North Area is assumed to be contaminated and should be placed back into the cell taking up volume associated with the top four (4) feet of material. Additionally, a cap of four (4) feet of "clean" material will be placed on top, for a cell total of eight (8) feet of depth subtracted from the calculations for each cell.

In addition, the proposed CAD cells are located within the federal channel and associated maneuvering /anchorage area. In order to account for future dredging activities, which may disturb the "clean" material cap, an additional contingency of three (3) feet was assumed. This additional contingency is expected to be either an additional cap thickness of 3-feet, or a depressed surface (i.e. leaving the final grade 3-feet below required depths). This extra compensation was added to protect the cap from being dredged as part of on going maintenance dredging during normal harbor/port operations. Illustration 7 below shows an estimate of the division of the available volume for the Channel Inner Area. Table 3 below summarizes the calculations for the Channel Inner Area.

Table 3. Volume Calculation summary for the Channel Inner Area CAD configuration shown in Illustration 6.

Cell	Average Bedrock Elevation	Average Bathymetric Elevation	Sediment Thickness	Available Dredge Depth	Total Dredged Volume	Total Storage Capacity
1	-57 ft	-31 ft	**26 ft**	16	**213,000 CY**	**48,500 CY**
2	-57 ft	-31 ft	**26 ft**	16	**213,000 CY**	**48,500 CY**
3	-58 ft	-28 ft	**30 ft**	20	**111,900 CY**	**55,750 CY**

Average Bedrock Elevation –Average Bathymetric Elevation = Sediment Thickness
Sediment Thickness – Bedrock buffer (10-feet) = Available Dredge Depth
Total Dredged volume = Available Dredge Depth X (length and width of cell) using 3:1 slope
Total Storage Capacity = Total Volume dredge – (top 4-foot contaminated material)

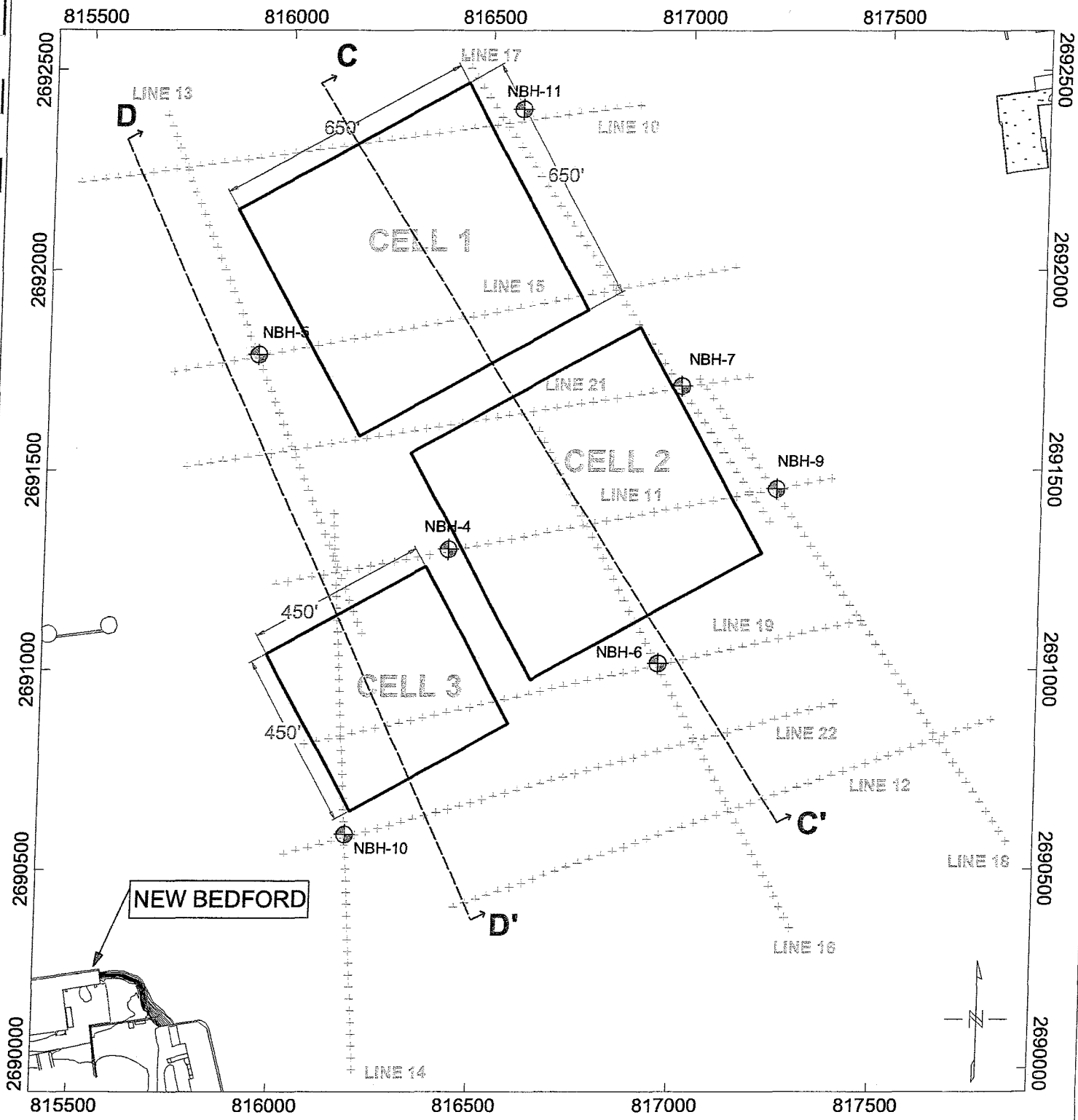
Table Assumptions:

- All volumes are calculated as Volume of the Void (VOV) and do not take into account sediment properties (i.e. bulking, etc.). The volumes are approximate, and are based on average elevations within each proposed cell.
- **Average Bedrock Elevations** were calculated using Oasis Montaj V5.16 minimum curvature model of the bedrock surfaces within each of the proposed CAD cells. A mathematical modeling cell size of 12 was maintained to construct the minimum curvature model of the bedrock surface.
- **Average Bathymetric Elevations** were calculated similarly to the Average Bedrock Elevations using the USACE bathymetric data 1997 and a mathematical cell size of 8.

- **Sediment Thickness** was calculated by subtracting Bathymetric/Mud line Elevation from the Bedrock Elevation.
- **Available Dredge Depth** is the depth of material excavated allowing the proposed CAD cell to terminate allowing a 10-foot sediment buffer between the bottom of the CAD cell and the bedrock surface. The available dredge depth can also be thought of as the depth of material to the bottom of the proposed CAD cell.
- **Total Volume Dredged** is the amount of material needed to be removed to form the proposed CAD cell given the average dredge depth and assuming a 3:1 (H:V) side slope for each cell.
- **Total Storage Capacity** is the final volume after disposing of the top 4-feet of "contaminated" material back into the cell and allowing for the 4-feet of clean cap material. A maintenance dredge contingency of 3-feet is also allowed for.

Cross Section Profiles – Channel Inner Area

Two Stratagraphic Cross Section were extracted from a profile cut through the Channel Inner Area proposed CAD cells 1 and 2 (C-C') and proposed CAD cell 3 (D-D'). Cross section locations can be seen in Illustration 6. Cross sections are shown on Illustration 8 and 9. The cross sections were constructed by digitizing the modeled bedrock surface and the bathymetric surface over the length of the profile. Boring information collected as part of the project was also extrapolated to the profile center line to depict the types and thickness of geology encountered.



LEGEND

- PROPOSED CELL EXTENT
- HYDROPHONE LOCATION
- BORING LOCATION
- CROSS SECTION LOCATION

Scale 1:4200

250 0 250

US survey foot

NAD83 / Massachusetts CS83 Mainland zone

NOTES:

1. Base Plan of the New Bedford harbor area was obtained from the US Army Corps of Engineers and has not been field verified.
2. Coordinates are shown in the State Plane Coordinate System, Massachusetts Mainland Zone 2001, Referenced to the 1983 North American Datum (NAD83). Vertical Datum referenced to NGVD29.
3. Boring information and position supplied by The Maguire Group.

REV.	DESCRIPTION	BY	DATE
1.	MOD CAD CONFIGURATION	TDM	05/13/03

ILLUSTRATION 6

CHANNEL INNER AREA
SEISMIC REFRACTION - REVISED MODEL

LOWER NEW BEDFORD HARBOR
BRISTOL COUNTY, NEW BEDFORD, MASSACHUSETTS

Apex
374 Congress St
Suite 500
Boston MA 02210
617 728-0070

SCALE:	DRAWN:	DESIGN:	CHECKED:	PROJECT# 8510.001.01
	TDM	TDM	JAB	

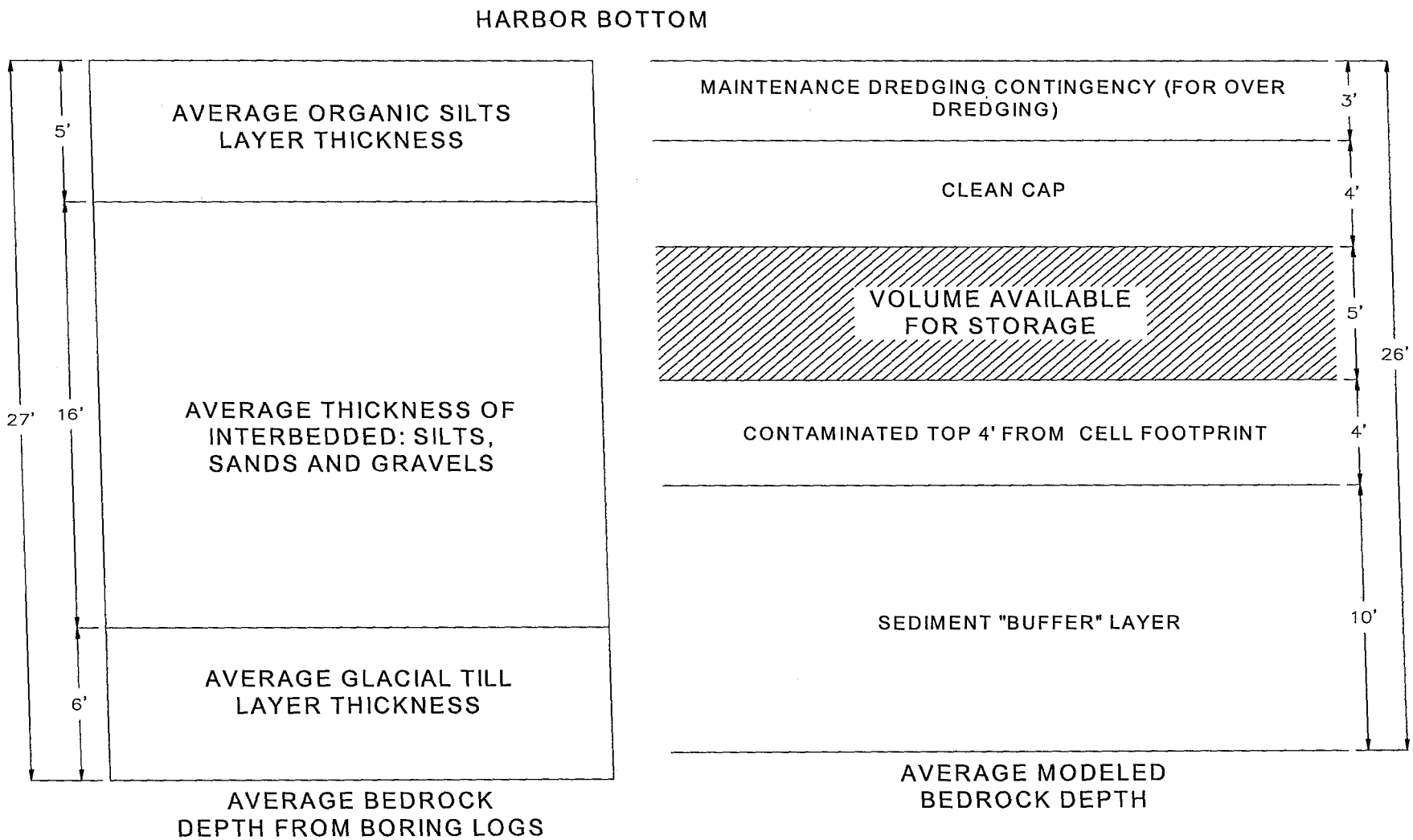
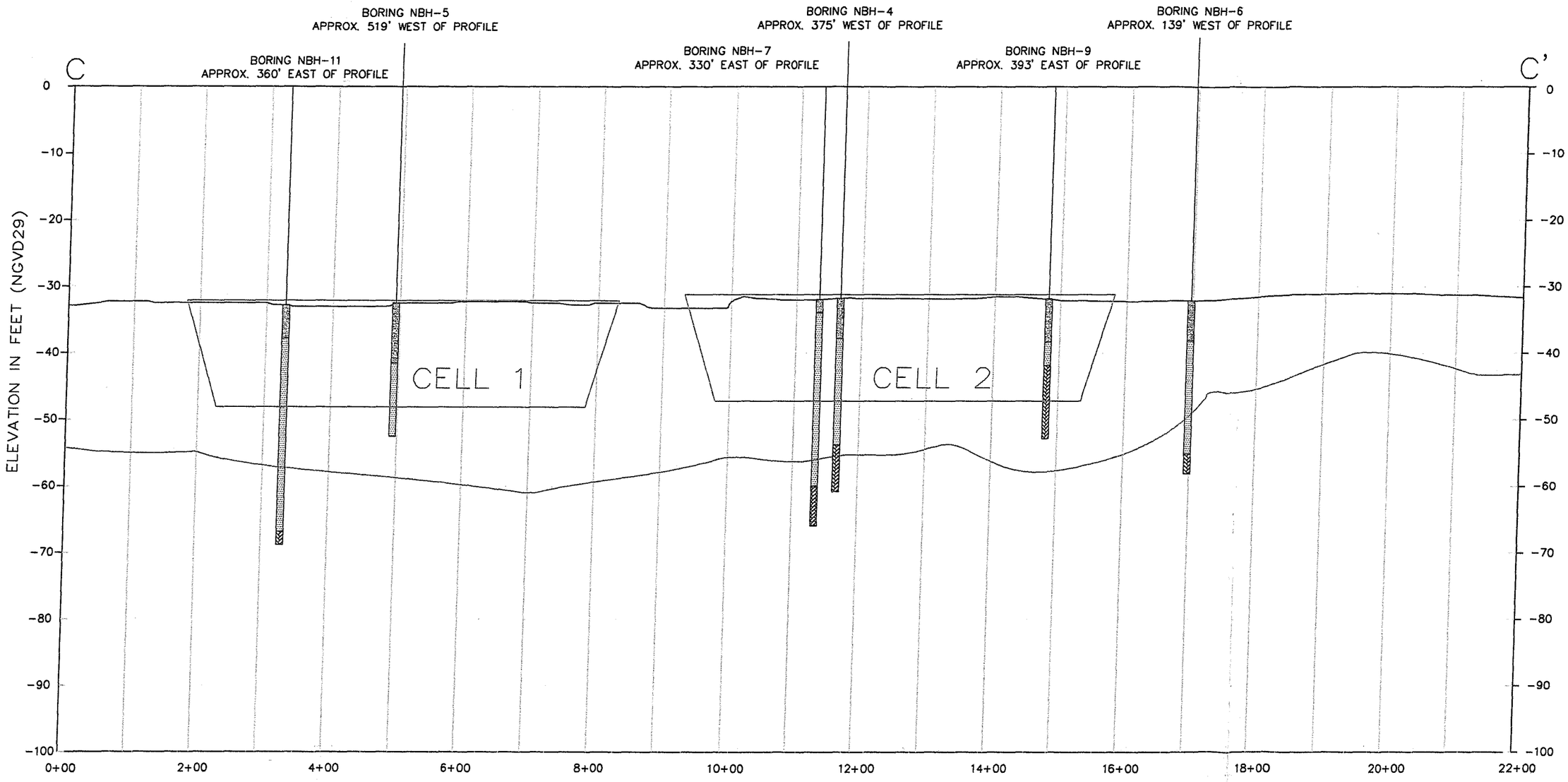


Illustration 7
Breakdown of the division of available storage capacity and average geological cross section as seen in the borings conducted in the Channel Inner Area

Illustration 8 Channel Inner Area Cross Section Profile C-C'

PROFILE – C–C'



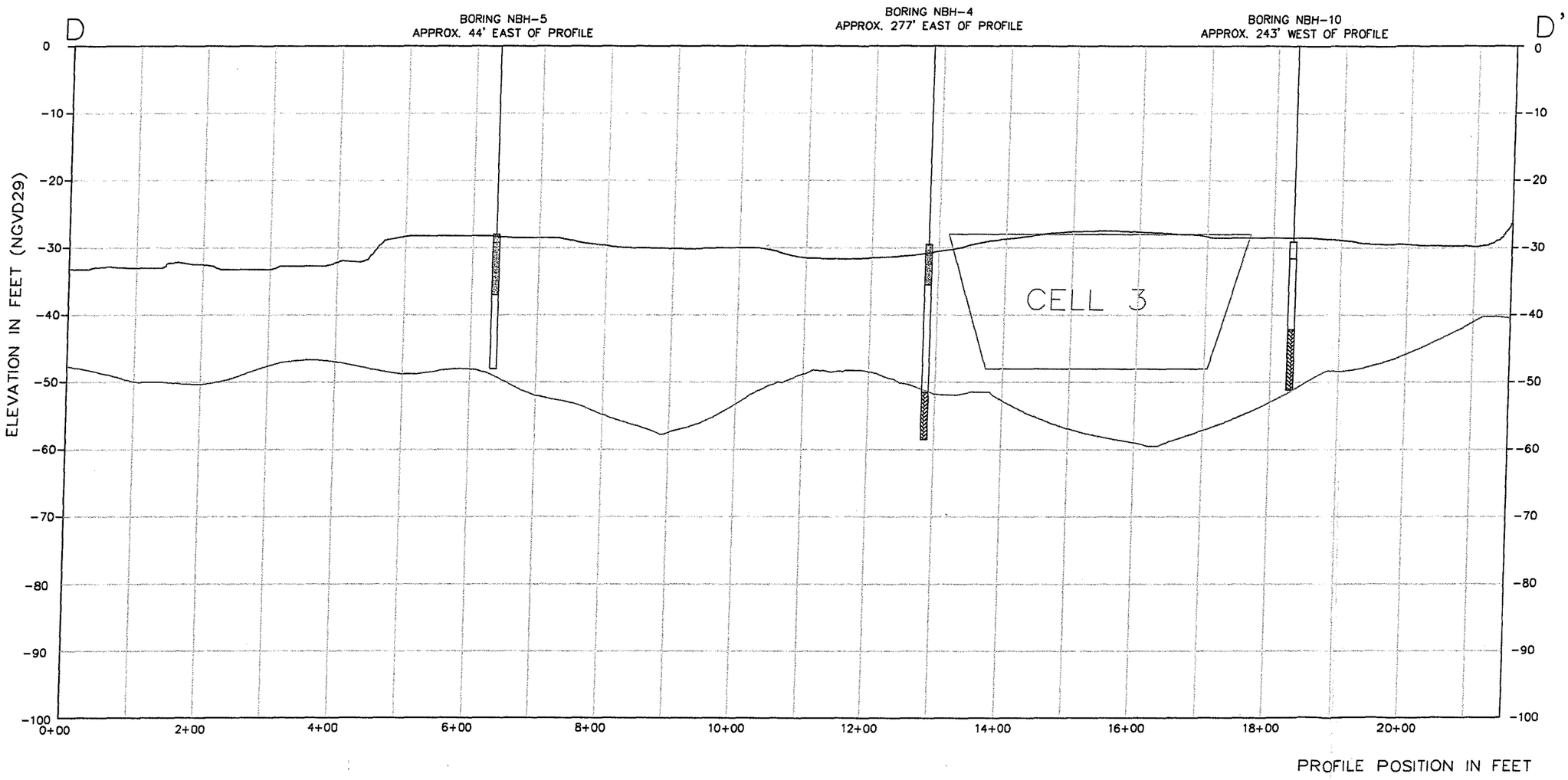
PROFILE LEGEND

- EXISTING MUDLINE ELEVATION
- MODELED BEDROCK SURFACE
- EXTRAPOLATED BORING LOCATION
- PROPOSED CAD CELL EXTENT
- ORGANIC SILT
- INTERBEDDED: SILTS, SAND AND GRAVELS
- GLACIAL TILL

ILLUSTRATION 8 CHANNEL INNER AREA PROFILE C-C'.
Stratagraphic cross section was extracted from a profile cut through proposed Channel Inner Area CAD Cells 1 and 2 (C-C'). The cross section digitizes the modeled bedrock surface and the bathymetric surface over the length of the profile shown on Illustration 6. Proposed CAD cells used in the volume calculations are also shown utilizing the proposed 3:1 side slopes. Boring information collected as part of the project is extrapolated to the profile center line to depict basic geological units encountered.

Illustration 9 Channel Inner Area Cross Section Profile D-D'

PROFILE – D–D''



PROFILE LEGEND

- EXISTING MUDLINE ELEVATION
- MODELED BEDROCK SURFACE
- EXTRAPOLATED BORING LOCATION
- PROPOSED CAD CELL EXTENT
- ORGANIC SILT
- INTERBEDDED: SILTS, SAND AND GRAVELS
- GLACIAL TILL

ILLUSTRATION 9 CHANNEL INNER AREA PROFILE D-D'.
Stratagraphic cross section was extracted from a profile cut through proposed Channel Inner Area CAD Cell 3 (D-D'). The cross section digitizes the modeled bedrock surface and the bathymetric surface over the length of the profile shown on Illustration 6. Proposed CAD cells used in the volume calculations are also shown utilizing the proposed 3:1 side slopes. Boring information collected as part of the project is extrapolated to the profile center line to depict basic geological units encountered.

CONCLUSIONS

Seismic refraction models were re-interpreted utilizing additional boring information obtained in a recent boring program to construct the new revised bedrock models.

Models generated by the re-interpretation of the data collected in the initial field program indicate that the bedrock character in both areas of interest is irregular and small adjustments have been made to refine the existing models.

Popes Island Area

The shallowest bedrock encountered in the seismic data was –31 feet on Lines 1 and 6 at the northeastern end of the survey area. This is within approximately 500 feet of where bedrock outcrops on Marsh Island. The deepest bedrock, at –93 feet, is found at the farthest northwestern edge of the survey area where lines 5, 6 and 20 meet. The thickness of sediment above modeled bedrock varies from between 24 - 86 feet, with an average of 58 feet. A possible relict bedrock channel trending northwest to southeast runs through the middle of the survey area. This lineal feature is approximately 250 to 300 feet wide and runs through the study area from northwest to southeast. At its deepest point, the bedrock channel may extend below –90 feet NGVD29. This channel inference is further supported by bedrock surface elevation data to the northeast of the survey area collected by another contractor (Foster Wheeler, 2001) in a report submitted to the USACE. In some places the bedrock elevation varies by as much as 36-feet of elevation change over 120-feet of lateral change (or approximately a 25% slope), indicating that there is some relatively steep bedrock topographic variation within the possible CAD footprint.

Channel Inner Area

The shallowest bedrock encountered in the seismic data was –36 feet on Lines 14 and 16 at the southern end of the survey area. This is within approximately 1100 feet north of where bedrock outcrops on Palmer Island. The deepest bedrock, at –65 feet, is found in the center of the survey area at line 16. The thickness of sediment over bedrock varies between 3 and 39 feet, with an average thickness of 22 feet. This average sediment thickness was used in the volume estimates of the area. Due to construction requirements, there is a limited capacity for a potential CAD cell in this area. The presence of several "Low Velocity Zones" (or "LVZs") was noted on several seismic lines in this area. These anomalies in the data occur at locations where the velocity of the energy wave traveling through the bedrock material is locally reduced, usually because the bedrock is fractured or severely weathered in that zone. LVZs are often indicators of faulted or severely fractured bedrock, and the locations of the LVZs noted in the data during this study are shown in Figure 3. These areas of possible fracturing were further supported by information on rock quality (RQD) obtained in borings at or near to these zones. For example boring NBH-7, in which nine feet of weathered rock was recovered, exhibited 33% RQD values. It should be noted that data in the LVZs may be subjectively interpreted, as the actual velocity within such a zone can only be determined relatively, and can vary dramatically depending upon the material, the amount of fracturing, and the amount of weathering.

In the Channel Inner Area, the presence of LVZs imply that a northeast-southwest trending fracture zone and two north-south trending fracture zones may cross in this area. These fracture zones are evident in the Time-Distance plots for most of the east-west refraction spreads (lines 10, 11, 12, 15, 16, 17, 19, 21 and 22). Fracturing in the rock is made evident on Time-Distance plots as a time offset in the linear normal move-out of first breaks. An example of a Time-Distance plot showing the effects of fracturing is shown below in Illustration 10. In areas of fracturing, void spaces or sediment filled fractures (or even highly weathered rock) create a localized Low Velocity Zone (LVZ). Within these zones, the seismic velocity is much slower than that of the surrounding material. Because Seismic Refraction utilizes time

and distance measurements to calculate bedrock geometry, data that contains LVZ's will tend to imply that a bedrock surface is lower than it actually is (increase in time at a fixed velocity increases distance by the geometric relation T=d/v).

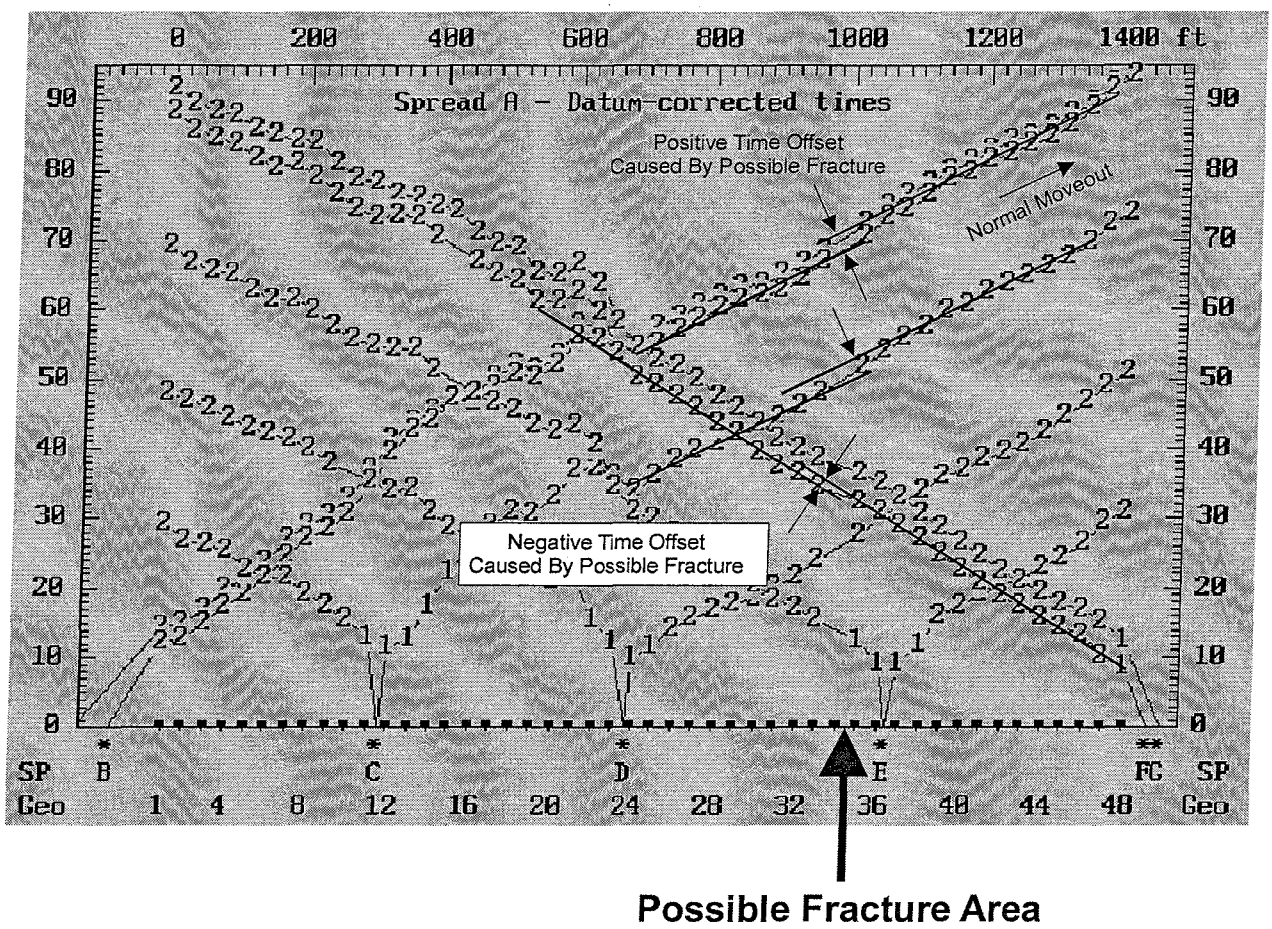


Illustration 10.
Time-Distance Plot Showing Areas of Possible Fracturing

In order to refine the thickness of contaminated organic silts to be deposited back into the proposed CAD cells a sub-bottom profiler survey could be utilized. The sub-bottom profiler uses high frequency seismic reflection to image stratagraphic interfaces such as those between organic silts and interbedded silts, sands and gravels. A survey using a similar approach was attempted within the harbor to help and identify depth to bedrock but was unsuccessful due to large amounts of reflective gasses. However, it is anticipated that a focused high resolution program is likely to yield the results necessary to define this layer, more accurately. By better defining this layer, a more accurate volume estimate can be achieved of the CAD cell parameters, which is expected, in turn, to yield a better overall design.

Summary

The Plan Map in Figure 6 is a depiction of the modeled total thickness of sediment within the two proposed CAD areas (Popes Island North & Channel Inner). As can be seen through a comparison of these two areas, there is limited sediment thickness (capacity) in the Channel Inner area. The average sediment thickness in the Channel Inner area is approximately 23 feet; with average water depths in the

area of approximately 30 feet. The Popes Island North area has an average sediment thickness of approximately 58 feet; while the bathymetric depths range between approximately 8-10 feet of water.

LIMITATIONS

The following limitations apply to all geophysical surveys conducted by Apex Environmental, Inc. it's subsidiaries and subcontractors. Every attempt has been made to conduct this survey to maximize the quality of the data collected and the interpretations rendered. However, a geophysical investigation is an indirect method of subsurface exploration whereby subsurface characteristics are inferred or interpreted from measurements collected at the ground or water surface. Many variables may affect these measurements. Due to the indirect, interpretive nature of geophysics, findings are generally considered precursory and subject to verification by more direct methods of investigation such as test borings or test pits. The following limitations are considered when evaluating geophysical data:

1. Subsurface features can be interpreted from the appropriate geophysical methods only insofar as they produce a discernible geophysical signature. They must have adequate homogeneity, size, and appropriate physical or chemical properties sufficient to contrast with the surrounding medium and be within reasonable proximity to the sensors. Additionally, their signature must be distinguishable from and not masked by background noise or interference.

2. Lithologic data inferred on the basis of geophysical data may not be identical to geologic or hydrogeologic data. Lithologies are generally interpreted from some geophysical signature (e.g., velocity differences) that may be the result of many factors (including density, susceptibility, angle to the sensors, amount of weathering, etc.). Lithology divisions based upon seismic velocity for example may not necessarily be identical to lithology changes identified by drilling. The discrepancy is generally related to formation density and/or compaction (i.e., a dense till may have a higher density than a weathered bedrock, and the difference can be difficult to resolve with seismic data).

3. Complex geological configurations may be impossible to resolve with surface geophysical methods. The resolution of geophysical data is limited by the spatial geometry of sensors, strength of signal, and distance of the object or layer of interest from the energy source and the sensor array used. Resulting interpretations are rendered by modeling geophysical response to known or presumed geometric relationships. The complexity of the relationships that can be modeled is limited by the resolution allowed by the method and geometry of equipment layout used, and the limitations of the software used.

4. Apex is not responsible for data quality in areas having excessive "background noise" which affect the specific physical parameters of the subsurface that are being measured by a particular geophysical technique. Examples of background noise include: heavy traffic on a nearby roadway, which induces vibrational energy into the ground which in turn interferes with seismic data collection; heavy machinery (i.e., boat, sand-blaster, or torch) operation adjacent to or in the water near a marine seismic survey line; or underground utilities (such as electric lines, tunnels, sewers, etc.), which can interfere with seismic instrumentation.

No guarantee or warranty (other than that stipulated in the contract under which this work was promulgated), expressly stated or implied, is given concerning the data and interpretations rendered in this report. All information is presented as "for information only." Apex Environmental, Inc., its parent company or any subsidiary, is not liable for any losses resulting from the misuse, misrepresentation, or misinterpretation of any information presented in this report by any person or entity.

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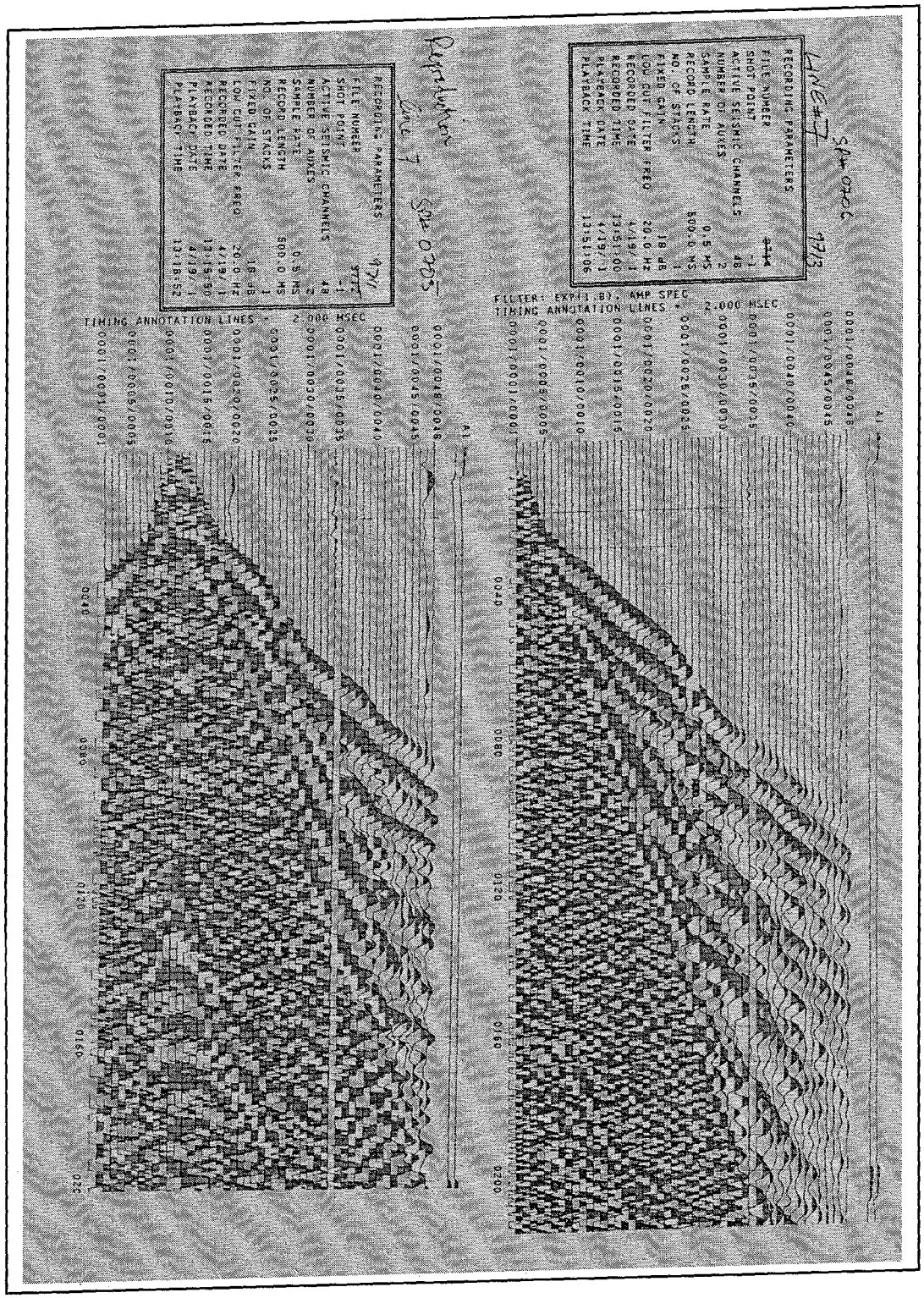
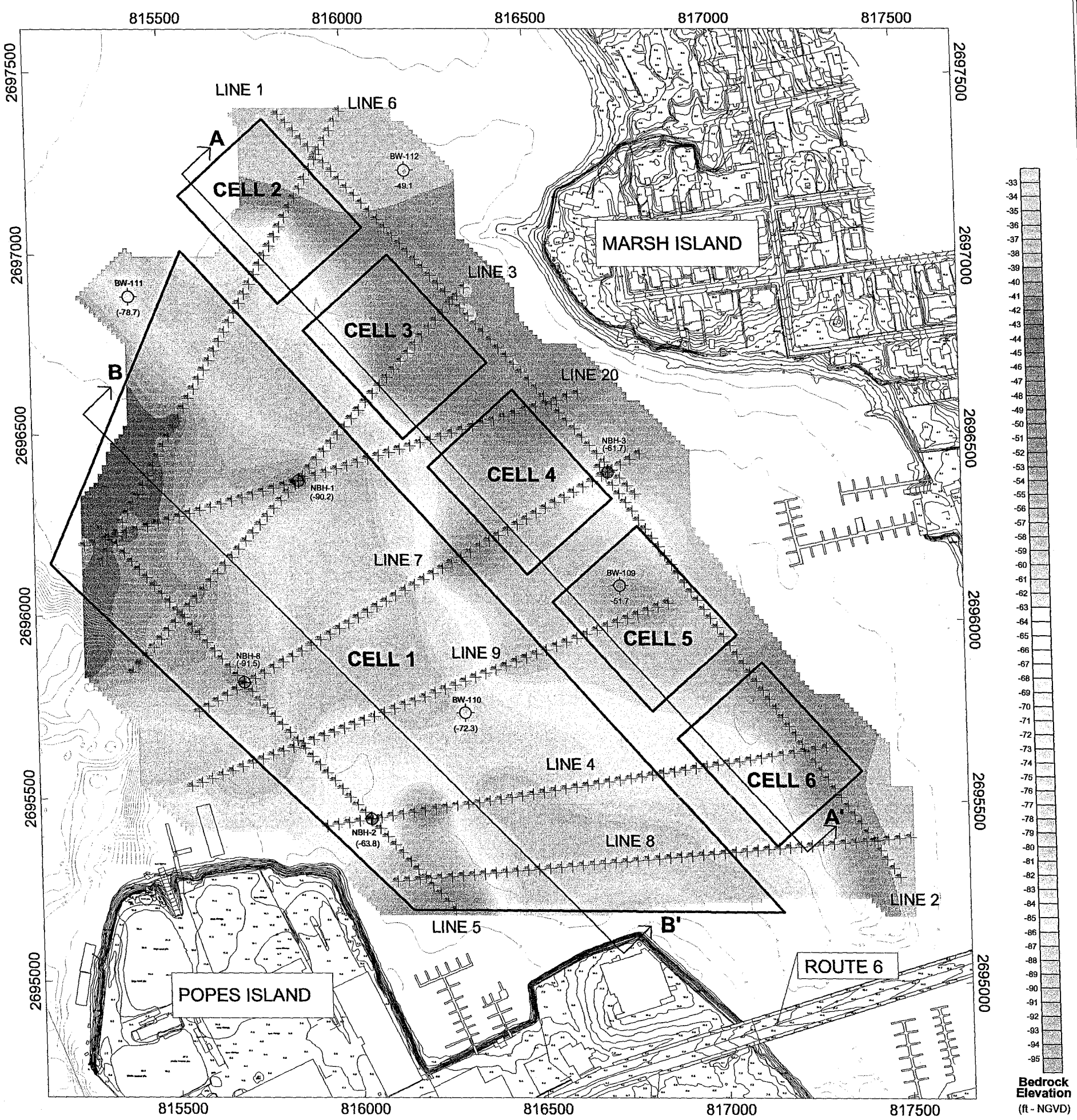
APPENDIX A
Example Seismograph Record





Scale 1:3600

250 0 250

US survey foot

NAD83(CSRS98) / Massachusetts CS83 Mainland zone

LEGEND

- SEISMIC CALIBRATION BORING
- EBASCO BORING (APPROXIMATE LOCATION)
- HYDROPHONE LOCATION (PHONE NUMBER & BEDROCK ELEVATION)
- 1' BATHYMETRIC CONTOUR
- PROPOSED CAD CELL EXTENTS
- CROSS SECTION LOCATION

NOTES:

1. Base Plan of the New Bedford harbor area was obtained from the US Army Corps of Engineers and has not been field verified.
2. Coordinates are shown in the State Plane Coordinate System, Massachusetts Mainland Zone 2001,Referenced to the 1983 North American Datum (NAD83). Vertical datum NGVD29.
3. Boring information and position supplied by The Maguire Group.

REV.	DESCRIPTION	BY	DATE
1.	MODIFIED DEPTH TO BEDROCK	TDM	01/08/02
2.	CAD CELL CONFIGURATION	TDM	05/05/03

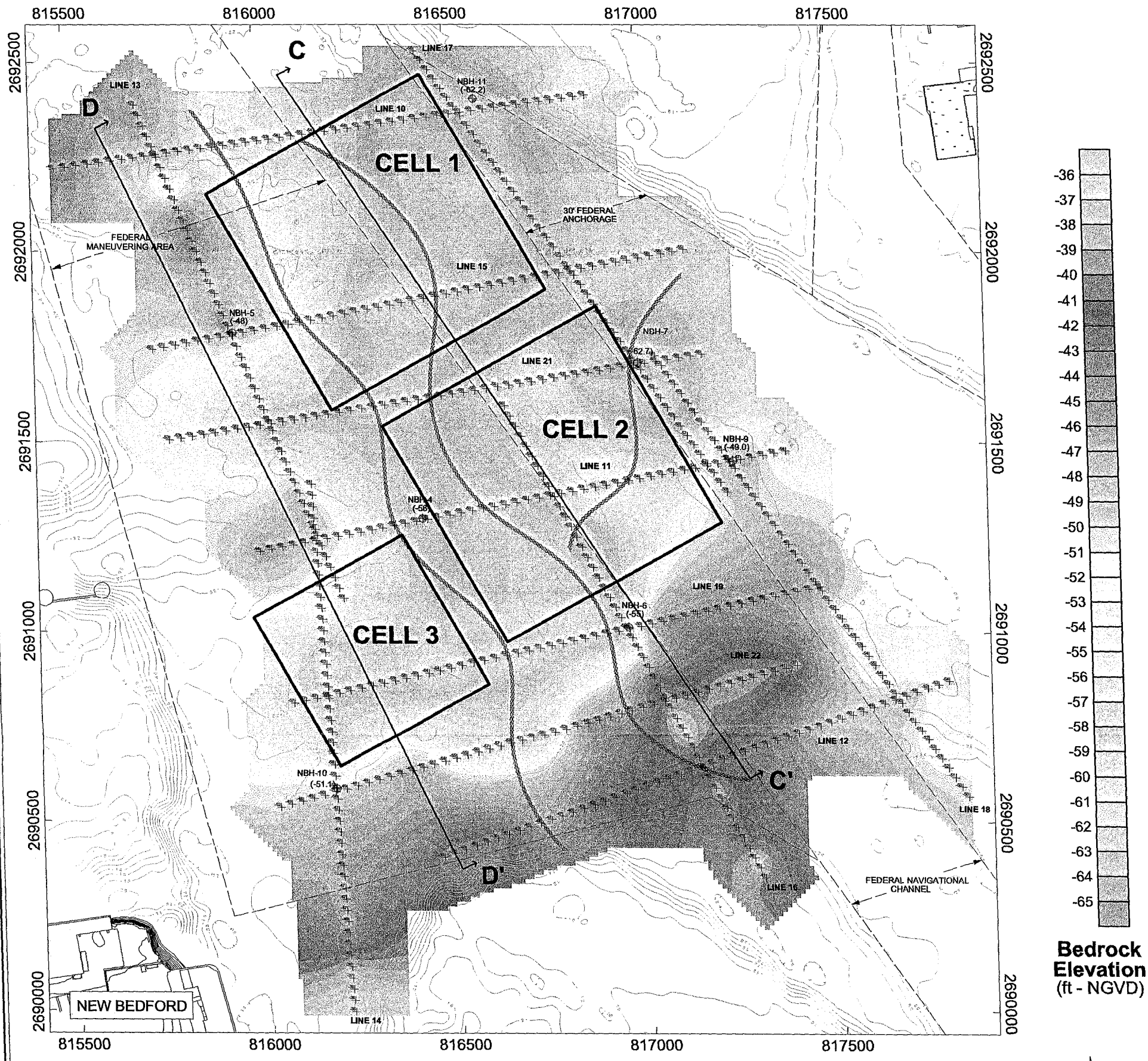
FIGURE 2 - BEDROCK ELEVATION

POPES ISLAND NORTH AREA
SEISMIC REFRACTION - REVISED MODEL

MIDDLE NEW BEDFORD HARBOR
BRISTOL COUNTY, NEW BEDFORD, MASSACHUSETTS

Apex Environmental, Inc.
374 Congress St
Suite 500
Boston MA 02210
617 728-0070

SCALE: 1" = 100'	DRAWN:	DESIGN:	CHECKED:	PROJECT# 6510.001.01
	TDM	TDM	JAB	



Scale 1:3600

250 0 250

US survey foot

NAD83 / Massachusetts CS83 Mainland zone

LEGEND:

- POSSIBLE FRACTURE ZONE INFERED FROM SEISMIC DATA
- SEISMIC CALIBRATION BORING (MAGUIRE)
- FEDERAL CHANNEL, ANCHORAGE AND MANEUVERING AREA LINE
- HYDROPHONE LOCATION (PHONE NUMBER & BEDROCK ELEVATION INDICATED)
- 2' BATHYMETRIC CONTOUR
- PROPOSED CAD CELL EXTENT
- CROSS SECTION LOCATION

NOTES:

1. Base Plan of the New Bedford harbor area was obtained from the US Army Corps of Engineers and has not been field verified.
2. Coordinates are shown in the State Plane Coordinate System, Massachusetts Mainland Zone 2001, Referenced to the 1983 North American Datum (NAD83). Vertical Datum referenced to NGVD29.
3. Boring information and position supplied by The Maguire Group.

REV.	DESCRIPTION	BY	DATE
1.	MODIFIED DEPTH TO BEDROCK	TDM	01/08/02
2.	POSSIBLE CAD CELL CONFIGURATION	TDM	05/05/03
3.	MOD CAD CELL CONFIGURATION	TDM	05/13/03

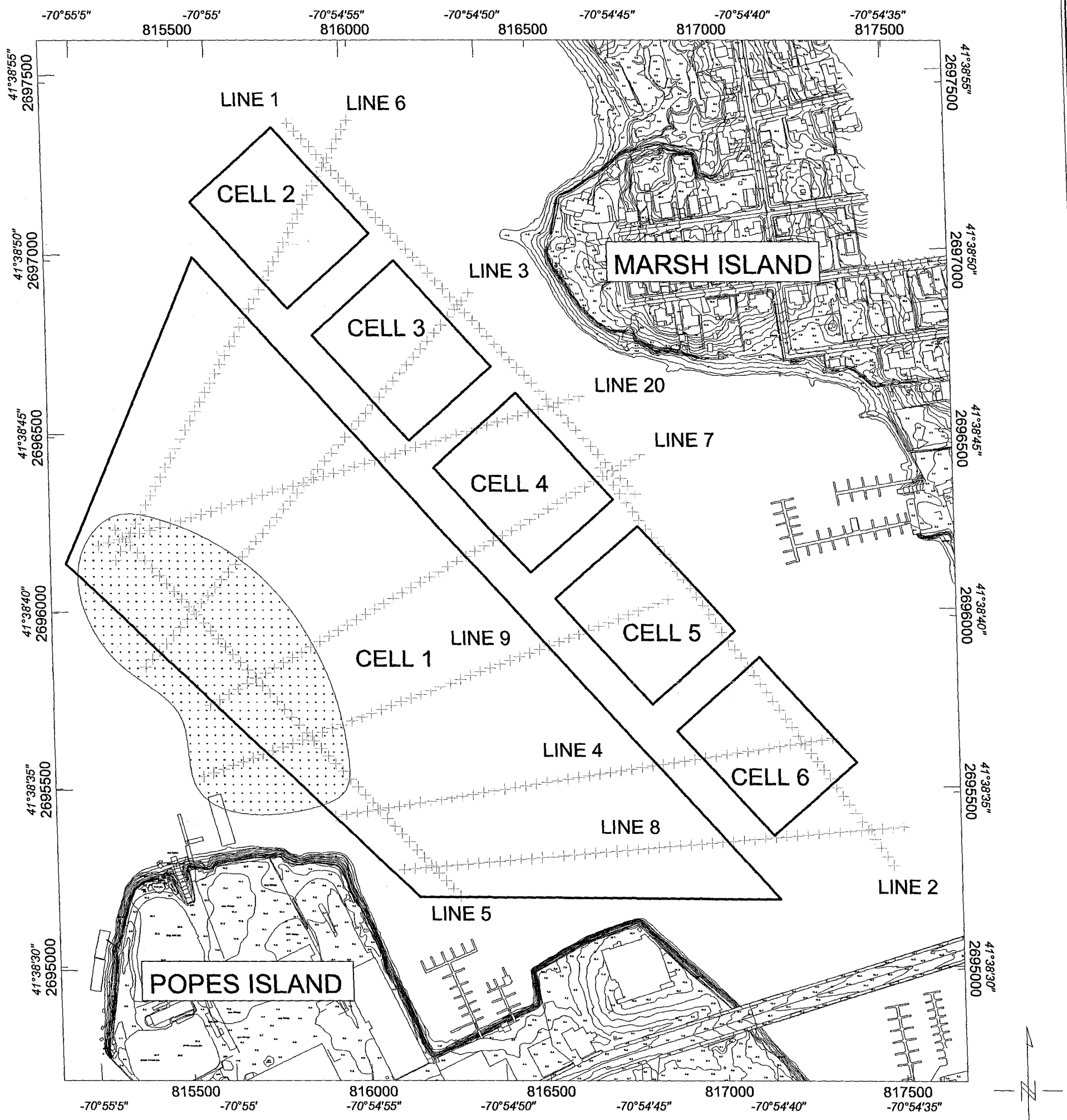
FIGURE 3 - BEDROCK ELEVATION

CHANNEL INNER AREA
SEISMIC REFRACTION - REVISED MODEL

LOWER NEW BEDFORD HARBOR
BRISTOL COUNTY, NEW BEDFORD, MASSACHUSETTS

Apex environmental inc.
374 Congress St
Suite 500
Boston MA 02210
617 728-0070

SCALE:	DRAWN:	DESIGN:	CHECKED:	PROJECT# 6510.001.01
	TDM	TDM	JAB	



LEGEND

- MODERATE DATA CONFIDENCE LEVEL
- HYDROPHONE LOCATION
- PROPOSED CAD CELL EXTENT

Scale 1:3600

250 0 250

US survey foot

NAD83(CSRS98) / Massachusetts CS83 Mainland zone

NOTES:

1. Base Plan of the New Bedford harbor area was obtained from the US Army Corps of Engineers and has not been field verified.

2. Coordinates are shown in the State Plane Coordinate System, Massachusetts Mainland Zone 2001,Referenced to the 1983 North American Datum (NAD83).

REV.	DESCRIPTION	BY	DATE
1.	MODIFIED DEPTH TO BEDROCK	TDM	01/08/02
2.	CAD CELL CONFIGURATION	TDM	05/05/03

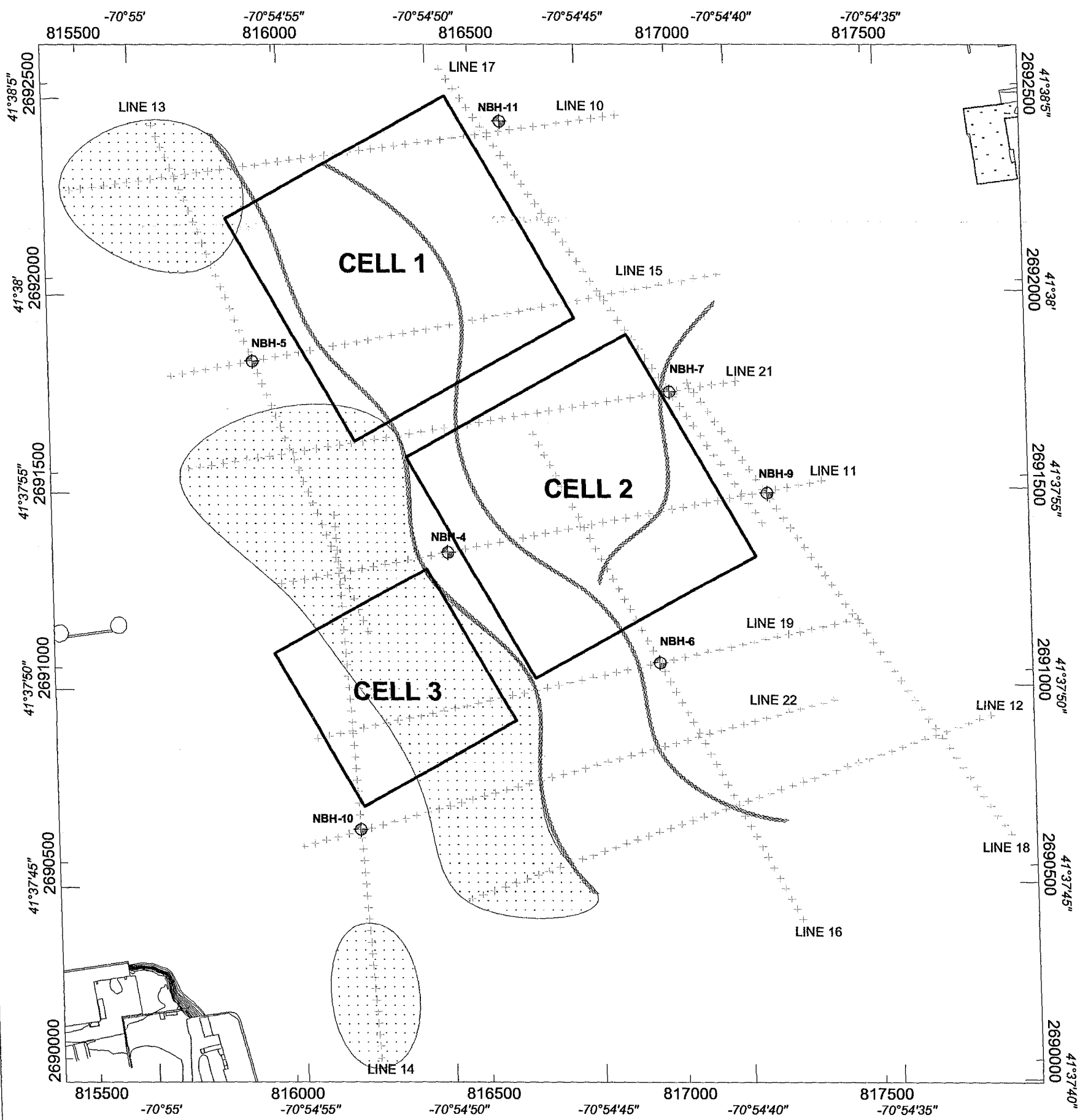
FIGURE 4

POPES ISLAND NORTH AREA - CONFIDENCE LEVELS
SEISMIC REFRACTION - REVISED MODEL

MIDDLE NEW BEDFORD HARBOR
BRISTOL COUNTY, NEW BEDFORD, MASSACHUSETTS

Apex environmental, inc.
374 Congress St
Suite 500
Boston MA 02210
617 728-0070

SCALE: 1" = 300'	DRAWN:	DESIGN:	CHECKED:	PROJECT# 6510.001.01
	TDM	TDM	JAB	SHEET 4 OF 6



LEGEND:

- POSSIBLE FRACTURE ZONE INFERED FROM SEISMIC DATA
- MODERATE DATA CONFIDENCE LEVEL
- HYDROPHONE LOCATION
- POSSIBLE CAD CELL EXTENTS

Scale 1:3600

250 0 250

US survey foot

NAD83 / Massachusetts CS83 Mainland zone

NOTES:

1. Base Plan of the New Bedford harbor area was obtained from the US Army Corps of Engineers and has not been field verified.
2. Coordinates are shown in the State Plane Coordinate System, Massachusetts Mainland Zone 2001, Referenced to the 1983 North American Datum (NAD83).

REV.	DESCRIPTION	BY	DATE
1.	MODIFIED DEPTH TO BEDROCK	TDM	01/08/02
2.	POSSIBLE CAD CELL CONFIGURATION	TDM	05/05/03
3.	MOD CAD CELL CONFIGURATION	TDM	05/13/03

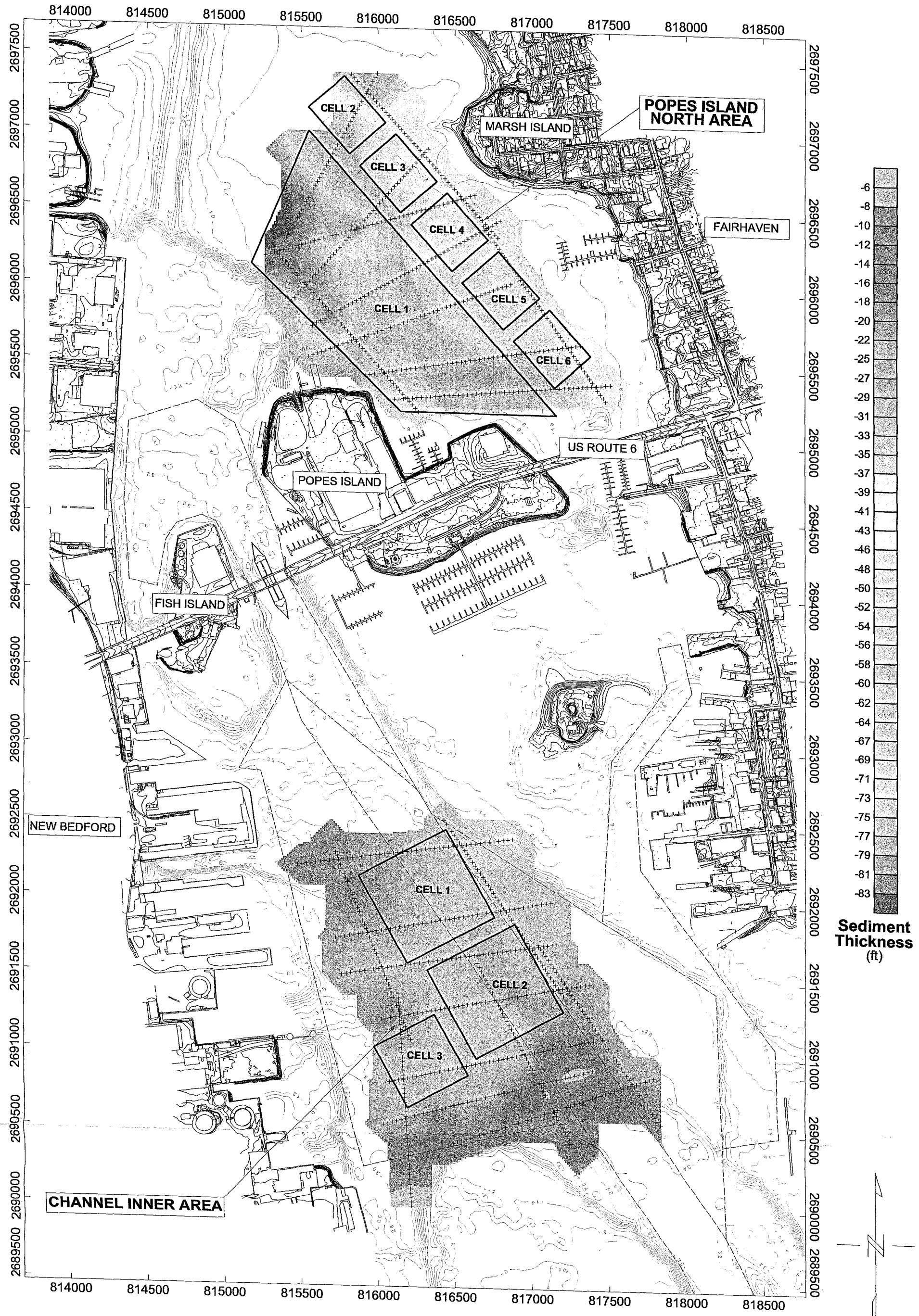
FIGURE 5

CHANNEL INNER AREA - CONFIDENCE LEVELS SEISMIC REFRACTION - REVISED MODEL

LOWER NEW BEDFORD HARBOR
BRISTOL COUNTY, NEW BEDFORD, MASSACHUSETTS

Apex environmental, inc.
374 Congress St
Suite 500
Boston MA 02210
617 728-0070

SCALE: 1" = 300'	DRAWN:	DESIGN:	CHECKED:	PROJECT# 6510.001.01
	TDM	TDM	JAB	



Scale 1:7200

250 0 250 500 750

US survey foot

NOTES:

1. Base Plan of the New Bedford harbor area was obtained from the US Army Corps of Engineers and has not been field verified.
2. Coordinates are shown in the State Plane Coordinate System, Massachusetts Mainland Zone 2001, Referenced to the 1983 North American Datum (NAD83).
3. Sediment Thickness Calculated as the Difference Between Bedrock and Mudline Elevations.

LEGEND

- FEDERAL CHANNEL, ANCHORAGE AND MANEUVERING AREA
- 2 FOOT BATHYMETRIC CONTOUR
- HYDROPHONE LOCATION
- POSSIBLE CAD CELL CONFIGURATION

REV.	DESCRIPTION	BY	DATE
1.	POSSIBLE CAD CONFIGURATION	TDM	05/05/03
2.	MOD CAD CONFIGURATION	TDM	05/13/03

FIGURE 6 - SEDIMENT THICKNESS MAP

CHANNEL INNER & POPES ISLAND NORTH AREAS
SEISMIC REFRACTION - REVISED MODEL

NEW BEDFORD HARBOR
BRISTOL COUNTY, NEW BEDFORD, MASSACHUSETTS

Apex environmental, inc.
374 Congress St
Suite 500
Boston MA 02210
617 728-0070

SCALE:	DRAWN:	DESIGN:	CHECKED:	PROJECT# 6510.001.01
	TDM	TDM	JAB	

APPENDIX C

UNDERWATER ARCHAEOLOGICAL & HAZARDS ANALYSIS REMOTE SENSING SURVEY

UNDERWATER ARCHEOLOGICAL & HAZARDS ANALYSIS
REMOTE SENSING SURVEY

DREDGED MATERIAL MANAGEMENT PROGRAM (DMMP)
NEW BEDFORD, MASSACHUSETTS SITE

Prepared for:

Massachusetts Coastal Zone Management Agency
251 Causeway Street, Suite 900
Boston, MA 02202

Submitted by:

Maguire Group Inc.

July 2003

UNDERWATER ARCHEOLOGICAL & HAZARDS ANALYSIS
REMOTE SENSING SURVEY

DREDGED MATERIAL MANAGEMENT PROGRAM (DMMP)
NEW BEDFORD, MASSACHUSETTS SITE

Prepared for:

Maguire Group Inc.

Prepared by:

Apex Environmental, Inc.
Boston, Massachusetts

July 2003

EXECUTIVE SUMMARY

A focused, multi-phase marine geophysical survey of two areas of New Bedford Harbor, Massachusetts was conducted by Apex Environmental, Inc. and its subcontractors. There are two purposes of the survey; to determine the presence or absence of submerged cultural resources potentially eligible for the National Register of Historic Places; and to identify possible hazards to future dredging activities. The presence of submerged cultural resources may affect future dredging operations and harbor development including the removal contaminated sediments or hazards (natural or manmade) on the harbor bottom and the construction of the proposed Confined Aqueous Disposal Cells (CAD) in New Bedford Harbor.

The surveys covered the areas of interest using two different geophysical survey techniques: Side Scan Sonar and Magnetometer. The data was processed and interpreted by geophysicists, and potential targets, which may represent hazards to the future operations, were identified and registered on summary maps of the areas. These target summary maps, included in this report as Figure 7 for the Channel Inner Area and Figure 8 for the Popes Island North, display the locations of the potential targets identified on a basemap of New Bedford Harbor. Specific results of the processing and interpretation of the data collected by each of the two geophysical methods are presented in this report as Figures 1 through 6 and in Appendices A and B. These maps and appendices display the processed images of the data, which were used to identify potential targets and to generate the final summary maps.

Numerous targets of interest, which may represent hazards to the future dredging or construction operations were identified on the summary maps. These targets included both potentially manmade and natural objects and features. The "cultural" objects identified include: linear features which are thought to be indicative of the presence of pipes and cables; individual targets thought to generally represent stand-alone features such as mooring blocks, anchors, and miscellaneous dropped objects; and groups of targets clustered together and thought to generally represent modern vessel debris. Analysis of remote sensing data identified 43 magnetic and/or acoustic targets in the two survey areas. The vast majority of the targets appear to be isolated single source objects, modern debris, or geologically-related objects. While three of the remote sensing targets found in the Channel Inner Survey Area generated magnetic signatures suggestive of submerged cultural resources, they are located within the dredged portion of the federal channel. This indicates that the target sources are very likely modern debris since such areas are subjected to periodic maintenance dredging, as needed.

Therefore, it is recommended that an archaeological monitor be present during dredging operations to ensure that no shipwreck sites are impacted during dredge operations.

Plotting of the targets interpreted from each of the geophysical data sets on the summary maps of the harbor revealed that many of the targets were identified using both geophysical methods. This correspondence between the geophysical surveys lends confidence to the interpretations. The targets where localized Magnetic anomalies are

coincident with localized Side Scan anomalies are presumed to be either metallic or contain significant metallic parts. Objects or features, which are identified by such coincident localized anomalies, are interpreted as being manmade.

From the geophysical data collected during this study, numerous features were identified which may represent significant hazards to future dredging and/or CAD cell construction operations. None of the remote sensing targets are suggestive of submerged cultural resources. No additional underwater archeological investigation is recommended.
It is anticipated that the plans and information presented within this report will be utilized by various project stakeholders in the design of future projects at the New Bedford Harbor Site. Several of the targets identified (such as large sections of old dock), may represent significant and difficult issues for future dredging or other project operations, and may require further investigation to determine exactly how these features may impact future operations.

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Appendix A – Detailed Side Scan Images Channel Inner Area
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INTRODUCTION

Site/Project Location

The New Bedford Dredged Material Management Plan Site is comprised of two proposed locations in New Bedford Harbor, Bristol County, Massachusetts (see Illustration I). Popes Island North Area is located in the middle harbor north of Popes Island and the Route 6 Fairhaven/New Bedford Bridge. It is bounded on the east by the Fairhaven shoreline and extends approximately 1500' west. The western edge of the study area borders the Federal Channel at the southern portion, and bears east (away from the federal channel) at the northern portion. The Channel Inner Area lies in the main portion of the harbor and is bounded by Palmers Island to the south and the New Bedford shoreline to the west. The study area extends approximately 1500' east to the eastern edge of the main federal channel and almost 4000' north to the New Bedford State Pier. The entire study area is located within the designated federal navigation channel and associated maneuvering and 30' anchorage areas. This area has been maintained by the US Army Corps of Engineers (USACE) with dredging of portions of this area occurred as recently as 2002 (State Pier Dredge Project) in which areas of the federal channel and anchorage was dredged by the City of New Bedford to a depth below -30' MLLW.

The harbor is flanked by the City of New Bedford on the west and the Town of Fairhaven on the east. The main portion of the harbor, the area between the Route 6 Bridge and the hurricane barrier (Illustration I), is naturally deep and is the home for one of the largest commercial fishing fleets in the country. In addition to the commercial fishing vessels, hundreds of recreational sail and powerboats are seasonally berthed and moored at marinas and in the various coves that are located in New Bedford Harbor.

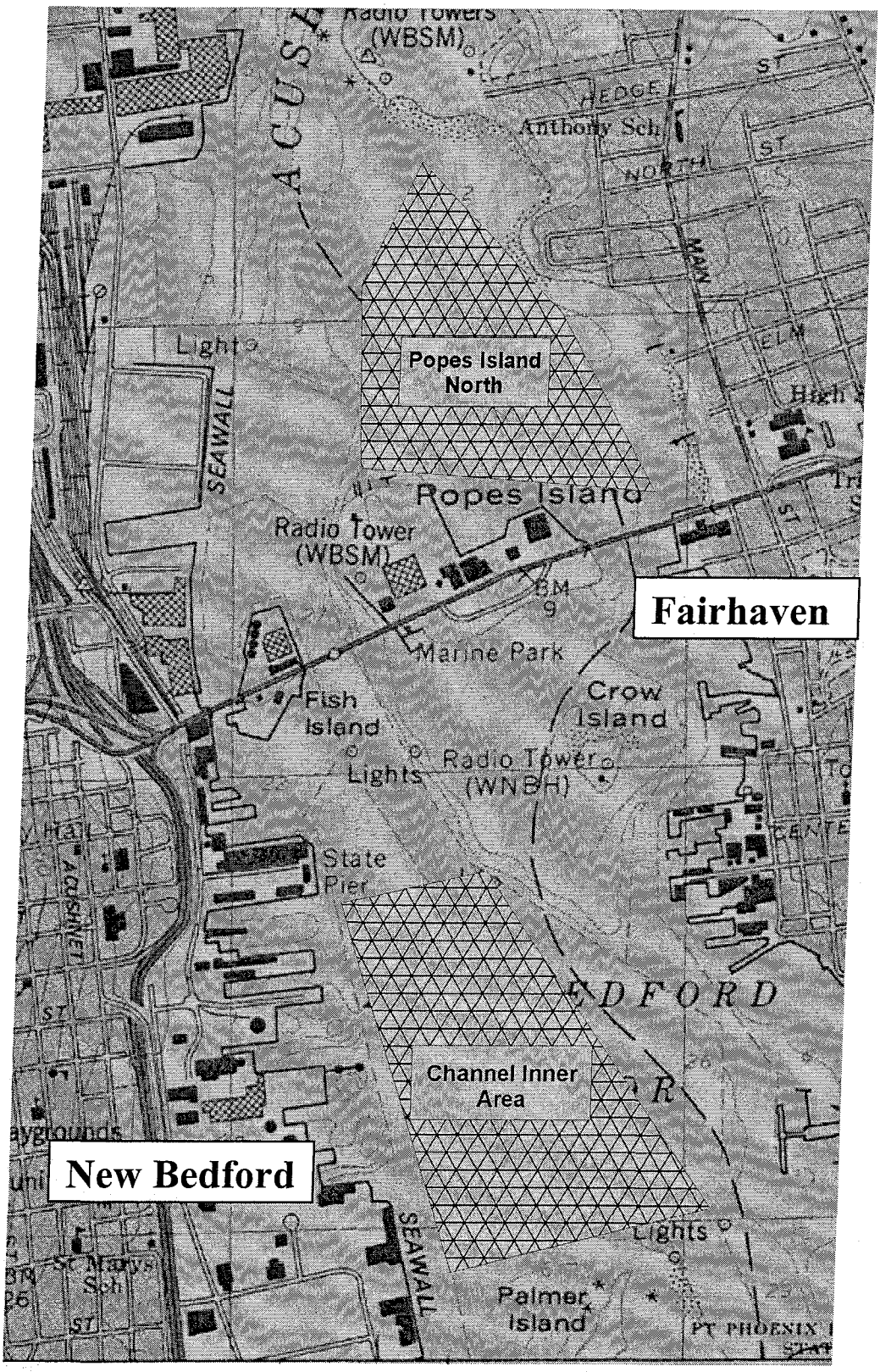

Illustration I - Overview of the Survey Area
New Bedford, Massachusetts

Project Background Information

This "Report of Marine Cultural Resources & Hazards Analysis Surveys: Side Scan Sonar, and Magnetics" was prepared by Apex Environmental, Inc. for Maguire Group, Inc. The work was completed as part of the Dredged Material Management Plan (DMMP) for New Bedford Harbor. As part of the maintenance for the Upper and Lower New Bedford Harbors it is expected that sediments contaminated with PCBs will be dredged in sections of the harbor and placed in Confined Aqueous Disposal (CAD) cells. The areas of interest for this investigation are Popes Island North and Channel Inner Area in New Bedford, Massachusetts (Illustration I).

Marine geophysical surveys were conducted at New Bedford Harbor to identify possible cultural anomalies and hazards to future dredging activities within the areas.

The information generated by this investigation represents background data that will be used for the following purposes:

- Cultural resources screening of the harbor area prior to dredging and CAD cell construction;
- Hazard/obstruction screening of the harbor areas affected by dredging and CAD cell construction;

This report presents the analysis of the geophysical data for identifying significant cultural and natural features lying on the harbor bottom that could pose an obstacle or a hazard to dredging.

Report Structure

Sections 1 through 4 will address Background information and field practices used in the collection, processing and Interpretation of data used to identify both Cultural Resources and Potential Hazards to future work. This report incorporates targets from both programs into a single set of maps (Sheets 1 to 8). Section 5 provides additional specific information on Cultural Resources. Section 6 summaries the findings and recommendations of the investigations. Section 7 presents the limitations of the program. Appendices show in greater detail the Side Scan Sonar Images. Section 8 lists the references cited throughout this report. A CD containing AutoCAD versions of the project drawings, target tables and processed datasets is included at the end of the report.

FIELDWORK INVESTIGATIONS

The following section outlines the fieldwork methodology used to acquire the geophysical data for the Cultural Resources and Hazards Analysis Survey. The geophysical methods utilized for this characterization were Acoustic (Side Scan Sonar) and Magnetometry. The Side Scan Sonar instrument creates images the surface of the harbor bottom, and the magnetometer identifies metallic objects (such as anchors, pipe, cables, moorings, or miscellaneous metallic debris) on the bottom or in the shallow subsurface.

Survey Operations

Field operations for the New Bedford Harbor Marine Geophysical Survey were conducted from October 21 through October 24, 2002. The marine surveys were conducted from a survey vessel outfitted with Side Scan Sonar and a Magnetometer. Shipboard systems were integrated with a Differential Global Positioning System (DGPS) so that the geophysical data collected from the instruments could be tagged with precise position information at regular intervals.

The survey operations were conducted with a team of Apex and specialty subcontractors onboard the survey vessels. CR Environmental, Inc. (a marine survey and equipment contractor) provided the survey vessels (including a boat captain), the DGPS system with navigation software, and the geophysical equipment (Side Scan Sonar). Dolan Research, Inc. (specialists in marine cultural resource projects) provided a magnetometer and an experienced archaeologist. Apex provided a qualified shipboard geophysicist to oversee and coordinate the collection of the marine geophysical data.

SURVEY EQUIPMENT

Survey Vessel

The principal survey vessel was the *R/V Cyprinodon*, a 32-foot aluminum workboat. This vessel was equipped with a large pilothouse for protection of the instrumentation and electronics from the elements, a hydraulic winch and A-frame for ease of deployment of equipment into the water, on-board power, and could accommodate two to three on-board scientists and boat captain required for the work.

The survey vessel was outfitted with equipment capable of producing accurate and detailed images of the harbor bottom and shallow sub-bottom. Side Scan Sonar was utilized to produce picture-like acoustic images of the harbor bottom in order to map bottom features and objects. A magnetometer was used to produce magnetic field maps of the harbor areas to detect metallic objects on the harbor bottom or in the shallow harbor sub-bottom. Both geophysical instruments were integrated with a DGPS for accurate location referencing information. The following provides a summary of the equipment used to complete the task.

Side Scan Sonar

The Side Scan Sonar system used included an Edgetech TD-374 dual frequency Side Scan Sonar tow-fish matched with an Edgetech Digital Control Interface (DCI). The Side Scan tow fish was towed off a stern A-frame in the Channel Inner Area to allow flying depths of approximately 10 feet. In the Popes Island North Area the bow pulpit was utilized to accommodate the shallow water depths and to minimize wake noise. The DCI board was connected to a computerized Side Scan Sonar data acquisition and processing system for shipboard data collection and processing. Chesapeake Technologies SonarWizz software was used for digital data recording from the tow fish and integrated the data with navigation inputs for real-time viewing of the Side Scan image in pseudo-map format. The data was stored digitally for future post-processing and interpretation using Chesapeake's Technologies SonarWeb. The data was recorded and displayed as digital location-corrected pseudo-maps of the acoustic response of the harbor bottom.

Magnetometer

Magnetic data was collected with a Geometrics G-881 Cesium Marine Magnetometer system consisting of a high-sensitivity in-water marine magnetic sensor coupled to a digital data processing computer system running Geometrics MagSea processing software. The MagSea software was utilized to calibrate the system and to record and display the raw digital magnetic data. The G-881 system was designed for shallow water applications (<50m) and is easily deployed from small survey vessels. The magnetic sensor was deployed from the stern of the survey vessel far enough behind the vessel (~45-50 feet) to be beyond the effects of the magnetic field generated by the boat's engines and electronics. In shallow water the depth of the sensor was controlled by attaching the cable leader to a floatation device such that the swim depth of the sensor remained constant, approximately one to two feet below the water surface. This allowed for the survey to be conducted in both shallow and deep-water conditions without the risk of hitting the bottom of the harbor with the sensor. The system was set up to output the raw digital magnetic signature values to a computer screen for on-board real-time initial interpretation and to the project positioning system computer (running HYPACK software) for permanent data storage and later post-processing and interpretation. The HYPACK system logged the raw magnetic data, time stamping each reading and tagging it with DGPS navigation positions obtained from the survey positioning system. Readings were collected at a rate of once per second. The sensor tow fish "layback" was entered into the HYPACK system and the correct position of the sensor was calculated and logged.

Positioning System

Horizontal positioning and navigation for the project was accomplished using a Trimble Ag DGPS. The DGPS consisted of a satellite beacon and radio transmitter mounted on the roof of the vessel and the Trimble Ag processing system mounted shipboard. Satellite positioning data was logged at a rate of once per second, and differential corrections were obtained from the nearest Coast Guard Beacon and processed with the

data in real-time for sub-meter position accuracy. The DGPS generated a constant stream of corrected position information which was output to all ship board systems, including the Side Scan System, the Magnetics system, and the HYPACK navigation system. The HYPACK software was utilized to store the time-tagged position data in both latitude-longitude format and in the project datum (US State Plane – NAD83, Zone - Massachusetts Mainland 2001, NGVD-29, US survey feet). The HYPACK system also provided real-time vessel position status on a helmsman's display for the running of track-lines. An outline of the harbor superimposed with the proposed data collection lines (track-lines) were entered into the HYPACK system at the start of the field program. These proposed track-lines were then retrieved onto the helmsman's display as the survey was in progress. The position of the vessel, as determined by the DGPS system, was superimposed in real-time onto the track-line layout, so that the vessel Captain could "steer-to" navigate to stay on course and run straight and accurate data collection lines.

Study Area Definition and Spacing

Marine geophysical data for this survey was collected from the two areas of New Bedford Harbor which are of interest to the project: Popes Island North and Channel Inner Area (Illustration I). Lines showing the ship's track path are superimposed onto the Magnetic Maps (Channel Inner Area - Figure 1, Popes Island North - Figure 4) generated for each area.

Prior to mobilization, a review of all available information was conducted. This review indicated that the appropriate track-line spacing for the survey was 50-feet for the collection of magnetic data and 100-feet for side scan data (due to swath data collection). The survey direction was primarily north to south, along the length of the harbor. The following number of lines and line-miles were surveyed in each of the harbor segments:

- Channel Inner: 43 survey lines (north-south), total nautical mileage of approximately 19.9 nautical miles.
- Popes Island North: 32 survey lines (north-south), total nautical mileage of approximately 11.6 nautical miles.

SURVEY PROCEDURES

Field Data Collection

Geophysical data was collected with both instrument systems (Side Scan Sonar, and Magnetometer) running concurrently. Sequencing of the work required consideration of the tide cycles. In the shallower portions of the Popes Island North Area (mostly near the Fairhaven shoreline), the survey had to be accomplished in pieces as low tides prohibited the entire area from being surveyed at one time. The field data collection occurred between October 21 and October 24, 2002. Daily equipment calibrations, and functional checks, were conducted daily with all field personal prior to starting field surveys. Operations were continuous during the day, except for minor periods of occasional equipment malfunction or loss of DGPS satellite coverage. Over the 4-day survey period over 30 nautical miles of data was collected in the two areas of interest. Water depths over the survey areas ranged from 3 feet to greater than 30 feet.

Data Processing

Initial data processing and interpretation was carried out as the survey was in progress to ensure that good quality data was being collected and that data quality objectives were being met. The initial shipboard data processing and interpretation varied between the instruments:

- Side Scan Sonar data was processed using the SonarWeb software into pseudo-map images along the data path. The initially processed data appeared as geo-referenced strip images of the harbor bottom displayed on a computer screen. The Side Scan operator would monitor the data collection at all times to ensure that the image was as clear as possible, and to make initial interpretations of the data in real-time. Targets (features of the bottom appearing as anomalous from the rest of the data) were "captured" digitally by the operator using the computerized target capture feature, and were cataloged and stored for later post-processing and enhancement. The Side Scan data was also stored digitally for later post-processing and more intensive interpretation.

- Magnetic data was initially processed in the field by the Edgetech MagSea system. Uncorrected magnetic data was then displayed on a computer screen in cross-sectional form so that the magnetometer operator could make observations concerning the data stream as it appeared on the screen. The magnetometer operator noted and cataloged any significant raw magnetic anomalies (deviations of the magnetic signal from background) identified as the survey was in progress. The magnetic data was also stored digitally for later post-processing and more intensive interpretation.

The initial interpretations of the data made in the field were utilized by the field team to continually assess the data collected and make minor modifications to the field program in order to ensure the highest possible data quality. Both the initial field interpretations

and the raw field data were brought into the office for further post-processing and interpretation upon completion of the survey.

Complete data processing and interpretation was carried out by Apex geophysicists and Dolan Research, Inc. archaeologists. The geophysical data required extensive computer reduction prior to interpretation. The basic processes for reduction of the digitally recorded data are summarized in the sections below.

Magnetics

The magnetic data collected in the field was stored on the navigation system computer in a HYPACK file. The data consisted of the x and y positions of the magnetic sensor, the total field magnetic reading (once per second), and the time that each reading was collected. Because the magnetic field of the earth (which is the parameter measured) varies with time and location, a series of corrections must be made to the raw field data before it can be displayed in map form and contoured. The following steps were involved in the processing of the magnetic data:

- Data files for each survey area were checked for proper geometry and recording interval and any lines corrupted by equipment malfunction or prematurely aborted were weeded out. Coordinate transformations, if necessary, were performed, and position "outliers or fliers" were removed from the data sets.
- A file of magnetic (diurnal) corrections was constructed using data from a magnetic base station that was operating during the field program and data from a U.S. Geological Survey Magnetic Recording Station. The corrections file was time-tagged for later merging with the raw data file from the survey.
- The position-corrected raw data was then merged with the file of magnetic corrections. This was accomplished by matching up the time–tag for each element of the two data sets. The result of the merging of the raw data and corrections was the creation of a file containing the corrected magnetic measurement data for the survey.
- The corrected data set (x, y position, raw and corrected magnetic reading) was then input into Geosoft's Oasis Montaj data processing software. Montaj creates maps of the magnetic readings, grids the data set, and produces a color-coded contour map of the magnetic intensity readings of the survey areas for interpretation.
- Filtering and data manipulation was performed to enhance any anomalies present in the data sets. Targets/anomalies within the data set were then identified by an experienced geophysicist.
- Once the interpreter was satisfied that all anomalies were identified, a target list was generated consisting of x and y positions in the project datum. This target list was output as a data table for inclusion in this report and as a DXF file for the plotting of a Target Location Plan on the project base map of the harbor.

Side Scan Sonar

The Side Scan data collected in the field was stored as raw data for post-processing. The data was merged with the position data in real-time as the data was collected, so that position-corrected strip images of the bottom were also created in real-time. These strip images are gray tone representations of the strength of the returned acoustic signal from the bottom as the survey was in progress. The Side Scan data files were further processed in the office to enhance the image quality, and mosaic images were created by digitally pasting together the strip images into a pseudo-map of the entire harbor bottom. The following steps were involved in the further processing and interpretation of the Side Scan data:

- All of the Side Scan data files were played back using the Sonar Web software in the office by an experienced geophysicist. The images were "cleaned up" by playing back the data using optimal imaging parameters to create as accurate an image as possible.
- Targets were identified through visual assessment by an experienced geophysicist of the replayed, enhanced strip images. The target images were then "captured" and output to an image enhancement program for final presentation and hard-copy printing.
- A "Side Scan mosaic" was then created by taking all of the Side Scan strip images from each area and merging them together into a single map. One mosaic was generated for each of the areas surveyed.
- The resulting position-corrected Side Scan Mosaic for each area was then output as a geo-referenced image "GeoTIF" file and was overlain on the project standard survey maps of the harbor edge, thus generating an acoustic map image of the harbor bottom features referenced to the shoreline.

Finally, an output file of the locations of all of the targets identified from the Side Scan data interpretation was created for inclusion in the text of this report. A "DXF" file of the target locations was also generated and overlain, along with the magnetics data, on the base map for the project.

Interpretation Techniques

Preliminary analysis and interpretation of the geophysical survey information was performed each day in order to plan the remaining work or modify the survey program in specific areas. The objective of the data analysis and interpretation phase was to characterize the responses from the geophysical data in terms of their most probable sources (i.e., rock, buried object, pipe, cable, etc.). An integrated approach to the analysis and interpretation phase was implemented for this project, in which targets and features detected by Magnetic and Side Scan imagery were collectively interpreted. This strategy allowed targets and features detected by both instruments to be more accurately characterized in terms of depth and probable source. The magnetic and Side Scan data

was also analyzed and interpreted in concert with the historic structure pattern and lithologic and geotechnical sampling data existent for the harbor.

Experienced geophysicists identified target and feature responses within the data and generated color–coded maps and target anomaly lists of the geophysical anomalies. The software used for the processing, analysis, and interpretation of the magnetic data was Oasis Montage, a geophysical data analysis program developed by Geosoft, Inc. Montage allows intensive mathematical and statistical analysis of geophysical data. The Side Scan data was analyzed on an office based PC using the software SonarWeb for post-processing and data enhancement. Representative symbols of the targets or features of interest were transcribed onto a summary plan map of the Site.

ANALYSIS OF REMOTE SENSING DATA

Analysis of remote sensing signatures identified during the survey was based on several criteria. Magnetometer data were contour plotted and each anomaly was analyzed according to: magnetic intensity (total distortion of the magnetic background measured in nanotesla-nT); pulse duration (detectable signature duration); signature characteristics (negative monopolar, positive monopolar, dipolar, or multi-component); and spatial extent (total area of disturbance). Acoustic targets were analyzed according to their spatial extent (total area of disturbance), signature characteristics (shape, relief above the bottom, strength of return and contrast with the background) and environmental context.

Criteria for analyzing remote sensing targets have been developed from a database of target signatures that have been compiled over the last three decades. Starting in the 1960s, archaeologists primarily relied on magnetic remote sensing data, collected with proton procession magnetometers, to locate submerged cultural resources. However, magnetic data collected alone often provides inconclusive evidence on submerged cultural resource sites. Underwater archeological research conducted over the last two decades indicates that shipwreck sites may produce a variety of magnetic signatures. Furthermore, modern debris often generates magnetic signatures that may share similar characteristics with certain types of shipwreck sites.

The ambiguous nature of magnetic signatures has led researchers to use acoustic and occasionally sub-bottom remote sensing equipment in conjunction with a magnetometer on most underwater archeological surveys. Side-scan sonar units gather acoustic data by processing sound waves emitted into the water column on both sides of the submerged sensor. The sound waves are then bounced back off the bottom surface and exposed objects. State of the art digital sonar units produce high-resolution records that are almost photographic in quality. However, a certain degree of structural integrity of a shipwreck site must remain above the bottom to produce a reliable shipwreck signature on side scan sonar. Where no structure survives above the bottom surface, researchers must rely on magnetic data to help locate shipwreck remains. Additional data provided by acoustic instruments frequently permits target identification to be made solely from remote sensing information. A combination of magnetic and acoustic remote sensing data has proven to be the most effective method to accurately identify and assess submerged archeological sites. Typically, the most attractive targets produce both a defined magnetic and acoustic signature.

In preparing the technical report, remote sensing targets were characterized according to potential significance. Target locations that generated signature characteristics suggestive of submerged cultural resources were designated as High Probability Targets. All other targets, including single source objects and modern debris, were simply listed as targets. Additional underwater archeological investigations were recommended at the former type of targets.

It must be noted that the entire Channel Inner Area is located within the federally maintained 30' channel MLLW. All targets found within this area were considered debris-related.

Findings of Remote Sensing Survey

Analysis of the Acoustic and Magnetics data collected during this phase of the geophysical work was completed by Apex geophysicists and the results are summarized on the Geophysical Target Summary Plan Maps presented as Figures 7 and 8 of this report. These plans were generated in order to provide easy and rapid reference and location information on all of the targets identified as a result of the analysis of the both data types.

The targets identified from the data sources fall into two primary categories:

- Those objects or features which appear to be of cultural origin (manmade); and
- Those objects or features, which are natural.

The "natural" objects are thought to consist primarily of large boulders either resting on the harbor bottom or buried in the shallow sub-bottom.

The "cultural" objects identified were of several different types. Linear features are thought to consist mostly of pipelines and cables. Individual targets are thought to generally represent stand-alone features such as mooring blocks, anchors, and miscellaneous dropped objects.

The remote sensing survey identified 43 targets, of them 20 were magnetic and 18 acoustic with 5 having both an acoustic and magnetic signature. The Channel Inner Area had 13 magnetic targets and 17 acoustic targets identified in the survey area. Of these targets identified 2 targets were recorded as coincident targets that possess both a magnetic and an acoustic signature. Appendix A has enlarged images of each of the Side Scan anomalies identified in the Channel Inner Area. The Popes Island North Area had 12 magnetic targets and 6 acoustic targets identified. Three of these targets were coincidence magnetic and acoustic anomalies. Enlarged Side Scan Sonar images identified in the Popes Island North Area can be seen in Appendix B.

Examination of the remote sensing data found no clear evidence of targets in either survey area that would be considered suggestive of potentially significant submerged cultural resources. While no additional underwater archaeological investigations are recommended, an archaeological monitor should be present during dredging operations to ensure no archaeological site are encountered during dredging operations.

The following tables in this section summarize the various anomalies identified for the Cultural and Hazards Analysis. Each of the anomalies will be further described in the following chapters.

Table 1. Channel Inner Area – Side Scan Sonar Targets

Side Scan Target ID	X Easting	Y Northing	Image Size (ft)	Image Characteristic	Associated Magnetic Signature/Target ID
C6-1	815825	2690708	6' x 3'	Debris	**Small magnetic signature**
C8-1	816258	2689933	<3'	Multiple Rocks	-
C12-1	816365	2690168	<4'	Rocks	-
C18-1	816449	2690409	4' x 6'	Channel Marker	**Magnetic signature**
C20-1	816822	2690147	20'	Two Pipes/Debris	**Magnetic signature**
C24-1	817016	2690424	6'	Rocks	-
C29-1	817271	2690460	10'	Rocks	-
C31-1	817408	2690383	10'	Rocks	-
C31-2	817203	2690719	4' x 6'	Channel Marker	**Magnetic signature**
C33-1	816579	2692460	35'	Section of Dock or Railing	**Magnetic signature**
C37-1	816881	2691984	25'	Wooden Pile	-
C35-3	817261	2690931	<3'	Area of Rocks	-
C37-2	817581	2690537	<3'	Multiple Tires/Debris	**CM-2**
C39-1	816841	2692258	20'	Pipe/Debris	**CM-12**
C39-2	817091	2691809	30'+	Cabling	**Small magnetic signature**
C39-3	817181	2691592	4' x 7'	Tires/Debris	**CM-11**
C41-1	817838	2690646	<16'	Multiple Tires/Debris	**Small magnetic signature**

Table 2. Channel Inner Area – Magnetic Targets

Magnetic ID	X Easting	Y Northing	Anomaly Characteristic	Anomaly Size (nT)	Comments	Side Scan Target ID
CM-1	816030	2690989	dipole	24	Anomalies seen across several lines up to 23 fiducials long. Anomalies extend to CM-7	-
CM-2	817685	2690538	positive monopole	21	small anomaly, 6 fiducials, seen across 3 lines associated with debris	C37-2
CM-3	816580	2690950	positive monopole	50	intense short anomaly seen across two lines (20 fidicals)	
CM-4	817475	2691191	dipole	89	broad intense anomaly across 2 lines (40 fidicals)	
CM-5	817193	2691224	positive monopole	39	intense anomaly, 20 fiducials	-
CM-6	817024	2691336	dipole	46	anomaly, 27 fiducials, seen across multiple lines	-
CM-7	816217	2691067	dipole	24	medium intense anomaly, 10 fiducials possibly associated with CM-1	-
CM-8	817083	2691928	positive monopole	56	medium intense anomaly,12 fiducials, seen across 3 lines	-
CM-9	815631	2691940	positive monopole	30	intense med/large anomaly, 20 fiducials seen across 3 lines	-
CM-10	816264	2690629	dipole	46	large broad anomaly 35 fiducials, possibly a geological effect	
CM-11	817202	2691515	multi component	19	small anomaly greatly influence by nearby anomaly	C39-3
CM-12	816902	2692251	positive monopole	60	Character influenced by nearby anomalies	C39-1
CM-13	816727	2691385	negative monopole	38	small anomaly seen over 16 fiducials, seen across a single line	

Table 3. Popes Island North – Side Scan Sonar Targets

Side Scan Target ID	X (Easting)	Y (Northing)	Image Size	Image Characteristic	Assocaiated Magnetic Target
P4-1	815854	2695524	10' x 4'	Debris	**Small magnetic signature**
P4-2	815720	2695563	60'	Possible Pipe	**PM-4**
P8-1	816370	2695103	<3'	Multiple Rocks	-
P13-1	815591	2696601	20' x 3'	Debris	**PM-6**
P22-1	816424	2696140	26'	Possible piling	-
P24-1	817257	2695397	5'	Rocks w/relief	-
P24-2	817184	2695448	5'	Rocks w/relief	-
P26-1	816293	2696661	8' x 4'	Possible sunken wooden boat	-
P28-1	817014	2695934	12'	Debris	**PM-1**
P28-2	816403	2696829	5'	Rocks	-
P30-1	816345	2697039	<3'	Multiple Rocks/tires/small Debris	-
P30-2	817583	2695503	10'	Rock	-

Table 4. Popes Island North – Magnetic Targets

Magnetic ID	X Easting	Y Northing	Anomaly Characteristic	Anomaly Size (nT)	Comments	Side Scan Target ID
PM-1	817009	2695936	dipole	34	short slight anomaly (6 fiducials), probable small metallic debris	P28-1
PM-2	816499	2695362	monopole	101	medium intense anomaly, 18 fiducials	-
PM-3	816132	2695638	monopole	140	large intense anomaly, 21 fiducials, seen across 3	-
PM-4	815718	2695565	dipole	680	large broad anomaly seen across 5 lines, associated with side scan image. Nearby moored barge may have influenced or altered the anomaly	P4-2
PM-5	815554	2696489	monopole	57	small intense anomaly, 12 fiducials	-
PM-6	815627	2696592	monopole	57	large intense anomaly, 26 fiducials associated with debris side scan	P13-1

Side Scan Sonar

Composite mosaic images for each of the areas of interest are presented as Side Scan Mosaics on Figures 3, (Channel Inner Area), and Figure 6 (Popes Island North Area).

Because the objects and features of interest to this project are relatively small compared with harbor plan maps, and are difficult to pick out in any detail from the mosaic maps, enlarged "blow-up" images of all of the relevant targets identified from the Side Scan data are included in Appendix A and B. These blow-ups indicate in some detail the nature of many of the objects identified from the Side Scan data and are described below.

Channel Inner Area

- The survey area revealed many areas of rocks (C8-1, C24-1, C29-1, C31-1, C35-3), which could be indicative of a shallow bedrock surface. Some of the rocks imaged (C29-1 and C1-1) are large in size and show relief indicating that they protrude from the harbor bottom.

- Image C6-1 shows a very strong acoustic return from a square object with a small associated magnetic anomaly. This is interpreted to be a wooden object with a small amount of metal.

- C18-1 and C31-2 are aids to navigation (Federal Channel markers) and were used as QA/QC checks in the field and through out the processing and interpretation phases.

- Two images shown are indicative of metallic pipes (C20-1 and C39-1) approximately 20' in length with associated magnetic signature.

- Image C37-1 has similar characteristics to the pipes (C20-1 and C39-1) but has no associated magnetic signature indicating that it could be a possible wooden piling. The image is approximately 25' long and is seen protruding off the harbor bottom.

- Image C33-1 has a definite structure and relief off the harbor bottom. This is interpreted to be a large piece of debris 5' x 35' and is thought to be a section of dock or railing since several similar sections of dock have been removed from the harbor in the vicinity of this target. There is a small coincident magnetic anomaly with this object possibly from the metallic fasteners used to secure the timbers together.

- Images C37-2, C39-3 and C41-1 show collections of debris including miscellaneous metallic items and tires. There are variable magnetic responses to these areas of debris and could indicate the presence of a large amount of metallic items.

- Image C39-2 shows a possible metal cable over 30' in length. There is a slight magnetic response.

Popes Island Area

- Two possible small wooden dinghies were imaged (P4-1 and P26-1). Target P4-1 has a corresponding small magnetic anomaly associated with it.

- Image P4-2 shows a possible pipe approximately 60' in length with a strong corresponding magnetic signature.

- Images P8-1, P24-1, P24-2, P28-2, P30-1 and P30-2 show collections of small rocks (less than 5').

- Two images (P13-1 and P28-1) are large pieces of metallic debris approximately 12' and 20' in length respectively. P13-1 is a rectangular object, approximately 12'X3' with a small debris field clustered nearby. P28-1 is a linear object, 12' long with a hinged piece at one end of the object. They both have large magnetic anomalies associated with them.

- Image P22-1 is a linear object 26' long that is likely a wood piling or timber (no associated magnetic signature).

Magnetics

Color Contour maps of the magnetic data are presented as Figures 1 & 2, and 4 & 5 in the figures section of this report. Figure 1 and 4 depict the Total Magnetic Intensity (TMI) in the Channel Inner Area and the Popes Island North Area, respectively. The maps display the raw (diurnally corrected) data and illustrate the broad larger trends, which tend to mask the smaller anomalies of interest. From this data the change in TMI is calculated and displayed as a color coded image with 2nT contours (Figures 2 and 5). These maps better depict the smaller anomalies and are used as the main magnetic interpretive tool in conjunction with the TMI maps. The magnetic maps display the data as color-coded magnetic intensity: magnetic highs are displayed as oranges, reds, and pinks; while the magnetic lows are depicted as blues, with greens acting as neutral. TMI maps of both areas show strong geological (long wavelength) anomalies or effects from possible undulating bedrock. The trends of these geological anomalies are predominately northeast – southwest trending and can complicate or alter smaller subsurface anomalies of interest to this report.

Potential anomalies were picked by experienced geophysicists utilizing the mapping software, Oasis Montaj. Targets were generally identified by picking anomalies that displayed a significant and localized shift in magnetic intensity from the background data. In particular, anomalies with localized extreme magnetic highs, extreme magnetic lows, or coupled highs with lows adjacent to one another were interpreted as being indicative of a magnetic target. Anomalies depicted by a cross on figures 2 and 5

indicate an anomaly caused by a surface mooring or boat as observed and noted in the field. Due to the mooring field located north of Popes Island a significant number of anomalies are identified as being moorings. Additional small anomalies in this area are due to sunken moorings.

Channel Inner Area

Due to the sensitivity of the instrument various surface metallic objects and shoreline structures can cause anomalies and are depicted by a cross symbol on Figure 2. At the southern portion of the survey area many magnetic anomalies can be seen and are probably due to shallow bedrock combined with shallow water depths allowing the sensor very close to the harbor bottom.

- CM-1 and CM-7 may be associated with multiple dipole signatures across 5 lines indicating the presence of a possible subsurface pipe or cable.

- CM-2 is a small anomaly associated with an area of debris seen in the Side Scan Target C37-2.

- CM-3 is a moderate anomaly seen across 3 lines probably associated with cable in the subsurface. CM-5 and CM-6 are similar type anomalies possibly enhanced by the geologic feature. While all three generated well-defined magnetic signatures, they are located within the federal channel that has been dredged to a 30' depth. They are not considered to be associated with an historic site.

- CM-10 is a medium intense broad anomaly that could be associated with geological effects or a large deep anomaly.

- CM-11 is a small anomaly, which is distorted by the nearby drilling barge. The anomaly is associated with Side Scan target C39-3 (collection of small metallic and non-metallic modern debris)

- CM-12 is a medium anomaly associated with Side Scan target C39-1 and is a possible metallic pipe/pole.

- CM-13 is a small negative anomaly possibly due to a change in survey boat speed when the data was collected. The anomaly can only be seen across a single line.

Popes Island North Area

Due to the sensitivity of the instrument numerous surface objects and shoreline structures cause anomalies especially within the mooring field. Anomalies caused by boats and moorings are noted as a cross on Figure 5.

- PM-1, PM-4 and PM-6 are anomalies associated with modern debris, as seen in the associated Side Scan Images.

- PM-2, PM-3 and PM-5 show a similar magnetic signature to the moorings in the area. It is suspected that this anomaly could be due to a sunken mooring or mooring anchor.

CULTURAL RESOURCES PROGRAM

MARITIME HISTORICAL OVERVIEW

Methodology

Prior to conducting fieldwork investigations, background research was undertaken to develop a generalized historic maritime context of the New Bedford Harbor for evaluation of potential historic submerged sites. However, much of historical research that follows was initially collected and submitted for a very similar study was completed in 2001 (Cox, 2001).

In addition to inspecting primary and secondary historical data, background research efforts included a records check for known archeological sites and National Register properties in the New Bedford project area and vicinity, and a review of Massachusetts state underwater archeological site files and prior technical reports.

While the emphasis of background research focused on maritime activity in the New Bedford Harbor, a broad-based historic overview was essential for providing the proper framework for assessing the potential significance of submerged cultural resources. Historic maps, secondary and primary shipwreck lists, primary historical accounts, newspapers, and county and thematic histories helped to identify a set of expected resources in New Bedford Harbor. During the course of background research staff contacted local archaeologists, watermen, avocational historians, and interested laypersons who may possess knowledge of the harbor area. Project staff also visited local and county libraries and historical societies. Site-specific research, pertaining to individual vessels was reviewed at Peabody Essex Museum, Salem, Massachusetts; New Bedford Whaling Museum, New Bedford, Massachusetts; and Independence Seaport Museum, Philadelphia, Pennsylvania. At each repository, computer indexes were inspected for references to specific ship-types, and maritime activity in and around New Bedford. In addition, sources were checked for data concerning potential shipwreck sites in New Bedford. Primary and secondary sources for shipwreck sites were also accessed during the collection of background data.

Information gathered during the background research was used to generate a framework for the project vicinity. The historical framework identified types of resources that may have been deposited in the New Bedford Harbor vicinity, and to determine the nature and extent of subsequent activities that may have removed or disturbed such resources. Each target or site identified during the fieldwork was analyzed and evaluated for potential historical significance within the context of this framework.

Maritime Historical Overview – New Bedford Harbor

Europeans first documented the Acushnet River and vicinity in 1602 when Englishman Bartholomew Gosnold, aboard the bark *Concord* sailed into the region after sailing from Falmouth, England (Baker, 1980). However, the first permanent European settlement in the study area did not start until 1652 when settlers from Plymouth bought the land

presently encompassing Dartmouth, New Bedford, Fairhaven and Westport. New Bedford was part of Dartmouth until the old township was divided in 1787. Fairhaven and New Bedford remained as one township until 1812 (Ricketson, 1858). New Bedford's spacious and naturally deep harbor became an ideal location for the development of the fisheries industry. Whaling soon became the primary industry in New Bedford and Fairhaven. The first whalers in the colonies left from Nantucket and New Bedford as early as 1690.

The country's whaling fleet initially centered on Nantucket Island, began to consolidate on the mainland at and around New Bedford after the Revolutionary War. In 1765, there were only two or three small vessels employed in the whale fishery at New Bedford. In that year, Joseph Russell operated the sloops *Nancy*, *Polly*, *Greyhound*, and *Hannah* (all between 40 and 60 tons) in the local whaling industry. Other boats built and operated by Mr. Russell include; *Joseph & Judith*, *Patience, No Duty on Tea, Russell*, and *Rebecca*. Russell was instrumental in founding the town of New Bedford to serve as homeport for his growing fleet of whaling vessels. As the principle landowner, Russell had designed the town from the start to be a whaling center. In sub-dividing and selling off his tract, Russell provided sites for shipwrights, boat builders, blacksmiths, coopers and other artisans essential to the fishery industry. (Kugler, 1980). Other notable early vessels launched at New Bedford include the merchant vessel *Dartmouth*. She was owned by Francis Roth and later became one of the vessels involved in the Boston Tea Party demonstration in Boston Harbor (Ricketson, 1858).

Another prominent family associated with the formation of New Bedford was the Rotch family. Joseph Rotch and his sons, initially of Nantucket, moved to New Bedford in 1767. They soon became the leading whaling merchants in the colonies. In 1768, Rotch also built New Bedford's first candleworks (Kugler, 1980).

By 1775, almost 50 boats were involved with the expanding whaling industry. However, the British destroyed the eighteenth century whaling industry in Massachusetts during the Revolutionary War. Almost the entire whaling fleet of New Bedford was wiped out during the Revolution: only four or five ships remained out of 200 sail before the war; the rest were lost, burned or captured (Morisson, 1921).

New Bedford was active during the Revolutionary War. Early in the war, New Bedford and Fairhaven inhabitants constructed a fort on the east side of the Acushnet River at Nobscot. Many privateers were fitted out of Boston and Providence, and many of the prize vessels they captured were sent to New Bedford. Once the British discovered the town was stored with prize goods of every description, Sir Henry Clinton dispatched an expedition under the command of General Gray. On September 5, 1778, a British fleet that consisted of 32 vessels, the largest of which was a 40-gun ship, entered Clark's Cove and formed a bridge of boats to the shore. Approximately 4,000 or 5,000 British soldiers and sailors landed at New Bedford to destroy the vessels in the harbor. Local resident, Mr. Gilbert Russell listed 34 ships that the British destroyed: seven ships, one barque, one scow, eight brigs, seven schooners, and 10 sloops (Russell, cited in Ricketson, 1858).

After the war, the whaling industry slowly revived. It took several years after the peace before any vessels were fitted out in New Bedford. In 1787, there was only one ship (180 tons) and 2 or 3 brigs in the business; but soon after this period the whaling industry revived (Ricketson, 1858). In the last decade of the eighteenth century, both New Bedford and Fairhaven competed with Nantucket and began their rise to world prominence in the whale trade. In 1789, more than 100 whaling vessels operated out of Massachusetts, mostly from Nantucket and New Bedford. In the 1790s New England whalers headed into the Pacific Ocean for the first time. Related maritime industries sprung up in New Bedford, and particularly Fairhaven, in support of the whaling industry, including shipbuilding, ropewalks, and candle factories.

In addition to whaling, merchants also began to ship cargo out of New Bedford after the Revolutionary War. In 1802, some 20 square-rigged merchantmen were sailing from New Bedford. They were carrying cargoes from New York and the southern ports of Europe. Occasionally, voyages were made to the East and West Indies directly from New Bedford. By 1807, New Bedford's waterfront had seven commercial wharves, between 90 and 100 ships and brigs, containing each on an average 250 tons, and between 20 and 30 small vessels: Twelve of the ships were whalers. By that year, three ropewalks were established in New Bedford and one in Fairhaven. Water depth in the harbor was reported between 18 and 24 feet (Ricketson, 1858).

During the War of 1812, the Navy Department provided four Jeffersonian gunboats for defense in Massachusetts; two at Newburyport and two at New Bedford. However, they proved useless. The two New Bedford boats remained hidden in the Acushnet River and did not even attack the *Nimrod* when she stranded on Great Ledge offshore New Bedford. Quaker ship owners who made fortunes by neutral trading before 1812, perceived the future of commerce trading from New Bedford was limited and refitted most of their vessels' as whalers. Typically, local ship owners converted their merchant ships that had outlived their usefulness in the trade service into whalers, a ship type that required capacity rather than speed as its main attribute (Morison, 1921).

In 1796, a company was created to construct the first bridge across the Acushnet River to connect New Bedford with Fairhaven and Oxford. The bridge was 4,000 feet long including abutments and the two islands it crossed over. The initial bridge was swept away in March, 1807 and was rebuilt later that year. In September, 1815, the second bridge was also washed away. A third bridge was built over the Acushnet River in 1819 and was still being used as of 1858. It was reported that the bridge significantly contributed to the shoaling up of the harbor (Ricketson, 1858). Despite the presence of a bridge, ferries connecting Fairhaven and New Bedford remained active for more than 100 years. The last of these ferries, the Fairhaven, a small side-wheel steamer was launched into service on February, 24, 1896. Typically, she made 19 daily roundtrips across the Acushnet River (Whitman, 1994).

New Bedford was made a city in 1847. Whaling was the primary industry and remained so for most of the nineteenth century. In 1838 there were 170 whaling vessels in New Bedford. By 1857, New Bedford's whaling fleet surpassed all other Massachusetts ports

combined with 329 whalers, with a tonnage of 111,364 (Sayer, 1889). Fairhaven provided most of the support services required by the whaling industry. With oil refineries, coopers shops, tool works and the other industries subsidiary to whaling, New Bedford Harbor became a center of industry. It became the fifth largest port for shipping in the country. Whaling and the manufacture of whaling products became the leading industry in Massachusetts after shoes and cotton and provided commerce with an important export medium (Morison, 1921). However, by 1888, whaling had declined dramatically. Only 74 whalers worked out of New Bedford in that year, with a tonnage of 18,911 (Sayer, 1889).

New Bedford was an urban center and was served by several steamboat lines during the nineteenth and twentieth centuries. Steamboat service from New Bedford to Nantucket dates to 1829, when Jacob Barker's steamer *Marco Bozzaris* made three trips a week. The New Bedford and Martha's Vineyard Steamboat Company was formed in 1846. In that year, the steamer *Naushon* made three trips a week between Edgartown and New Bedford, with a stop at Woods Hole (Foster & Weiglin, 1989). Steamboat service between New Bedford and New York began in 1853. The New Bedford and New York Steamship Company occupied a long, narrow roofed over wharf that could accommodate the large steamers operating in Long Island Sound (Whitman, 1994). Their boats connected with the Boston, Clinton & Fitchburg Railroad. In 1879 the Old Colony Steamboat Line took over the New Bedford-New York line (Foster & Weiglin, 1989). A second steamboat line, New Bedford, Martha's Vineyard and Nantucket Steamboat Company started service between New Bedford and the two islands in 1854. Assets from this company passed thorough several mergers and were acquired by the New England Steamship Company in 1945. Ships from the Fall River Steam Ship Line also served New Bedford.

Over-fishing, a cheaper source of oil, and the Civil War, (Confederate Commerce Raiders captured and destroyed a vast number of New Bedford whalers on the high seas) combined to reduce the role of the whale industry and related maritime commerce. More than 50 whaling vessels were captured by rebel cruisers, 28 of which sailed out of New Bedford. All but a few of the whalers were burned. In June 1865, Confederate Cruiser *Shenandoah* alone captured 25 whalers in Behring strait. Many other whalers were bought by the government during the Civil War. Forty New Bedford whalers purchased by the United States formed the major portion of the two famous stone fleets which in 1861 were sunk off the harbors of Charleston and Savannah to impede blockade runners and privateers (Sayer, 1889). Numerous whalers were also lost in Arctic ice. In September 1871, 33 whaling ships (22 from New Bedford) were crushed by ice in the Arctic Ocean. Arctic mishaps in 1876 and 1888, claimed 17 more whaling ships. Ultimately, the future of whaling as a source of oil was sealed once Colonel Drake discovered oil in the ground in northwestern Pennsylvania in 1859.

By the end of the nineteenth century, whaling had given way to textile mills as the leading industry in the New Bedford economy. Cotton mills, ushered in with the advent of the Industrial Revolution, began to replace the fish-processing and candle-making plants on the New Bedford waterfront. And with the decline of whaling, the shipyards

and associated maritime industries were slowly abandoned. It was not until the after the First World War when the introduction of diesel powered fishing boats allowed vessels to economically reach the rich offshore fishing banks that New Bedford once again became a prominent fishing port.

SUBMERGED CULTURAL RESOURCES

National Register of Historic Places Evaluation Criteria

Nautical vessels and shipwreck sites are generally, excepting reconstructions and reproductions, considered historic if they are eligible for listing in the National Register of Historic Places. As set forth at 36 CFR 60.4, to be eligible for the National Register of Historic Places, a vessel or site must be significant "in American history, architecture, archeology, engineering, or culture" and "possess integrity of location, design, setting, materials, workmanship, feeling, and association" and meet one or more of the following criteria:

a. be associated with events that have made a significant contribution to the broad patterns of our history; or

b. be associated with the lives of persons significant in our past; or

c. embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

d. have yielded, or may be likely to yield, information important in prehistory or history.

National Register of Historic Places Bulletin 20 clarifies the National Register review process with regard to shipwrecks and other submerged cultural resources. Shipwrecks must meet at least one of the above criteria and retain integrity of location, design, settings, materials, workmanship, feelings and association. Determining the significance of a historic vessel depends on establishing whether the vessel is:

1. the sole, best, or a good representative of a specific vessel type; or

2. is associated with a significant designer or builder; or

3. was involved in important maritime trade, naval recreational, government, or commercial activities.

Properties that qualify for the National Register must have significance in one or more "Areas of Significance" that are listed in *National Register Bulletin* 16A. Although 29 specific categories are listed, only some are relevant to the submerged cultural resources in New Bedford Harbor. Architecture, commerce, engineering, industry, invention, maritime history and transportation are potentially applicable data categories for the type of submerged cultural resources that may be expected in the Acushnet River study area.

Shipwrecks in the New Bedford Vicinity

A wide variety of shipwrecks may exist in New Bedford's harbor. Historic records indicate that maritime activity in the region's waterways dates to the first decade of the seventeenth century. The first documented shipwreck losses in the region are associated with Revolutionary War activity in September 1778. In the nineteenth century, New Bedford became the principal whaling port in the country and was home for hundreds of square-rigged whalers. Although whaling was phased out as an industry by the end of the nineteenth century, New Bedford has remained a preeminent commercial fishing port throughout the twentieth century. Shipwrecks undoubtedly occurred in and around New Bedford harbor during each phase of the port's historical development. However, it is highly unlikely that any intact wrecks remain within the navigable portions of the harbor, since they would have been removed long ago as a hazard to navigation. Nonetheless, a list of shipwrecks and derelict vessels provides insights into the expected vessel types that might be found in and around New Bedford.

A number of sources were accessed during the compilation of wrecked vessels in New Bedford's Harbor. The lists have been divided according to the sources. In all, more than 65 different vessels are documented as wrecked in or around New Bedford Harbor.

The following is a shipwreck list maintained at the Massachusetts Board of Underwater Archaeological Resources (MBUAR). It was provided by Mr. Victor Mastone, MBUAR Director. The vast majority of the sites included in the list were derived from data gathered by Mr. Brad Luther, local expert on New Bedford Harbor, and Mr. John Fish, an underwater researcher.

Vessel Name	Date	Type	Location
Wasp	6/12/1903	Barge	New Bedford
Thomas H. Lawrence	9/21/1938	Schooner	West of Palmer's Island, New Bedford Harbor
H.M.S. Nimrod	1815		Mass.
Unidentified	1/7/1844	Schooner	Near New Bedford
Rival	10/14/1844	Brig	Ashore at New Bedford
Caravan	11/6/1847	Schooner	Off New Bedford
Chopaquoit	1947	Ketch	Off West Beach, Westport
Aloha	3/13/1870	Bark	New Bedford
A. Francis Edwards	5/26/1892	Schooner	New Bedford
Freeman	9/15/1898	Schooner	New Bedford
Rattler	10/13/1915	Oil	New Bedford
Sally W. Ponder	10/9/1916	Schooner	New Bedford
Lorna	11/1/23	Gas	New Bedford
Mogadore	9/11/1930	Gas	New Bedford
Althea Louke	12/4/1932		New Bedford
Eurybia	8/9/1935	Gas	New Bedford
Winifred	9/21/1938	Oil	New Bedford
Alma Bell	9/14/1944	Oil	New Bedford
Marion Dorothy	9/14/1944	Oil	New Bedford
Alice May	1950		New Bedford
Debbie II	8/1/54	Gas	New Bedford
Rose Mary Mello	8/31/1954	Oil	New Bedford
Phillip R.	11/15/1954	Barge	New Bedford
Onward	3/17/1956	Oil	New Bedford
Mariner	1956	Yacht	Fairhaven, 1 mile east of West Island
Francis Edward	5/1892		Fairhaven

Shipwrecks listed for the New Bedford/Fairhaven vicinity in *Encyclopedia of American Shipwrecks* (Berman, 1972) include:

Lizzie W. Hannum, a two-masted schooner, wrecked at Great Ledge, Buzzards Bay on April 10, 1895
Marjorie Parker, an oil screw vessel, 76 tons, built in 1923, foundered at Fairhaven on August 31, 1954
Olive M. Williams, an oil screw fishing boat, 50 tons, built in 1928, sank in a storm at Fairhaven on September 1, 1954.
Sally W. Ponder, schooner, 107 tons, built in 1855, foundered at New Bedford on October 9, 1916.
Sankaty, steam screw, 677 tons, built in 1911, burned at New Bedford on June 30, 1924.
Wm A. Grozier, schooner, 116 tons, built in 1865, foundered off New Bedford on July 1, 1913.

Local New Bedford resident, Mr. Gilbert Russell listed by name and type each vessel that was destroyed by the British expedition on September 5, 1778 (in Ricketson, 1858, pg. 75).

Leopard, Ship
Spaniard, Ship
Caesar, Ship
Nanny, Barque
Rosin, Brig
Sally, Fishing Brig
Simeon, Snow
Sally, Continental Brig
Adventure, Schooner
Loyalty, Continental Schooner
Nelly, Sloop
Fly Fish, Sloop
Captain Lawrence, Sloop
Defiance, Schooner
Captain Jenny, Schooner
No Duty on Tea, Brig
Sally, Schooner
Bowers, Sloop
Sally (12 guns), Sloop
Ritchie, Brig
Dove, Brig
Holland, Brig
Joseph R, Sloop
Bociron, Sloop
Pilot Fish, Sloop
The Other Side, Schooner
Sally, Brig
Retaliation. Sloop
J. Brown's, Sloop
Eastward, Schooner

Other documented wrecks in the vicinity include:

Capt. Lavoeiro, 75-foot long New Bedford fishing vessel sank at the State Pier on December 26, 1984, after it struck a barge outside the harbor and returned to the pier where it sank. However, salvagers used a crane and divers to raise it three days later (Quinn, 1988)

Removal of Derelict Vessels

In 1989, a project was conducted to identify and remove derelict vessels from around the harbor. Parson, Brinckerhoff, Quade, & Douglas, Inc., (Parsons) organized the project that removed 13 derelict boats from New Bedford Harbor, in the municipalities of Fairhaven and New Bedford (Parsons 1989). Seven of those vessels were located in Fairhaven and six were in New Bedford.

One of the derelict vessels, the 85-foot long *Evelina Goulart*, in Fairhaven, was raised on May 25, 1989. She was towed to the Essex Shipbuilding Museum where it was to be restored, near where it was launched in 1927, as one of the last sail-driven fishing schooners.

Other derelict vessels that were removed in 1989 include:

1. a 30-foot wood hull boat (Fairhaven),
2. three construction barges, approximately 60-feet x 20-feet (Fairhaven),
3. a 40-foot fiberglass (Fairhaven),

4. a 20-foot wood vessel (Fairhaven),
5. a barge, approximately 150-feet x 32-feet (New Bedford),
6. a fishing vessel, *Alydar*, approximately 92-feet x 26-feet (New Bedford),
7. a fishing trawler, *Plymouth*, approximately 100-feet x 28 feet (New Bedford),
8. two barges, each approximately 150-feet x 32-feet (New Bedford),
9. a Navy Launch, approximately 150-feet x 32-feet (outside of Hurricane Barrier, New Bedford).

In 2001/2002, 16 derelict and abandoned vessels at the Melville Ship Yard in New Bedford were removed and destroyed as part of the ongoing Superfund Clean-Up of New Bedford Harbor. An archaeological project documented each of the derelict vessels and evaluated their significance in terms of National register of Historic Places eligibility criteria (Cox, 2001a). The report concluded that none of the vessels satisfied NRPA criteria.

Potential Submerged Cultural Resource Types

Recorded maritime activity in the New Bedford region dates to the first decade of the seventeenth century. However, it was not until the middle of the eighteenth century that the port of Dartmouth/New Bedford became a prominent fishing harbor. From that era to present, the harbor in the Acushnet River has hosted a consistently high volume of maritime traffic.

Historic documentation confirms that many types of ships and vessels were wrecked in the New Bedford vicinity. A preliminary list of documented vessels wrecked or lost in New Bedford (see Section 3.2) provides an indication of the quantity and types of shipwreck sites that have been deposited on the bottom of the waterway. Drawing from a variety of primary and secondary sources, these lists, while far from comprehensive, give an indication of the wide variety of shipwrecks that have been lost in the waterway over the last 225 years.

Potential shipwreck types in/near New Bedford may include a variety of material dating from Revolutionary War-era through the twentieth century. To discuss the types of vessels potentially present, it is necessary to include vessels from all phases of the commercial and naval activity in this portion of Massachusetts. Wood-hulled ships, ranging from small fishing sloops, shallops, brigs, recreational sailing craft, gas/diesel powered fishing trawlers and coastal schooners, to ship-rigged whalers, have been likely lost near New Bedford. Numerous steamers and ferries also plied the Acushnet River for well over 150 years. Iron-hulled vessels, including paddle wheel and screw steamboats, have been used extensively in the harbor. Indigenous, small rowed- and sailed-vessels were also used throughout all active harbors. Since such a wide range of vessels has been used in New Bedford over such an extended time period, it is almost impossible to feature one particular type of vessel type most likely to be found. Many of these types of vessels would lend historic insights into a wide-range of maritime-related topics and would be considered historically significant.

PREVIOUS UNDERWATER ARCHEOLOGICAL INVESTIGATIONS

MBUA files contained information on four previous underwater archeological surveys in the project vicinity. Robert Cembrola served as the Principal Investigator for the Marine Archaeological Report that was completed for the New Bedford Phase II Facilities Plan (Cembrola, 1989). Potential submerged cultural resources were identified within a three-mile vicinity of two candidate outfall diffuser sites and within 0.5 miles on either side of the proposed outfall pipeline alignment that extended from the southern tip of New Bedford out 3.5 miles into Buzzards Bay. Two known wrecks sites, the *Margeret Kehoe*, a 62-ton fishing boat sank near Church Rock in 1963, and the *Yankee*, a 6,225 ton, 391-foot steam ship ran aground and sank on Great Ledge on September 23, 1908, were identified in Buzzards Bay, near the mouth of the Acushnet River. The wrecks were outside the area affected by the outfall pipeline and no additional fieldwork was conducted.

J, Lee Cox, Jr., served as the Principal Investigator for the other three local underwater archaeology projects. Two of the projects were completed in conjunction with the New Bedford Harbor Superfund Project in the towns of New Bedford, Fairhaven and Acushnet. The primary project was a magnetic and acoustic remote sensing investigation to determine the presence or absence of submerged cultural resources potentially eligible for the National Register of Historic Places that might be affected by dredging to remove contaminated sediments (Cox, 2001). Analysis of remote sensing data identified sixty magnetic and/or acoustic targets. The vast majority of the targets appear to be related to isolated, single source objects, modern debris, or shoreline-related objects. Two of the remote sensing targets are suggestive of submerged cultural resources. However, divers confirmed that modern debris was the target source at both locations.

In conjunction with Superfund Project, archaeologists also documented the derelict vessels at the Melville Shipyard, New Bedford (Cox, 2001a). Sixteen vessels were documented and evaluated according to NRHP criteria. The report concluded that none of the vessels satisfied NRHP criteria.

A remote sensing investigation was conducted by Apex Environmental for the New Bedford State Pier Dredge Project. Mr. Cox served as the Principal Investigator for the project. The report concluded that several miscellaneous objects were present on the river bottom within the 800'-long by 150'-wide project area, along the New Bedford waterfront. However, all of the objects were scattered pieces of debris that were not suggestive of historically significant submerged cultural resources (Cox, 2001b).

CONCLUSIONS AND RECOMMENDATIONS

Cultural Resources

Historic sources confirm a sustained level of maritime activity in New Bedford harbor since the middle of the eighteenth century. Dozens of vessels were documented as having been stranded, foundered, burned, capsized and destroyed in the New Bedford vicinity. Secondary sources have listed numerous wrecks in the project vicinity. Many of these vessels, including a number of Revolutionary War wrecks, were lost in the section of the harbor between the Route 6 Bridge and the Hurricane Wall. However, large portions of the harbor have been dredged during navigational improvements and many potential submerged sites were likely removed long ago as hazards to navigation. Since New Bedford is still a very busy commercial port, it is unlikely that potentially significant submerged cultural resources have been deposited within New Bedford harbor and have remained undetected and unknown. Local residents and watermen familiar with the harbor were unaware of any potential wreck sites within the harbor. Nonetheless, the harbor potentially contains cultural material from each phase of the port's extensive maritime history.

In an effort to identify submerged cultural resources that may be affected by the construction of CAD Cells in New Bedford Harbor, a comprehensive Phase I remote sensing survey was conducted across two project areas: Channel Inner Area and Pope Island North Area. Magnetic and acoustic remote sensing records were processed and correlated to determine the presence of targets that possessed signature characteristics suggestive of submerged cultural resources. Although analysis of the remote sensing data identified 43 magnetic and/or acoustic targets in the two project areas, only three of the targets were considered to be significant targets (CM-3, CM-5 and CM-6). However, the three magnetic targets are located within the Channel Inner Area which has been previously dredged. The source of the target signatures is therefore considered to be either debris-related material or associated with a geological feature. No additional underwater archaeological investigations are recommended. All of the rest of the target signatures were suggestive of modern debris, geologic features or isolated, single source targets.

Examination of the remote sensing data found no clear evidence of targets that would be considered suggestive of potentially significant submerged cultural resources. Numerous objects were identified on sonar records; however each sonar target appeared to be associated with debris or discarded objects. There were also numerous magnetic anomalies found. In the opinion of Principal Investigator, none of the magnetic anomalies generated signatures clearly suggestive of submerged cultural resources. However, prominent geologic features found throughout the project areas generated magnetic signatures that could have masked the presence of submerged cultural resources.

While the project area has very likely been dredged and the historic waterfront filled in over the last 200 years, the historic significance of the port should be taken into consideration when evaluating the potential presence of submerged cultural resources. While remote sensing records do not indicate the presence of potentially significant

targets, archaeological sites could remain undetected in these sections of the New Bedford harbor. During the Revolutionary War dozens of ships that were reportedly destroyed along this New Bedford waterfront close to the Channel Inner Area.

Hazards Analysis

Numerous targets were identified in this remote sensing survey as shown in Figures 7 and 8. It can be seen that a large number of the identified targets are located outside of the current CAD cell footprints. Several of the targets identified may represent significant issues to future work performed in the vicinity of these targets. For example, a large section of dock identified as target C33-1 located just north of the current CAD footprint as well as several pipes and piles (C20-1, C37-1 and C39-1) could potentially impact dredging and construction operations.

Additionally, it can be seen from Side Scan mosaics and the Change in Total Magnetic Intensity maps that there are numerous smaller debris (both metallic and non-metallic) that may effect dredging operations.

Finally, it should be noted that interpretations stated in this report are not necessarily exclusive but are rather the best-fit interpretations of the currently available information and data. This interpretation may be improved upon as additional information becomes available.

LIMITATIONS

The following limitations apply to all geophysical surveys conducted by Apex Environmental, Inc, its subsidiaries and subcontractors. Every attempt has been made to conduct this survey in such a fashion so as to maximize the quality of the data collected and the interpretations rendered. However, a geophysical investigation is an indirect method of subsurface exploration whereby subsurface characteristics are inferred or interpreted from measurements collected at the ground or water surface. Many variables may affect these measurements. Due to the indirect, interpretive nature of geophysics, findings are generally considered precursory and subject to verification by more direct methods of investigation such as test borings or test pits. The following limitations are considered when evaluating geophysical data:

1. Subsurface features can be interpreted from the appropriate geophysical methods only insofar as they produce a discernible geophysical signature. They must have adequate homogeneity, size, and appropriate physical or chemical properties sufficient to contrast with the surrounding medium and be within reasonable proximity to the sensors. Additionally, their signature must be distinguishable from and not masked by background noise or interference.

2. Lithologic data inferred on the basis of geophysical data may not be identical to geologic or hydrogeologic data. Lithologies are generally interpreted from some geophysical signature (e.g., velocity differences) that may be the result of many factors (including density, susceptibility, angle to the sensors, amount of weathering, etc.). Lithology divisions based upon seismic velocity for example may not necessarily be identical to lithology changes identified by drilling. The discrepancy is generally related to formation density and/or compaction (i.e., a dense till may have a higher density than a weathered bedrock, and the difference can be difficult to resolve with seismic data).

3. Complex geological configurations may be impossible to resolve with surface geophysical methods. The resolution of geophysical data is limited by the spatial geometry of sensors, strength of signal, and distance of the object or layer of interest from the energy source and the sensor array used. Resulting interpretations are rendered by modeling geophysical response to known or presumed geometric relationships. The complexity of the relationships that can be modeled is limited by the resolution allowed by the method and geometry of equipment layout used, and the limitations of the software used.

4. Apex Environmental, Inc. is not responsible for data quality in areas having excessive "background noise" which affect the specific physical parameters that are being measured by a particular geophysical technique. Examples of background noise include: water traffic (large fishing boat); or underground utilities (such as electric lines, tunnels, sewers, etc.), which can interfere with magnetic instrumentation.

No guarantee or warranty (other than that stipulated in the contract under which this work was promulgated), expressly stated or implied, is given concerning the data and interpretations rendered in this report. All information is presented as "for information only". Apex Environmental, Inc., or any subsidiary, is not liable for any losses resulting from the misuse, misrepresentation, or misinterpretation of any information presented in this report by any person or entity.

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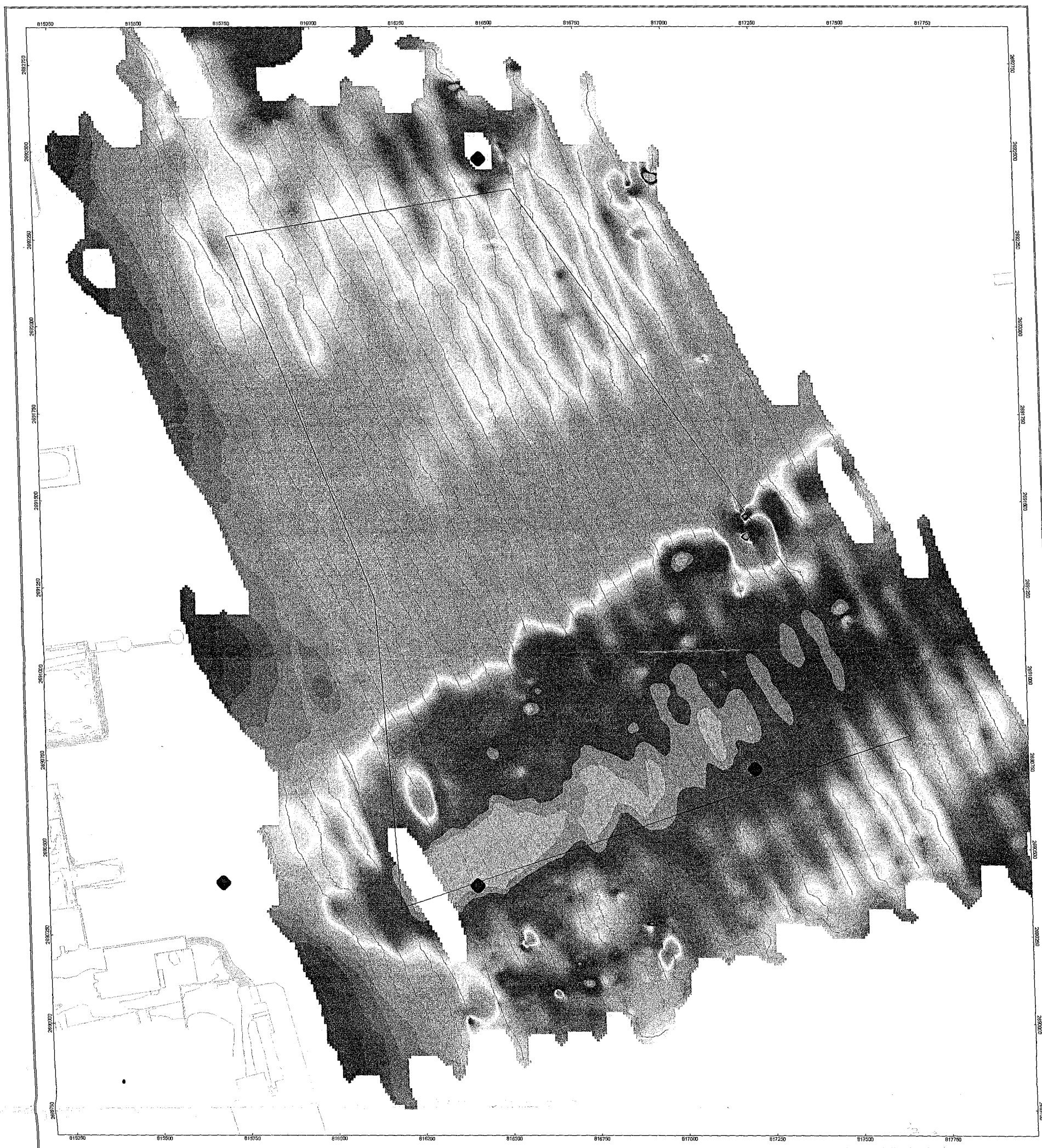


NOTES:

1. Base Plan of the New Bedford harbor area obtained from the US Army Corps of Engineers and has not been feild verified.
2. Coordinates are shown in the State Plane Coordinate System, Massachusetts Mainland Zone 2001,Referenced to the 1983 North American Datum (NAD83).
3. Data was collected over a four day period between October 21-24, 2002 using a G-881 Cesium magnetometer flown at a depth of approximately 6 feet. Planned line spacing of 50 feet.

LEGEND:

- ◆ Aids To Navigation
- — Area of Proposed Cell
- ⌒ Survey Line Path

N

Scale 1:3600

50 0 50 100 150 200 250 300

US survey feet

REV.	DESCRIPTION	BY:	DATE:

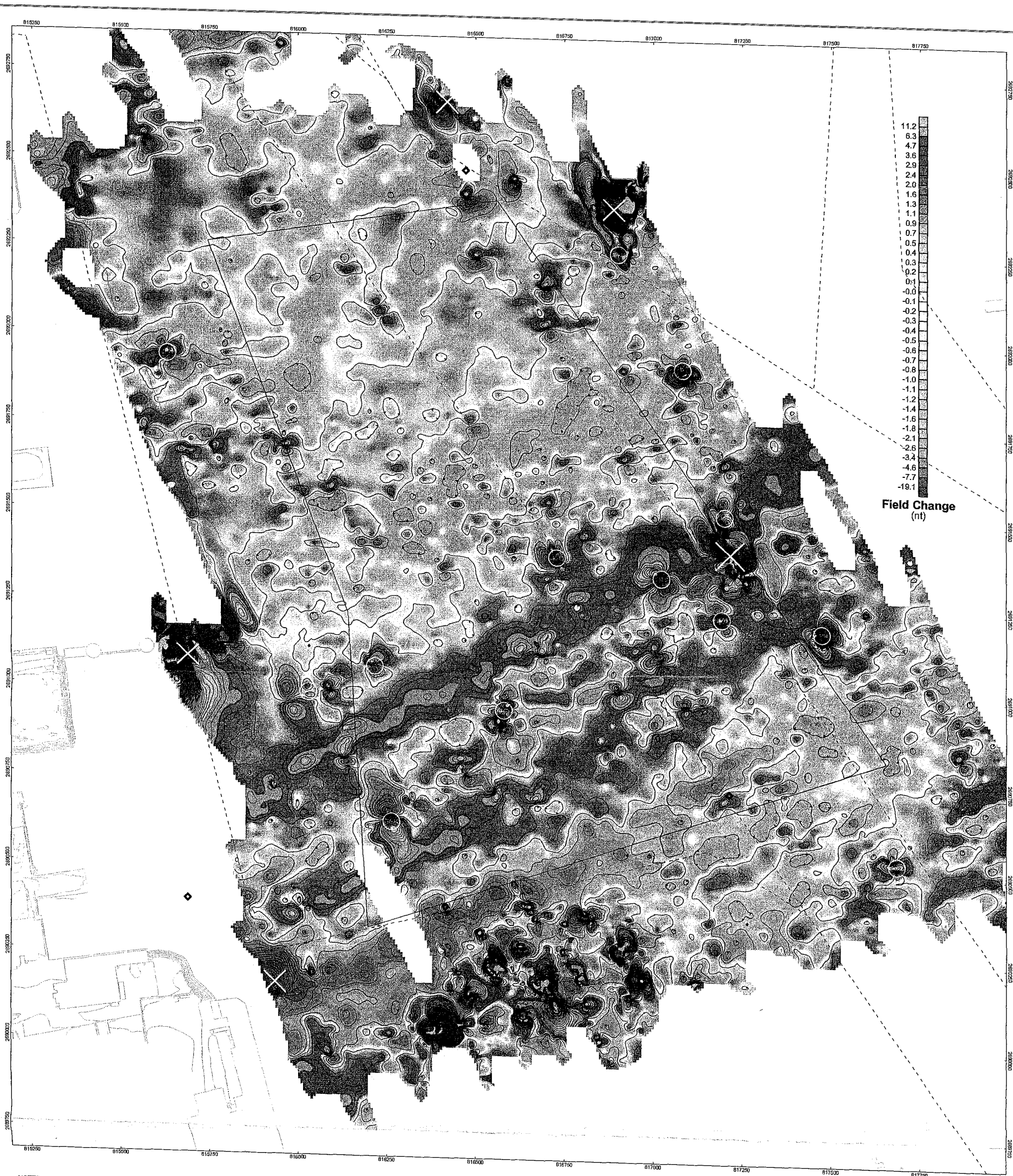
HAZARDS & CULTURAL IDENIFICATION - MAGNETICS

CHANNEL INNER AREA
NEW BEDFORD HARBOR, MA

TOTAL MAGNETIC INTENSITY (TMI)

Apex environmental, inc.
374 Congress St
Suite 500
Boston MA 02210
(617) 728-0070

SCALE: 1"=300'	DRAWN BY:	DESIGN BY:	CHECKED BY:	PROJECT: 6510.002	ISSUE
DATE: 12-20-02	TM	TM	JAB	SHEET 1 OF 8	



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3. Data was collected over a four day period between October 21-24, 2002 using a G-881 Cesium magnetometer flown at a depth of approximately 6 feet. Planned line spacing of 50 feet.

LEGEND:

- Aids To Navigation
- Area of Proposed Cell
- 2nT Contour
- Magnetic Anomaly
- Anomaly Due To Surface Boats
- Federal Navigation Channel

Scale 1:3600

US survey feet

REV.	DESCRIPTION	BY	DATE

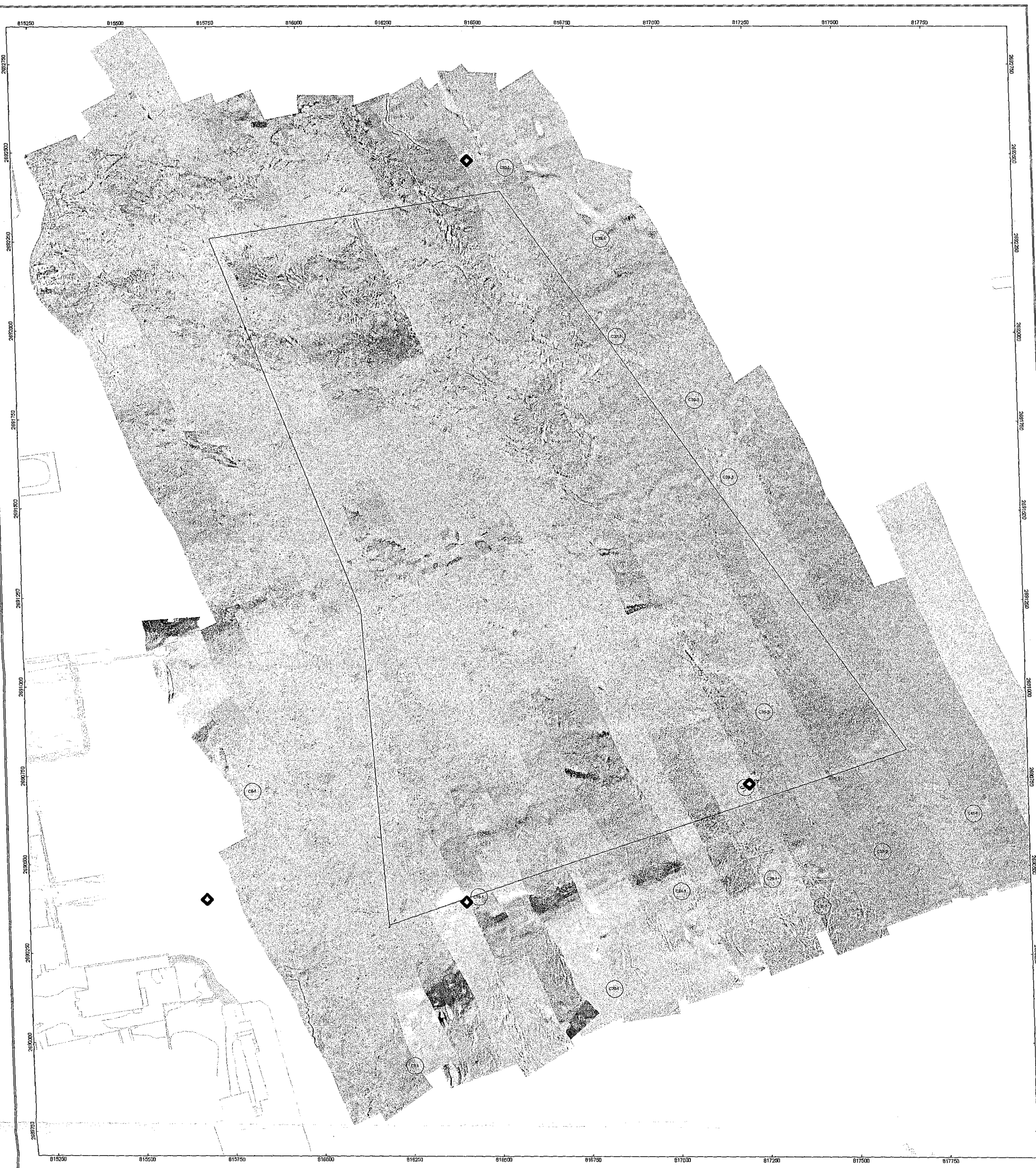
HAZARDS & CULTURAL IDENIFICATION - MAGNETICS

CHANNEL INNER AREA
NEW BEDFORD HARBOR, MA

CHANGE IN TOTAL MAGNETIC INTENSITY

Apex environmental inc.
374 Congress St
Suite 500
Boston MA 02210
(617) 728-0070

SCALE: 1"=300'	DRAWN BY:	DESIGN BY:	CHECKED BY:	PROJECT: 6510.002	ISSUE
DATE: 12-20-02	TM	TM	JAB	SHEET 2 OF 8	



NOTES:

1. Base Plan of the New Bedford harbor area obtained from the US Army Corps of Engineers and has not been feild verified.
2. Coordinates are shown in the State Plane Coordinate System, Massachusetts Mainland Zone 2001,Referenced to the 1983 North American Datum (NAD83).
3. Data was collected over a four day period between October 21-24, 2002 using an EdgeTech 272TD towfish operating at 500kH flown at a depth of approximately 10 feet. Planned line spacing of 100 feet.

LEGEND:

- ◆ Aids To Navigation
- — Area of Proposed Cell
- ◯ Side Scan Target

N

Scale 1:3600

60 0 60 120 180 240 300 360

US Survey feet

REV.	DESCRIPTION	BY	DATE

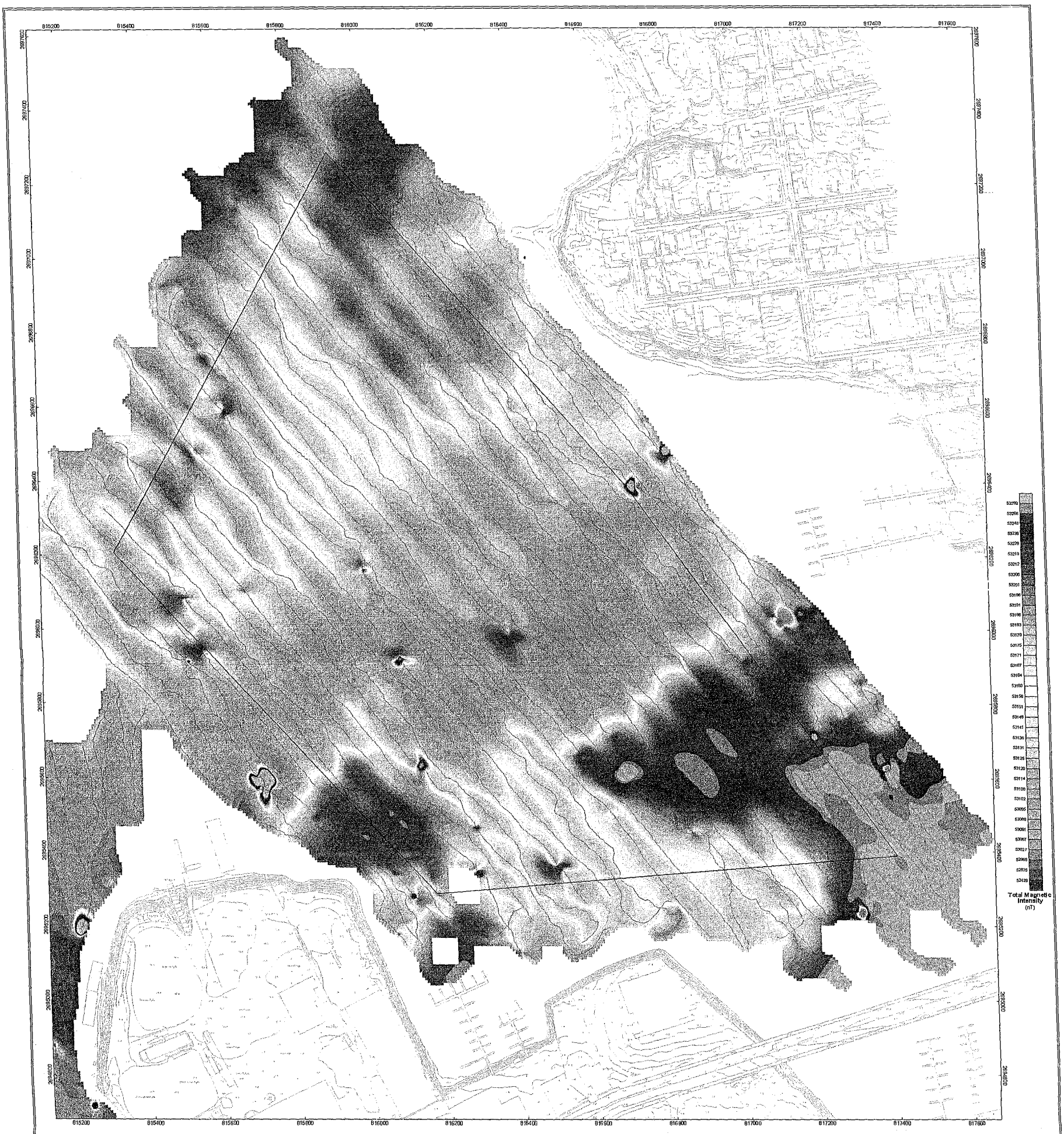
HAZARDS & CULTURAL IDENIFICATION - SIDE SCAN

CHANNEL INNER AREA
NEW BEDFORD HARBOR, MA

SIDE SCAN SONAR MOSAIC

Apex environmental,inc.
374 Congress St
Suite 500
Boston MA 02210
(617) 720-0070

SCALE: 1"=300'	DRAWN BY:	DESIGN BY:	CHECKED BY:	PROJECT: 6510.002	ISSUE
DATE: 12-20-02	TM	TM	JAB	SHEET 3 OF 8	



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2. Coordinates are shown in the State Plane Coordinate System, Massachusetts Mainland Zone 2001, Referenced to the 1983 North American Datum (NAD83).
3. Data was collected over a four day period between October 21-24, 2002 using a Geometrics G-881 Cesium magnetometer flown on the water surface. Planned line spacing of 50 feet.

LEGEND:

AREA OF PROPOSED CAD CELL

SURVEY LINE PATH

Scale 1:3600

REV.	DESCRIPTION	BY:	DATE:

HAZARDS & CULTURAL IDENTIFICATION - MAGNETICS

POPES ISLAND NORTH AREA
NEW BEDFORD HARBOR, MA

TOTAL MAGNETIC INTENSITY (TMI)

Apex environmental, inc.
374 Congress St
Suite 500
Boston MA 02210
(617) 728-0070

SCALE: 1"=300'	DRAWN BY:	DESIGN BY:	CHECKED BY:	PROJECT: 6510.002	ISSUE
DATE: 12-28-02	TM	TM	JAB	SHEET 4 OF 8	

NOTES:

1. Base Plan of the New Bedford harbor area obtained from the US Army Corps of Engineers and has not been feild verified.
2. Coordinates are shown in the State Plane Coordinate System, Massachusetts Mainland Zone 2001, Referenced to the 1983 North American Datum (NAD83).
3. Data was collected over a four day period between October 21-24, 2002 using a Geometrics G-881 Cesium magnetometer flown on the water surface. Planned line spacing of 50 feet.

LEGEND:

- AREA OF PROPOSED CAD CELL
- ANOMALY DUE TO MOORING OR PLEASURE BOAT
- 2 nT CONTOUR
- SURVEY LINE PATH
- MAGNETIC TARGET

Scale 1:3600

50 0 50 100 150 200 250 300

US Survey feet

NAD83(CSRS) NAD Adjustment Grid: CGS2 Mainland Zone

N

REV.	DESCRIPTION	BY:	DATE:

HAZARDS & CULTURAL IDENTIFICATION - MAGNETICS

POPES ISLAND NORTH AREA
NEW BEDFORD HARBOR, MA

CHANGE IN TOTAL MAGNETIC INTENSITY

Apex environmental inc.
374 Congress St
Suite 500
Boston MA 02210
(617) 728-0070

SCALE: 1"=300'	DRAWN BY:	DESIGN BY:	CHECKED BY:	PROJECT: 6510.002	ISSUE
DATE: 12-20-02	TM	TM	JAB	SHEET 5 OF 8	

NOTES:

1. Base Plan of the New Bedford harbor area obtained from the US Army Corps of Engineers and has not been feild verified.

2. Coordinates are shown in the State Plane Coordinate System, Massachusetts Mainland Zone 2001, Referenced to the 1983 North American Datum (NAD83).

3. Data was collected over a four day period between October 21-24, 2002 using a Edgetech 272D towfish operating at 500kH flown at a depth of approximately 6 feet. Planned line spacing of 100 feet.

LEGEND:

AREA OF PROPOSED CAD CELL

(P01) POSSIBLE TARGET

N

Scale 1:3600

60 0 60 120 180 240 300 360

US survey feet

REV.	DESCRIPTION	BY:	DATE:

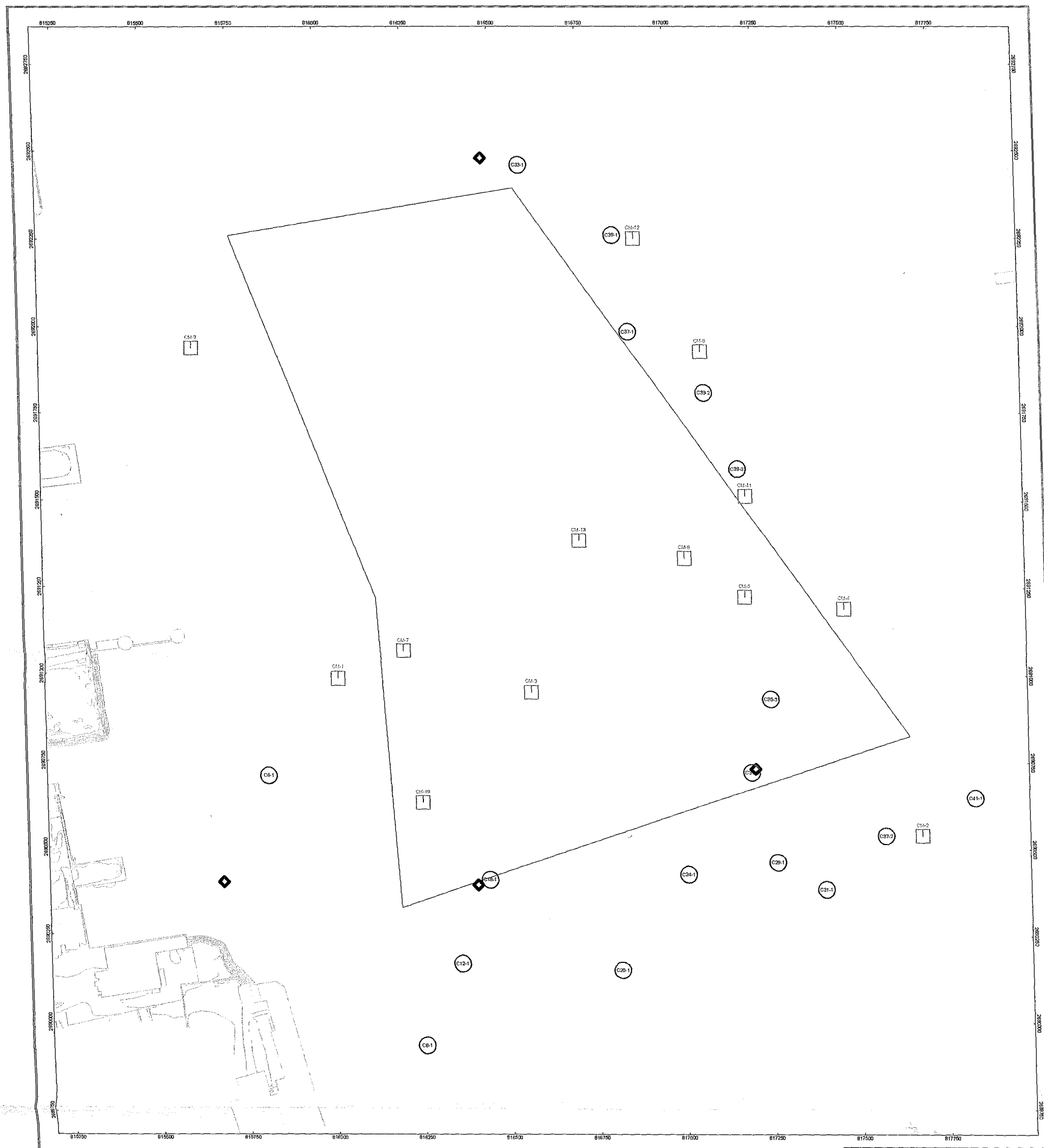
HAZARDS & CULTURAL IDENTIFICATION - SIDE SCAN

POPES ISLAND NORTH AREA
NEW BEDFORD HARBOR, MA

SIDE SCAN SONAR MOSAIC

Apex environmental, inc.
374 Congress St
Suite 503
Boston MA 02210
(617) 728-0070

SCALE: 1"=300'	DRAWN BY:	DESIGN BY:	CHECKED BY:	PROJECT: 6510.002	ISSUE
DATE: 12-04-02	TM	TM	JAB	SHEET 6 OF 8	



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2. Coordinates are shown in the State Plane Coordinate System, Massachusetts Mainland Zone 2001,Referenced to the 1983 North American Datum (NAD83).

LEGEND:

- ◆ Aids To Navigation
- — Area of Proposed Cell
- [1] Magnetic Anomaly
- ○ Side Scan Soanr Target

Scale 1:3000

50 0 50 100 150 200 250 300

US survey feet

REV.	DESCRIPTION	BY:	DATE:

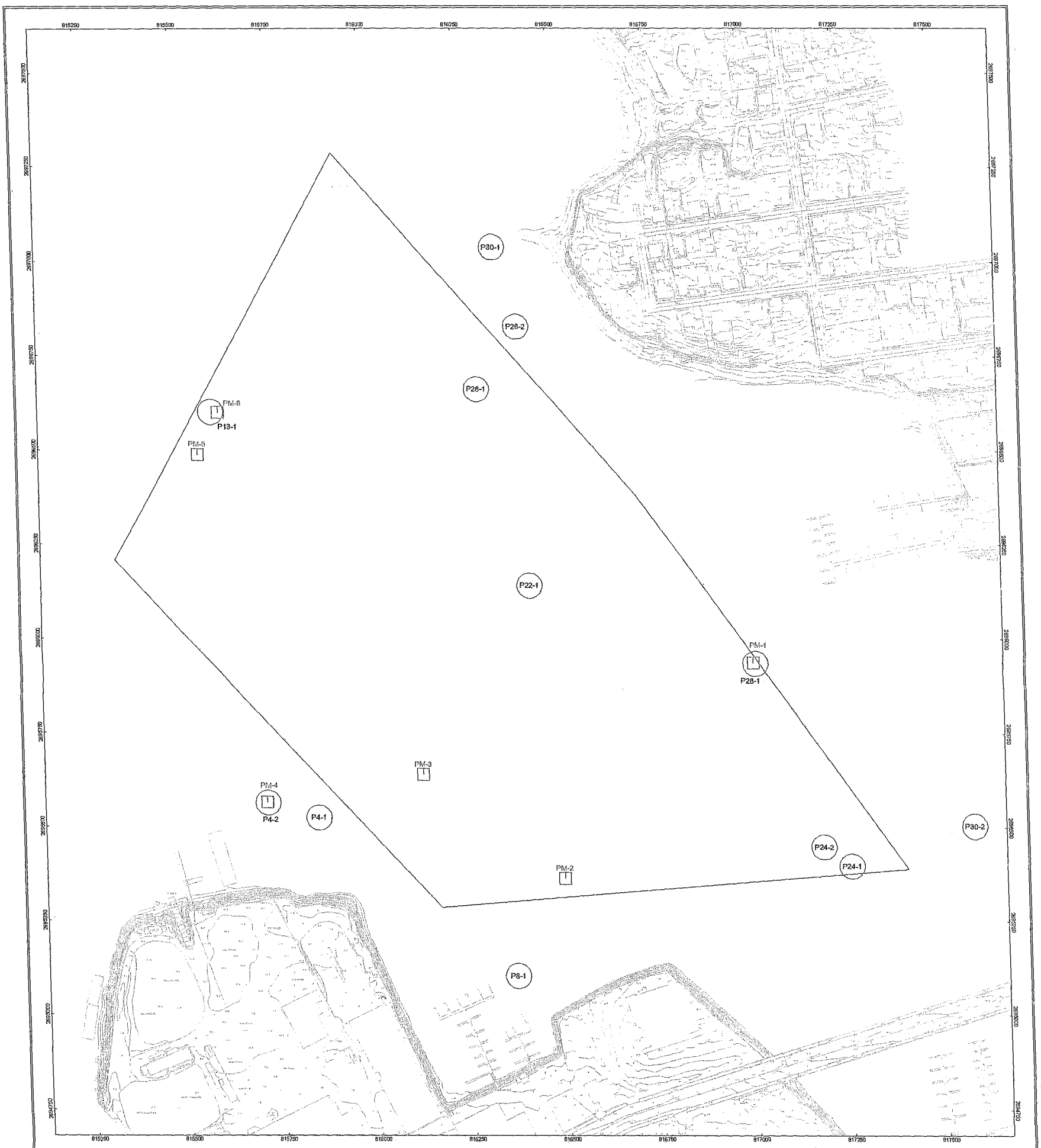
HAZARDS & CULTURAL IDENIFICATION - MAGNETICS

CHANNEL INNER AREA
NEW BEDFORD HARBOR, MA

INTERPRETED TARGETS

Apex environmental, inc.
374 Congress St
Suite 502
Boston MA 02210
(617) 728-0070

SCALE: 1"=300'	DRAWN BY:	DESIGN BY:	CHECKED BY:	PROJECT: 6510.002	ISSUE
DATE: 12-20-02	TM	TM	JAB	SHEET 7 OF 8	



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3. Data was collected over a four day period between October 21-24, 2002 using a Geometrics G-881 Cesium magnetometer flown on the water surface. Planned line spacing of 50 feet.

LEGEND:
- AREA OF PROPOSED CAD CELL
- MAGNETIC ANOMALY - TARGET
- SIDE SCAN SONAR ANOMALY

Scale 1:3600

REV.	DESCRIPTION	BY	DATE

HAZARDS & CULTURAL IDENTIFICATION - SUMMARY

POPES ISLAND NORTH AREA
NEW BEDFORD HARBOR, MA

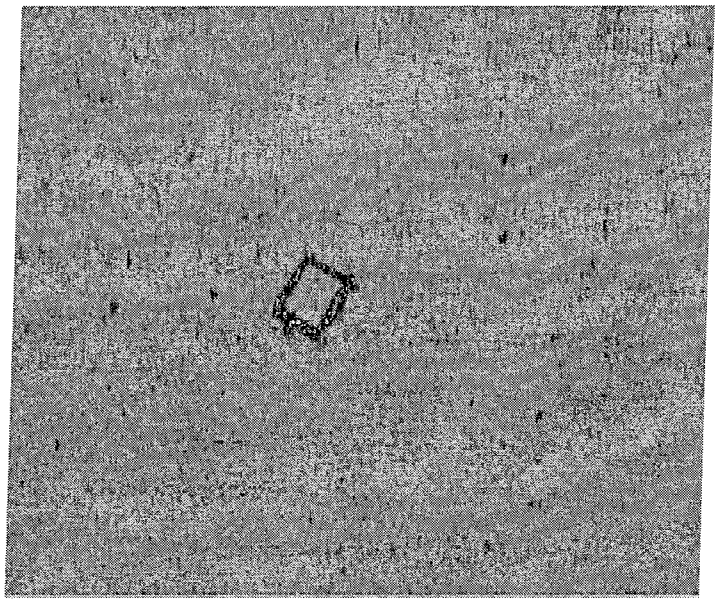
INTERPRETED TARGETS

Apex environmental, inc.
374 Congress St
Suite 500
Boston MA 02210
(617) 728-0070

SCALE: 1"=300'	DRAWN BY:	DESIGN BY:	CHECKED BY:	PROJECT: 6510.002	ISSUE
DATE: 12-20-02	TM	TM	JAB	SHEET 8 OF 8	

APPENDIX A

Detail Side Scan Images
Channel Inner Area



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Target Location: 41° 37.7976' N 070° 54.9543' W

Target # C8-1
SonarWeb V3.13M PRO
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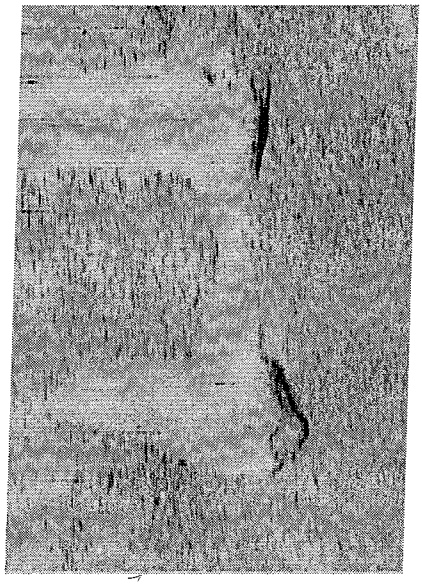

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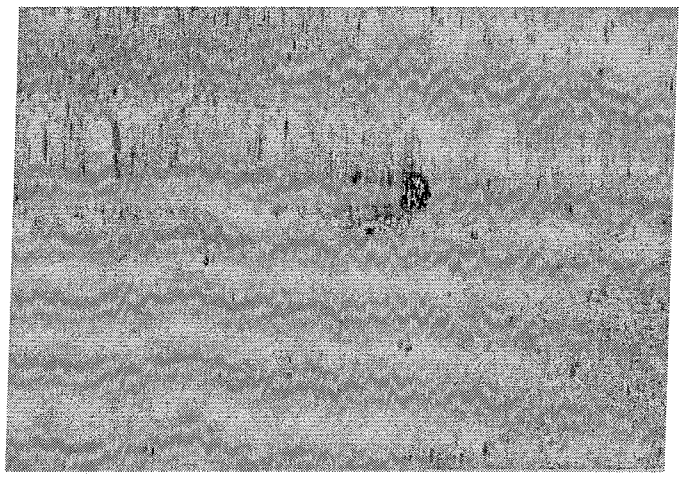

Target # C18-1
Sonar Web V3.13M PRO
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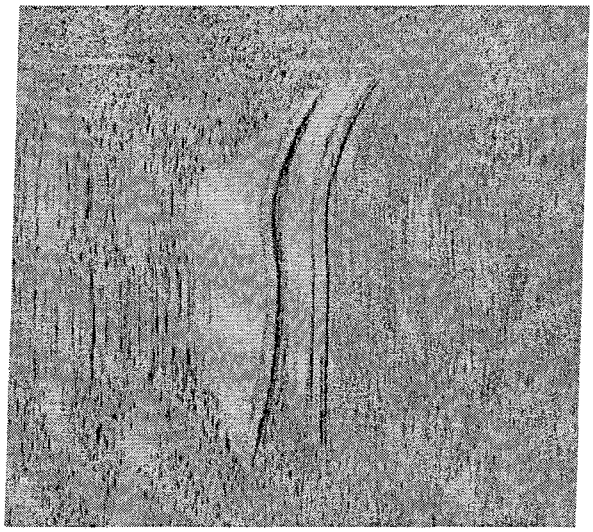

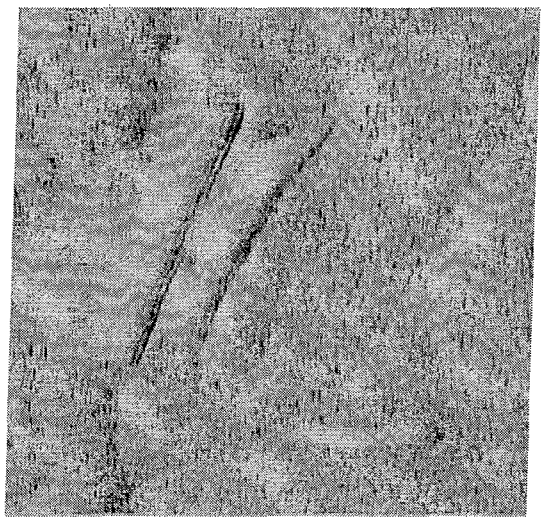

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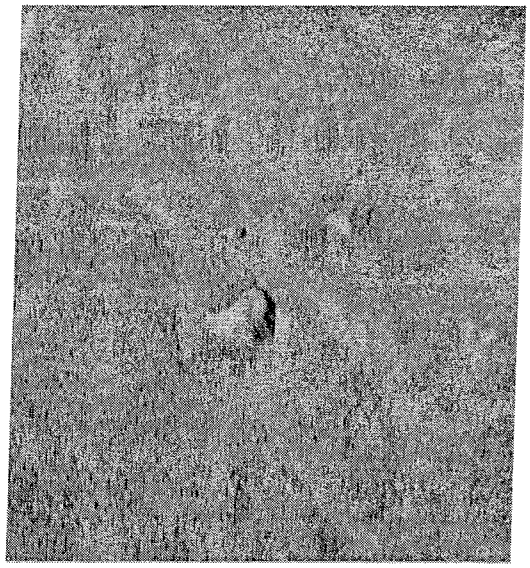

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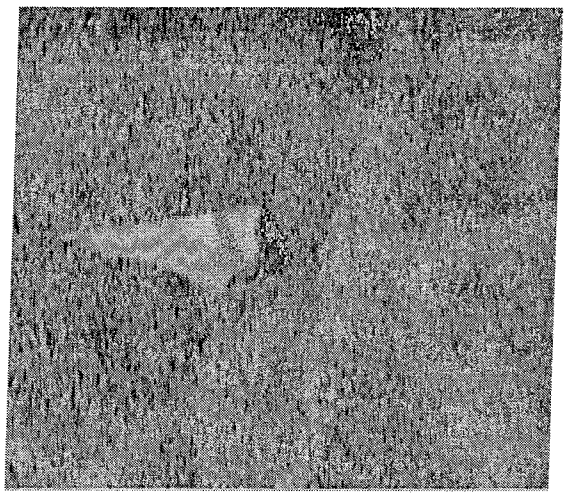

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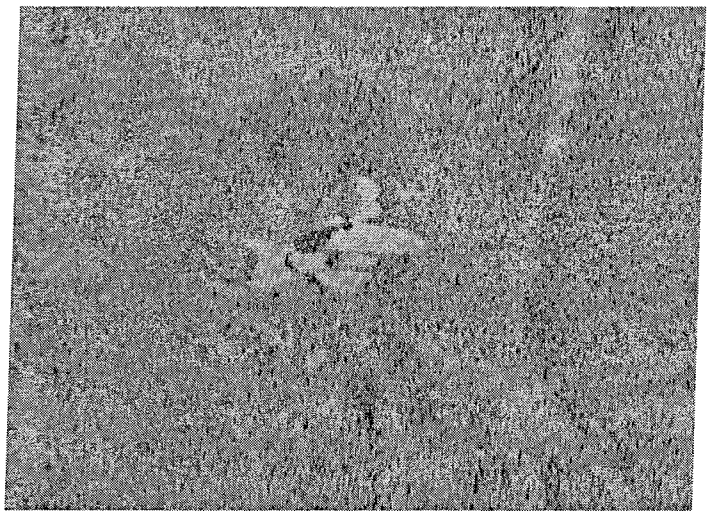

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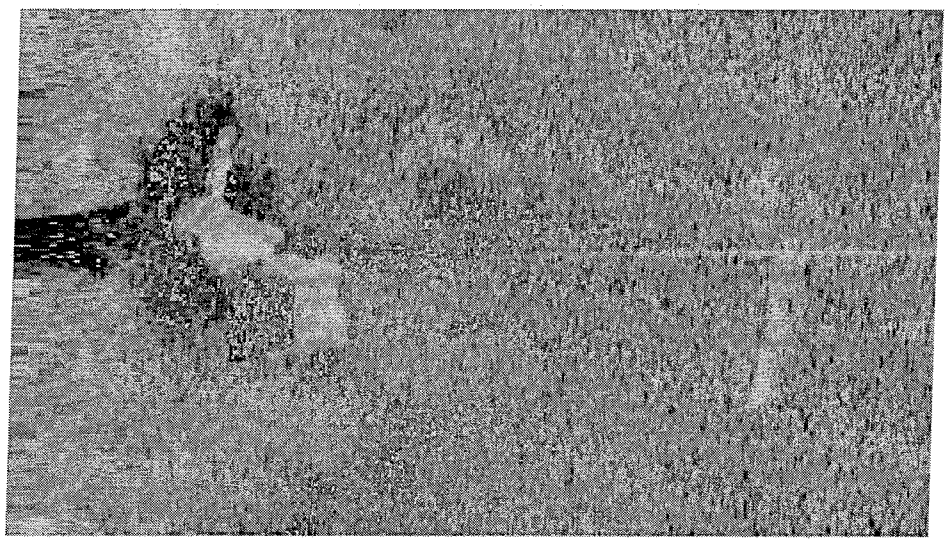

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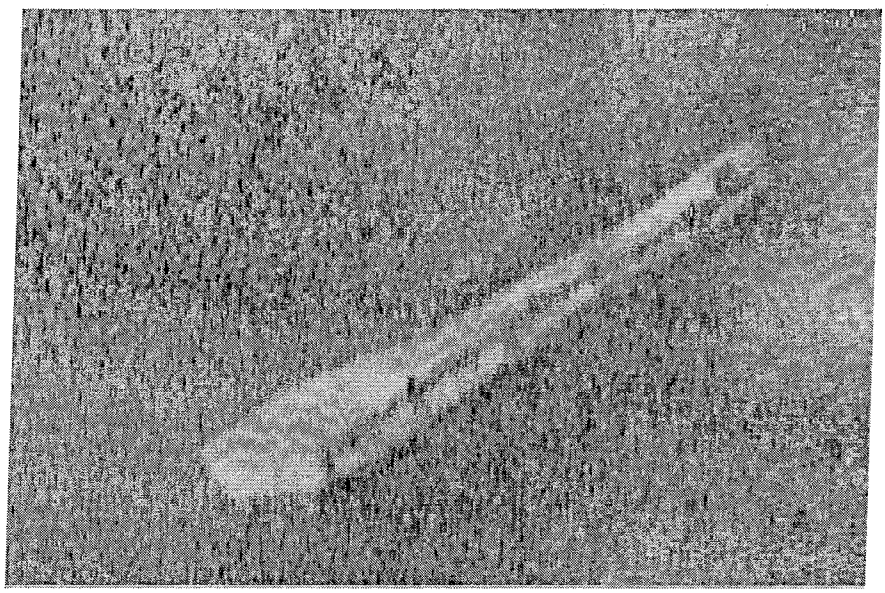

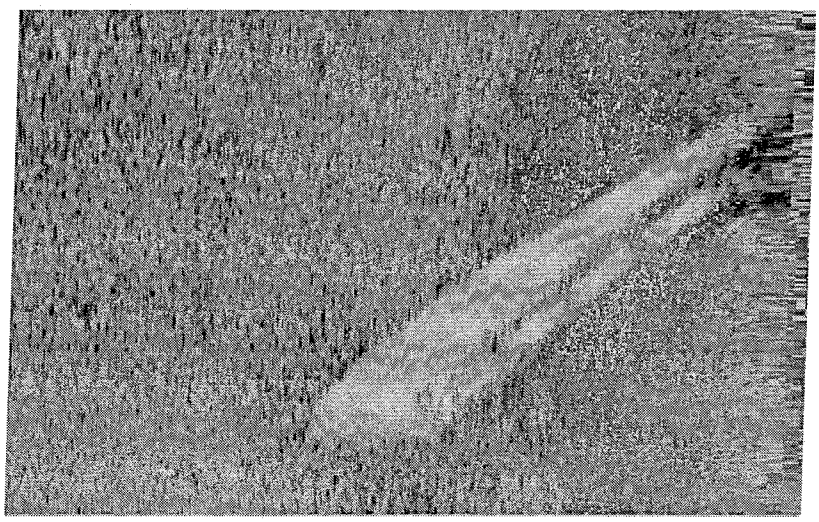

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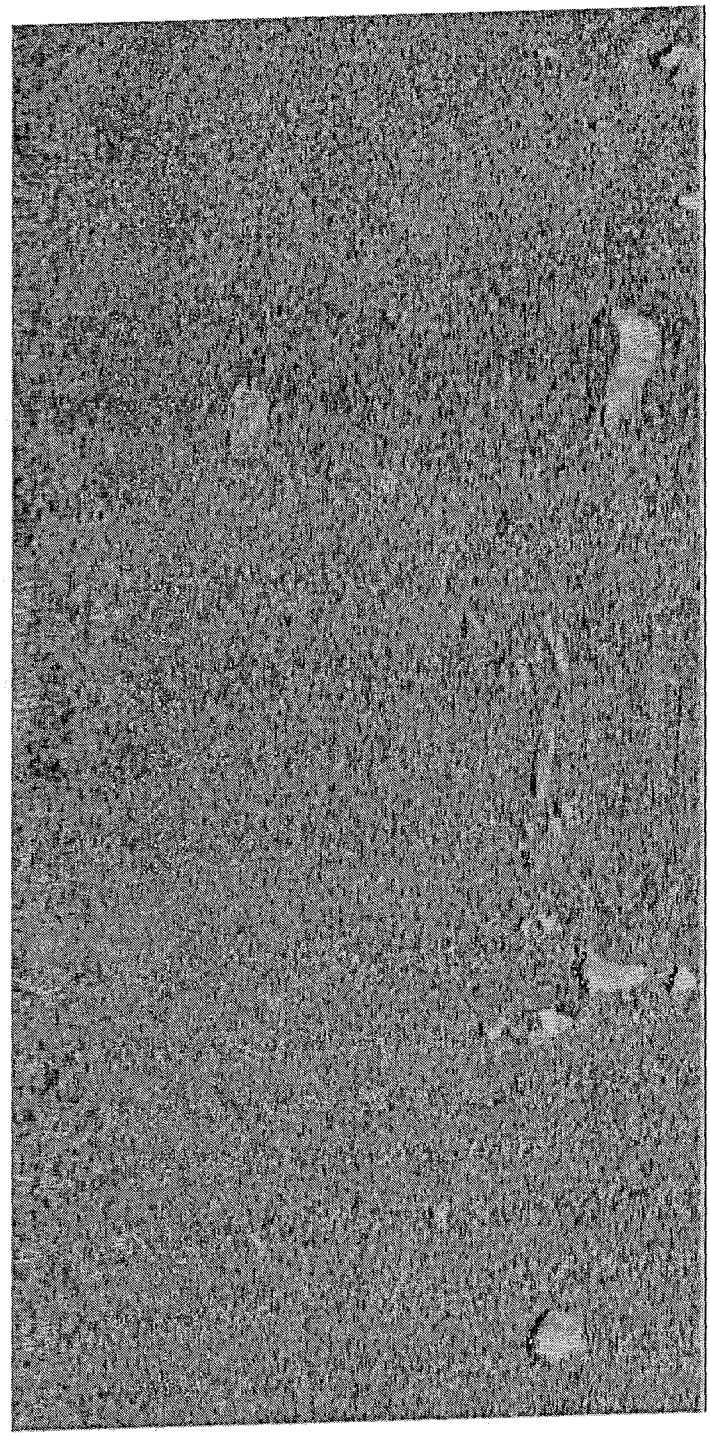

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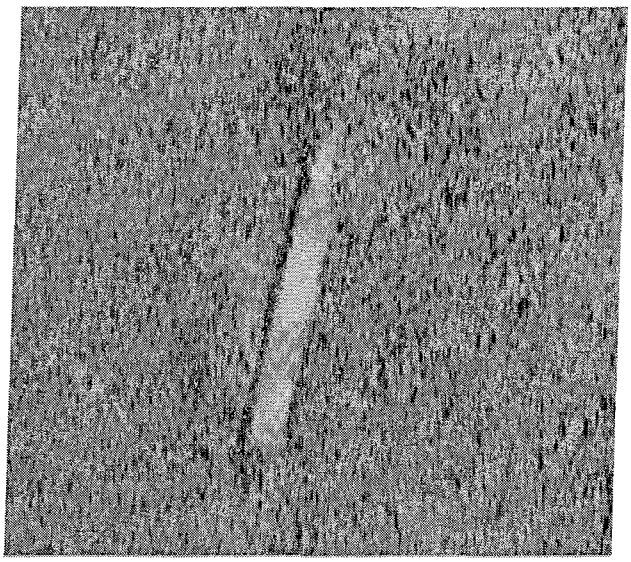

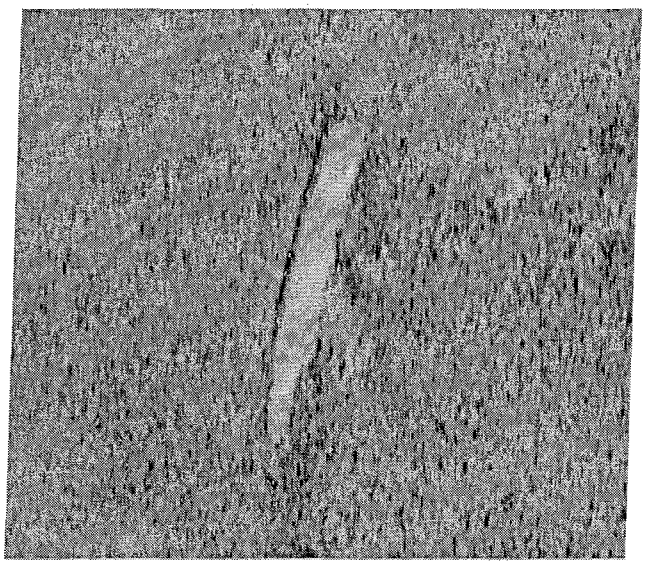

Target # C37-1
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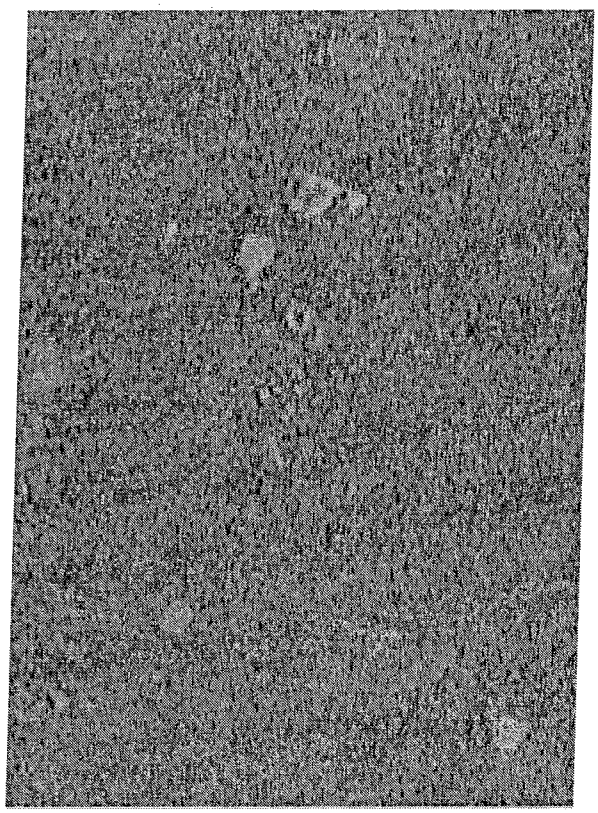
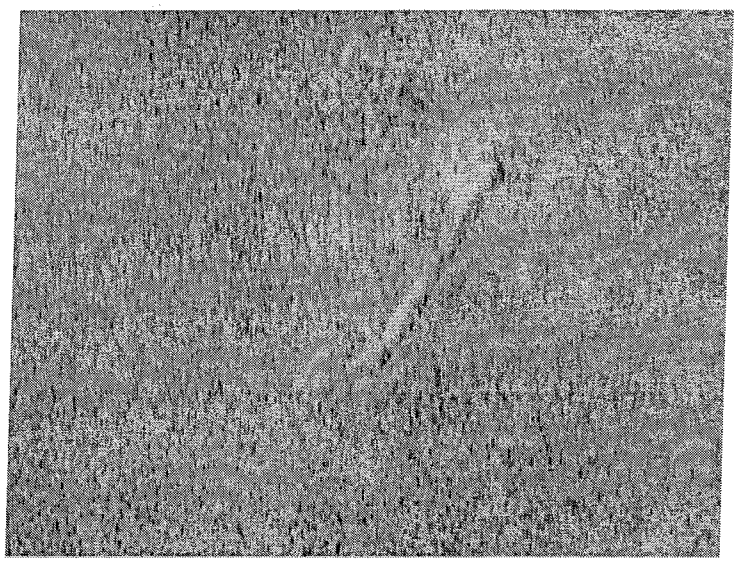
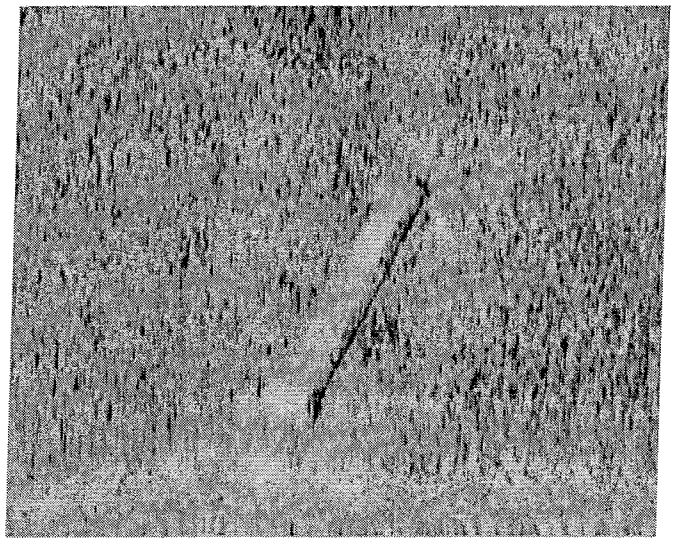
File Creation Time: 11/19/02 15:38:25
First Target Ping Num: 3337 at 10/21/2002 15:23:07
Target Location: 41° 38.0097' N 070° 54.7183' W

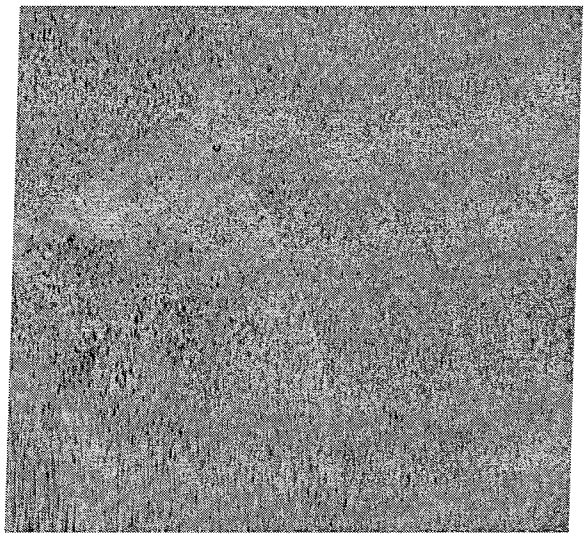


Target # C37-2
SonarWeb V3.13M PRO
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\Channel\SlantRangeCorrected\37chan-BAC.CMN
File Creation Time: 11/19/02 15:40:54
First Target Ping Num: 10851 at 10/21/2002 15:27:49
Target Location: 41° 37.7658' N 070° 54.5651' W

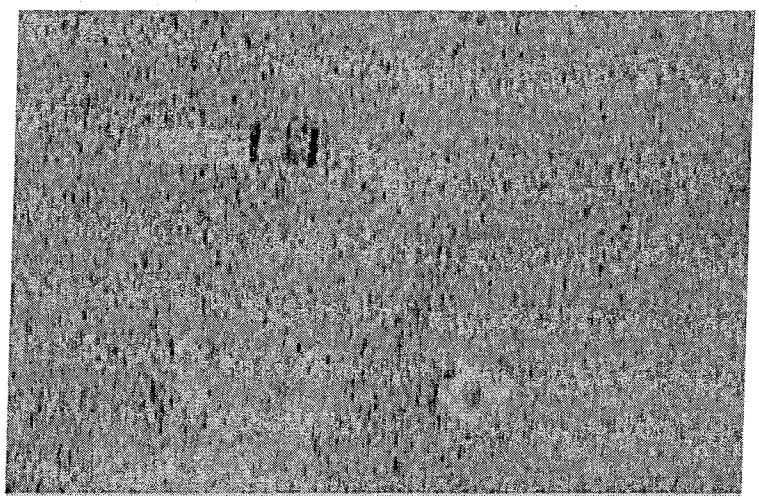




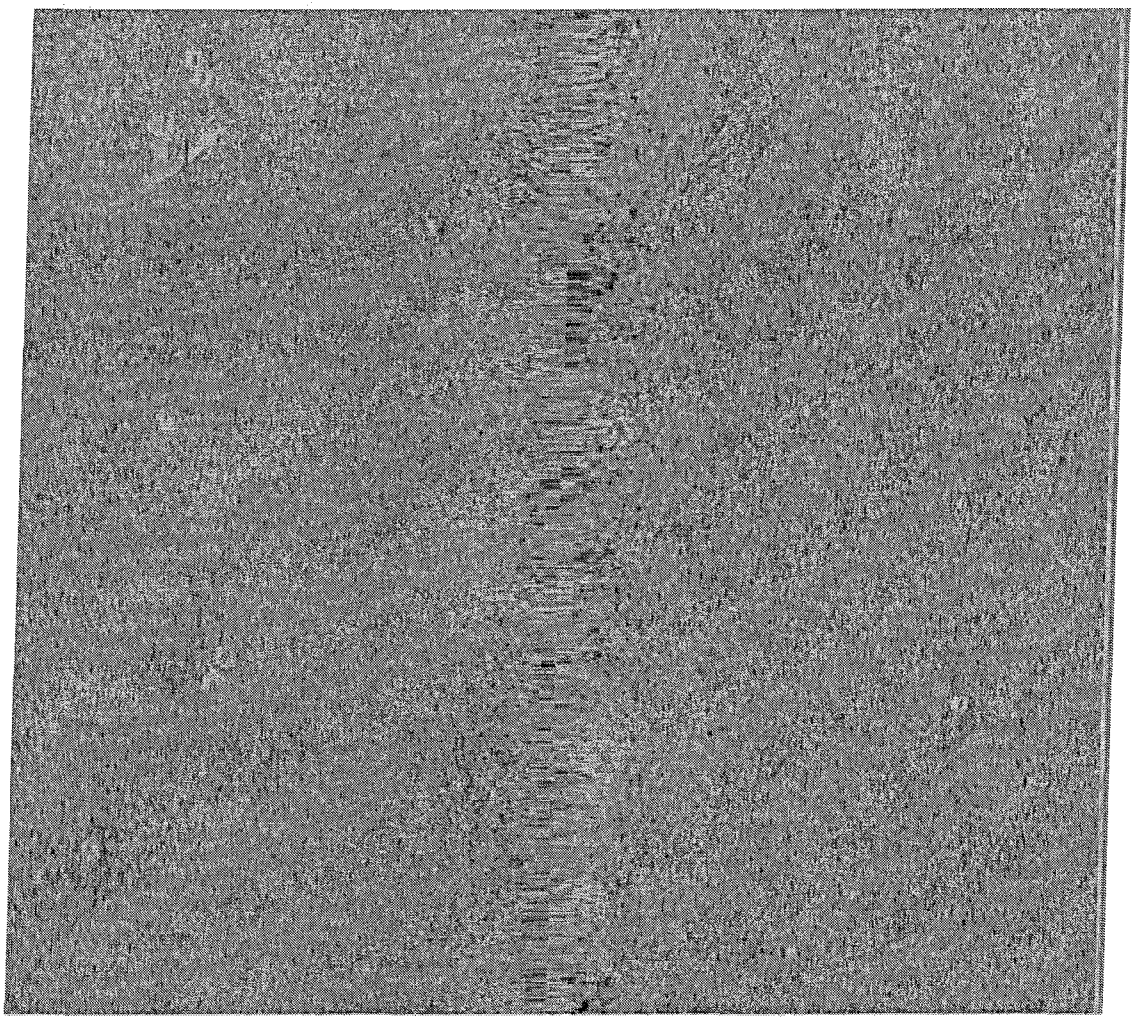
Target # C39-1
SonarWeb V3.13M PRO
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\Channel\SlantRangeCorrected\39chan-BAC.CMN
File Creation Time: 11/19/02 16:38:07
First Target Ping Num: 12674 at 10/21/2002 15:37:14
Target Location: 41° 38.0526' N 070° 54.7209' W



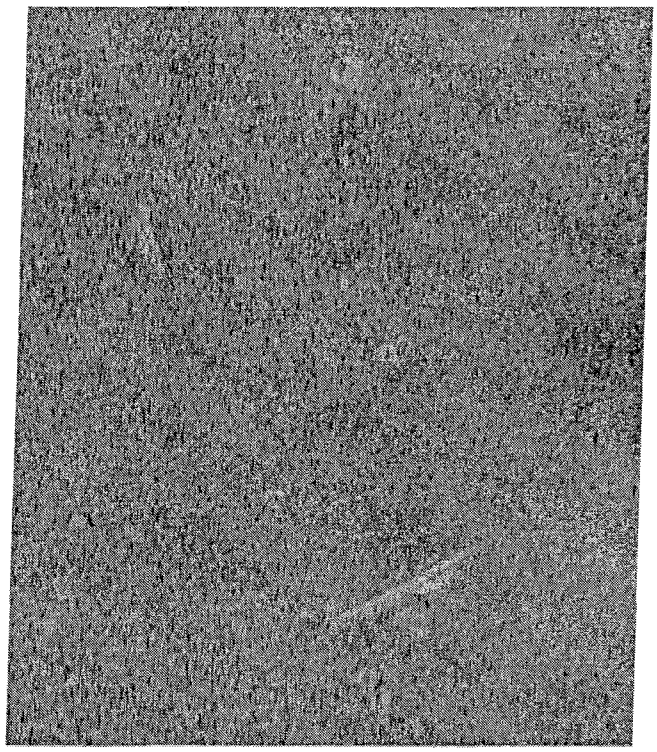
Target # C39-2
SonarWeb V3.13M PRO
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\Channel\SlantRangeCorrected\39chan-BAC.CMN
File Creation Time: 11/19/02 16:38:29
First Target Ping Num: 9321 at 10/21/2002 15:35:08
Target Location: 41° 37.9714' N 070° 54.6694' W



Target # C39-3
SonarWeb V3.13M PRO
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\Channel\SlantRangeCorrected\39chan-BAC.CMN
File Creation Time: 11/19/02 16:38:43
First Target Ping Num: 7943 at 10/21/2002 15:34:17
Target Location: 41° 37.9385' N 070° 54.6510' W



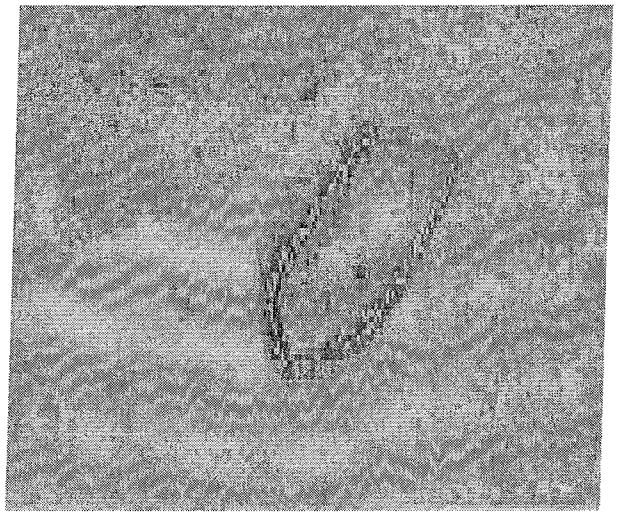
Target # C41-1
SonarWeb V3.13M PRO
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\Channel\SlantRangeCorrected\41rchan-BAC.CMN
File Creation Time: 11/19/02 16:39:44
First Target Ping Num: 5711 at 10/21/2002 17:02:49
Target Location: 41° 37.7838' N 070° 54.5322' W



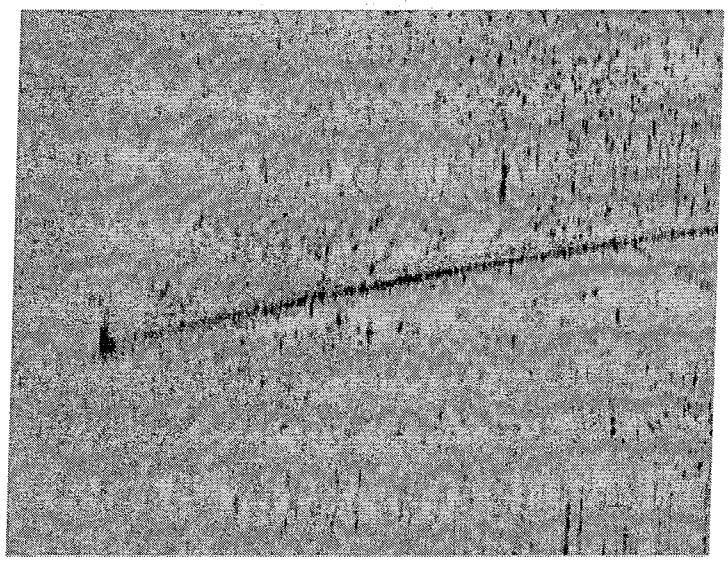
Target # C41-1
SonarWeb V3.13M PRO
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\Channel\SlantRangeCorrected\41rchan-BAC.CMN
File Creation Time: 11/19/02 16:39:44
First Target Ping Num: 5711 at 10/21/2002 17:02:49
Target Location: 41° 37.7838' N 070° 54.5322' W

APPENDIX B

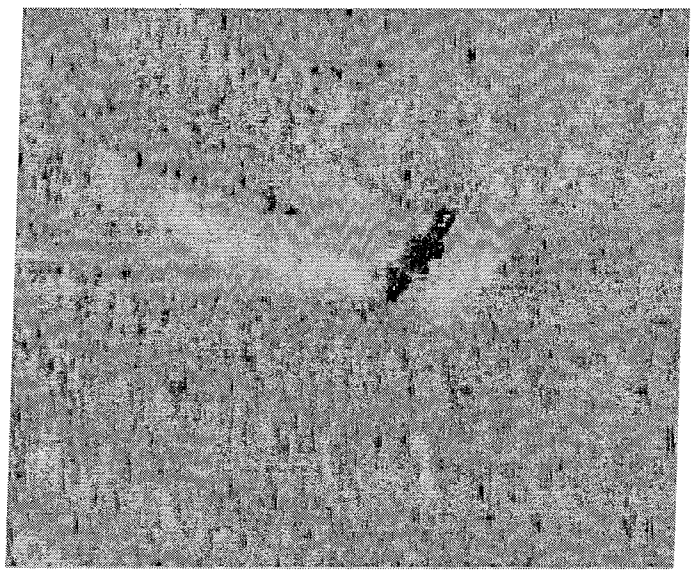
Detail Side Scan Images
Popes Island North Area



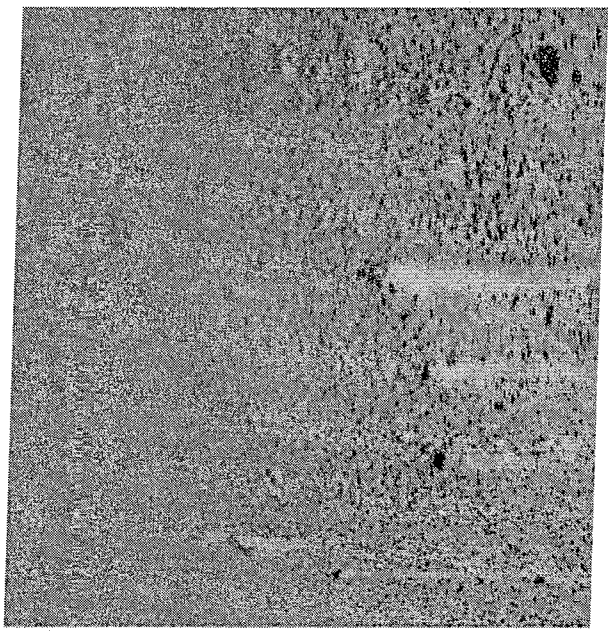
Target # P4-1
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\popes\SlantRangeCorrected\04popes-BAC.CMN
First Target Ping Num: 4117 at 10/23/2002 17:59:56
Target Location: 41° 38.5894' N 070° 54.9566' W



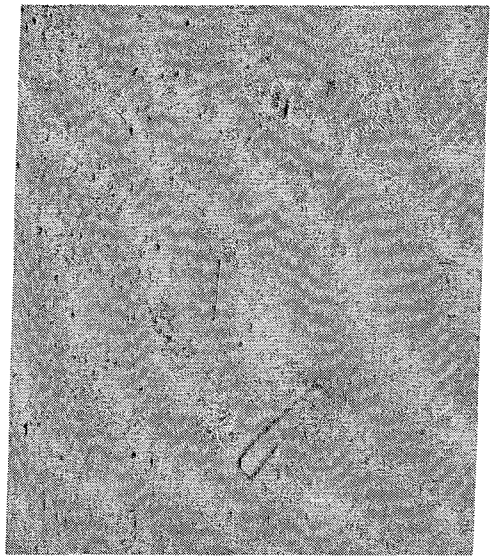
Target # P4-2
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\popes\SlantRangeCorrected\04popes-BAC.CMN
First Target Ping Num: 3520 at 10/23/2002 17:59:33
Target Location: 41° 38.6064' N 070° 54.9768' W

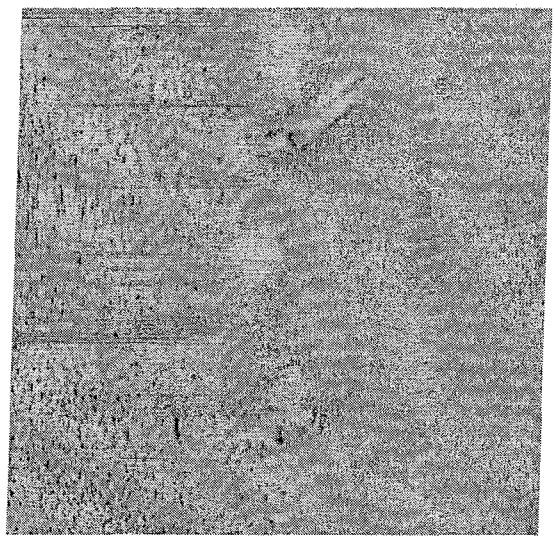


Target # P6-1
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\popes\SlantRangeCorrected\06popes-BAC.CMN
First Target Ping Num: 6434 at 10/23/2002 17:54:43
Target Location: 41° 38.6559' N 070° 54.9933' W

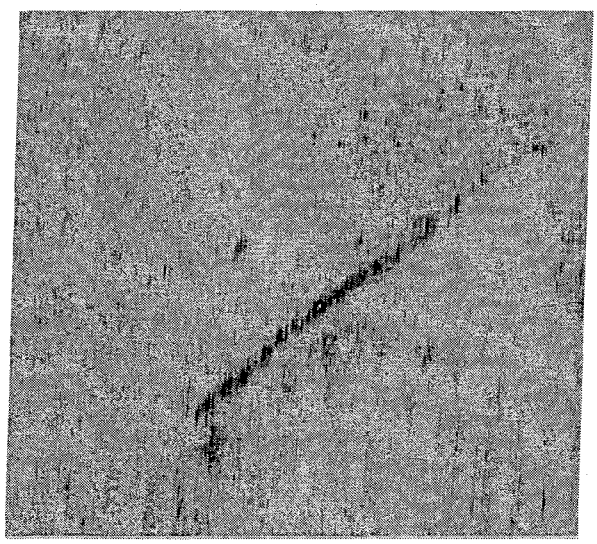


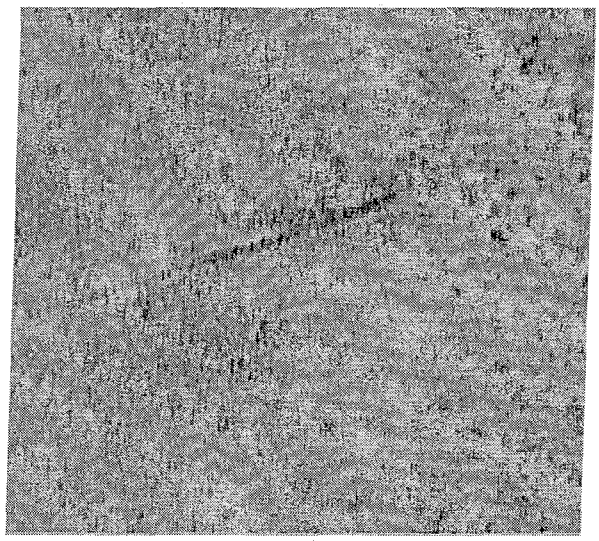
Target # P8-1
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\popes\SlantRangeCorrected\08popes-BAC.CMN
First Target Ping Num: 7346 at 10/23/2002 17:48:25
Target Location: 41° 38.5349' N 070° 54.8380' W



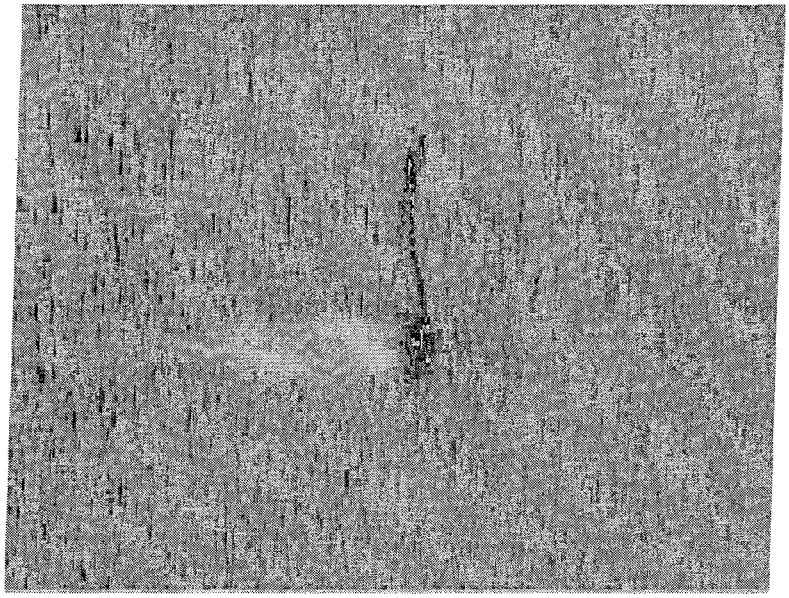


Target # P13-1
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\popes\SlantRangeCorrected\13popes-BAC.CMN
First Target Ping Num: 383 at 10/23/2002 12:45:34
Target Location: 41° 38.7706' N 070° 55.0220' W

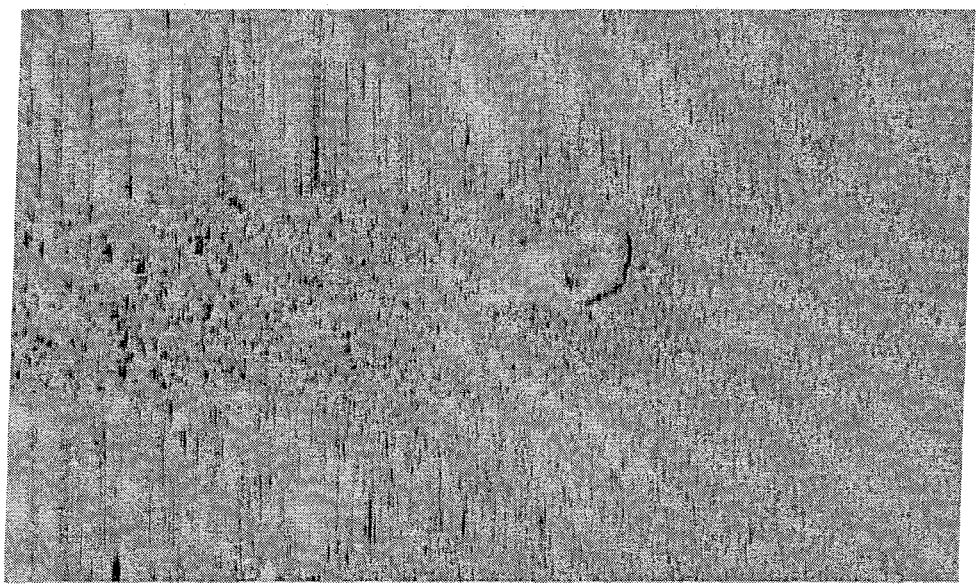




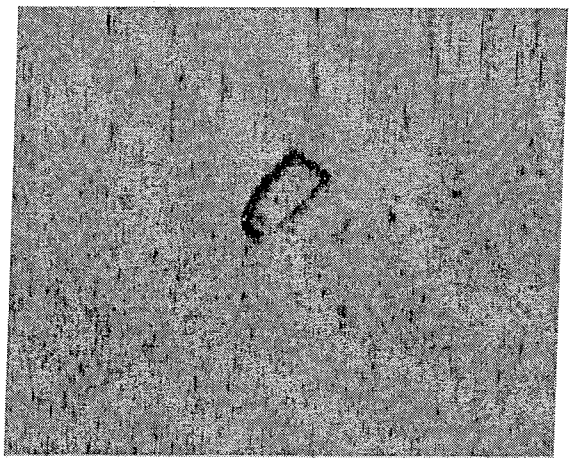
Target # P22-1
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\popes\SlantRangeCorrected\22rpopes-BAC.CMN
First Target Ping Num: 6604 at 10/23/2002 15:26:44
Target Location: 41° 38.7015' N 070° 54.8190' W

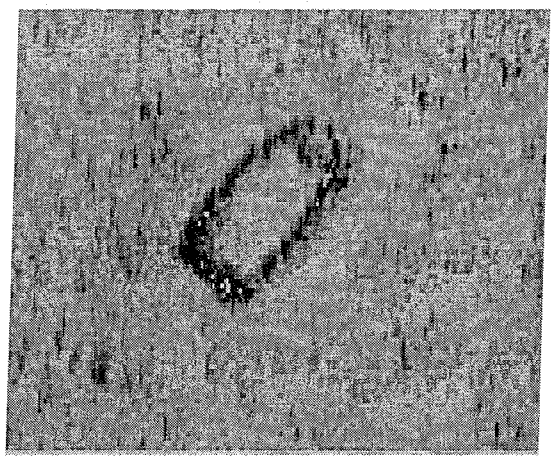


Target # P24-1
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\popes\SlantRangeCorrected\24popes-BAC.CMN
First Target Ping Num: 1716 at 10/23/2002 14:58:10
Target Location: 41° 38.5588' N 070° 54.6286' W

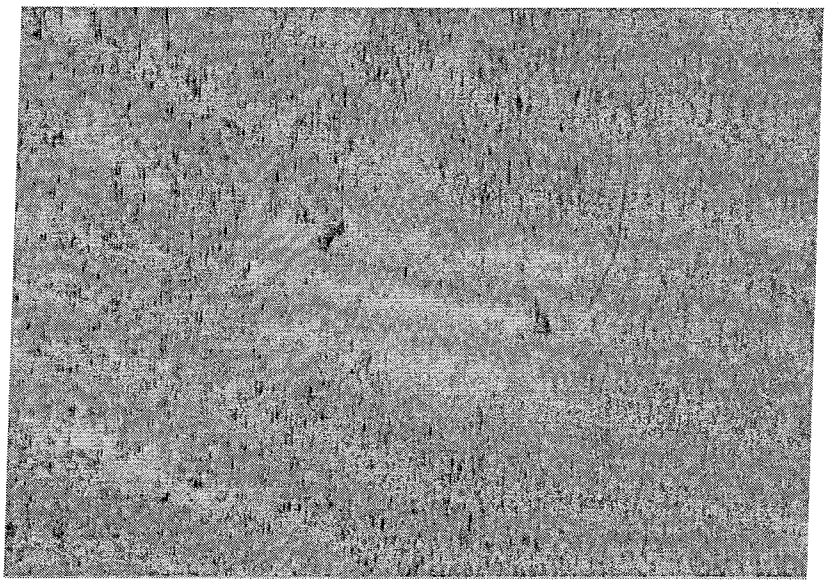


Target # P24-2
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\popes\SlantRangeCorrected\24popes-BAC.CMN
First Target Ping Num: 2188 at 10/23/2002 14:58:27
Target Location: 41° 38.5723' N 070° 54.6404' W

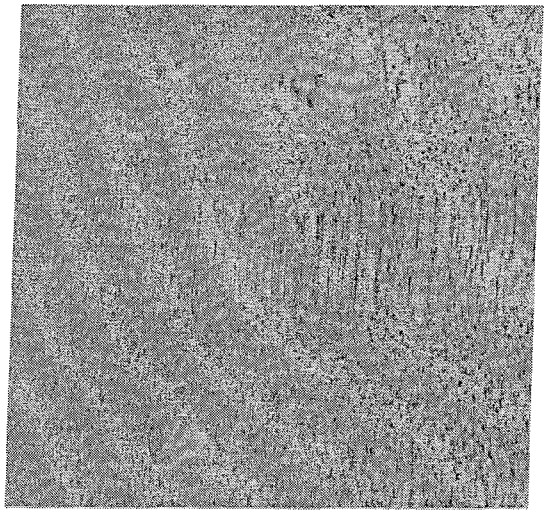


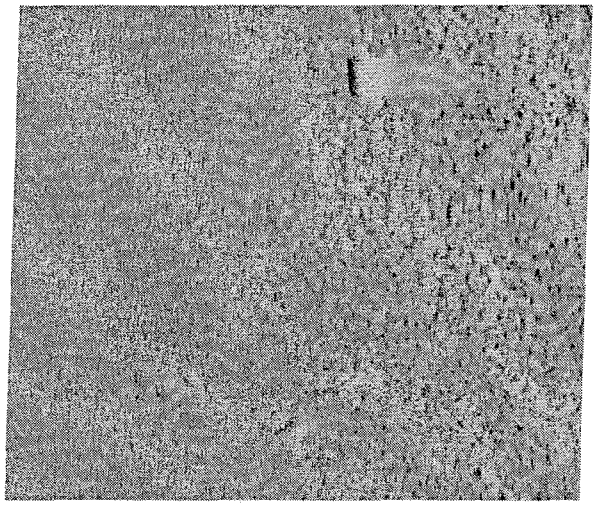


Target # P26-1
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\popes\SlantRangeCorrected\26rpopes-BAC.CMN
First Target Ping Num: 4406 at 10/23/2002 14:49:43
Target Location: 41° 38.7815' N 070° 54.8469' W

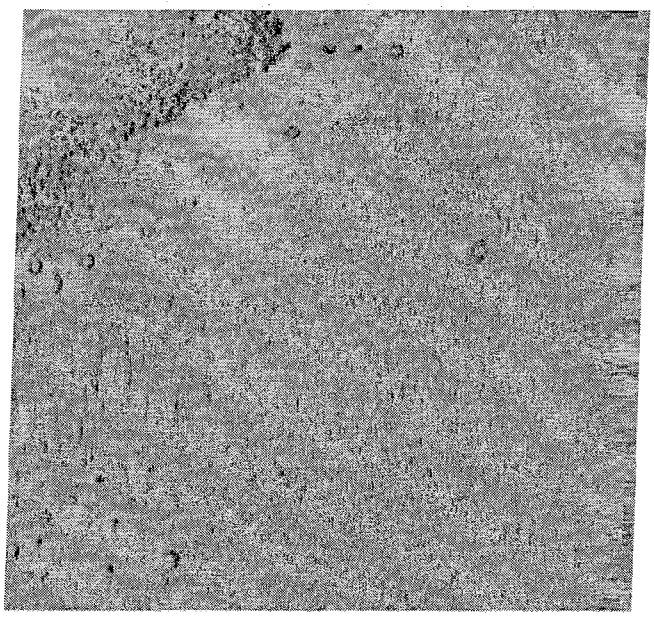


Target # P28-1
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\popes\SlantRangeCorrected\28popesd-BAC.CMN
First Target Ping Num: 4679 at 10/23/2002 14:36:39
Target Location: 41° 38.6508' N 070° 54.6768' W

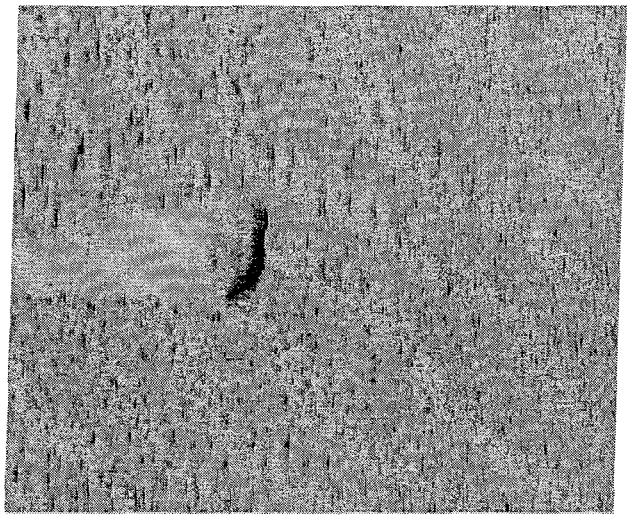




Target # P28-2
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\popes\SlantRangeCorrected\28popesd-BAC.CMN
First Target Ping Num: 11022 at 10/23/2002 14:40:37
Target Location: 41° 38.7876' N 070° 54.8212' W



Target # P30-1
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\popes\SlantRangeCorrected\30popes-BAC.CMN
First Target Ping Num: 3634 at 10/23/2002 14:25:16
Target Location: 41° 38.8340' N 070° 54.8502' W



Target # P30-2
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\popes\SlantRangeCorrected\30popes-BAC.CMN
First Target Ping Num: 14724 at 10/23/2002 14:32:12
Target Location: 41° 38.5810' N 070° 54.5852' W

Dredged Material Management Plan (DMMP) EOEA No. 11669 Final Environmental Impact Report (FEIR) Appendices D, E, F, G, H, I, J, and K - Volume II

for New Bedford and Fairhaven Massachusetts

Office of Coastal Zone Management
City of New Bedford, MA

Town of Fairhaven, MA

October 15, 2003

APPENDIX – VOLUME II

D. Physical and Chemical Analysis of Surficial Sediments

E. Benthic Infaunal Analysis

F. Comparison of Sediment Profile Image and Benthic Community Analysis

G. Suspended particulate Phase Acute Toxicity Testing with Mysids

H. Toxicity Identification Evaluation Testing with Mysids and Sea Urchins

I. Water Effect Ratio Study

J. Current, Water Level and Turbidity

K. Dredged Material Transport Modeling Analysis

APPENDIX D

PHYSICAL AND CHEMICAL ANALYSIS OF SURFICIAL SEDIMENTS

AMRO Environmental Laboratories Corporation

111 Herrick Street, Merrimack, NH 03054
TEL: (603) 424-2022 · FAX: (603) 429-8496

November 04, 2002

Tom Hevner
Maguire Group, Inc.
225 Foxborough Boulevard
Foxborough, MA 02035
TEL: (508) 543-1700
FAX: (508) 543-5157

RE: 16421 NB Harbor FEIR Workorder No.: 0210114

Dear Tom Hevner:

AMRO Environmental Laboratories Corp. received 20 samples on 10/11/02 for the analyses presented in the following report.

AMRO operates a Quality Assurance Program which meets or exceeds National Environmental Laboratory Accreditation Conference (NELAC), state, and EPA requirements. A copy of the appropriate state and/or NELAC Certificate is attached.

The enclosed Sample Receipt Checklist details the condition of your sample(s) upon receipt. Please be advised that any unused sample volume and sample extracts will be stored for a period of 60 days from sample receipt date (90 days for samples from New York). After this time, AMRO will properly dispose of the remaining sample(s). If you require further analysis, or need the samples held for a longer period, please contact us immediately.

This report consists of a total of 40 pages. This letter is an integral part of your data report. All results in this project relate only to the sample(s) as received by the laboratory and documented in the Chain-of-Custody. This report shall not be reproduced except in full, without the written approval of the laboratory. If you have any questions regarding this project in the future, please refer to the Workorder Number above.

Sincerely,

Nancy Stewart
Vice President/LabDirector

1987 AMRO ENVIRONMENTAL LABS 15th ANNIVERSARY MERRIMACK, NH 2002

AMRO Environmental Laboratories Corp.

Date: *01-Nov-02*

CLIENT: Maguire Group, Inc.
Project: 16421 NB Harbor FEIR
Lab Order: 0210114
Date Received: 10/11/02

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Collection Date
0210114-01A	NBH-201-1-SED	10/10/02
0210114-02A	NBH-201-2-SED	10/10/02
0210114-03A	NBH-201-3-SED	10/10/02
0210114-04A	NBH-202-1-SED	10/10/02
0210114-05A	NBH-202-2-SED	10/10/02
0210114-06A	NBH-202-3-SED	10/10/02
0210114-07A	NBH-203-1-SED	10/10/02
0210114-08A	NBH-203-2-SED	10/10/02
0210114-09A	NBH-203-3-SED	10/10/02
0210114-10A	NBH-204-1-SED	10/10/02
0210114-11A	NBH-204-2-SED	10/10/02
0210114-12A	NBH-204-3-SED	10/10/02
0210114-13A	NBH-205-1-SED	10/10/02
0210114-14A	NBH-205-2-SED	10/10/02
0210114-15A	NBH-205-3-SED	10/10/02
0210114-16A	NBH-205-4-SED	10/10/02
0210114-17A	NBH-206-1-SED	10/10/02
0210114-18A	NBH-206-2-SED	10/10/02
0210114-19A	NBH-206-3-SED	10/10/02
0210114-20A	NBH-206-4-SED	10/10/02

AMRO Environmental Laboratories Corp.

16-Oct-02

Lab Order: 0210114
Client: Maguire Group, Inc.
Project: 16421 NB Harbor FEIR

DATES REPORT

Sample ID	Client Sample ID	Collection Date	Matrix	Test Name	TCLP Date	Prep Date	Analysis Date	Batch ID
0210114-01A	NBH-201-1-SED	10/10/02	Sediment	ICP METALS, 3051/6010		10/13/02	10/14/02	7884
				MERCURY, Soil		10/14/02	10/15/02	7894
				Percent Moisture			10/14/02	R15932
				SELENIUM, Soil 3051/7740		10/13/02	10/16/02	7884
0210114-02A	NBH-201-2-SED			ICP METALS, 3051/6010		10/13/02	10/14/02	7884
				MERCURY, Soil		10/14/02	10/15/02	7894
				Percent Moisture			10/14/02	R15932
				SELENIUM, Soil 3051/7740		10/13/02	10/16/02	7884
0210114-03A	NBH-201-3-SED			ICP METALS, 3051/6010		10/13/02	10/14/02	7884
				MERCURY, Soil		10/14/02	10/15/02	7894
				Percent Moisture			10/14/02	R15932
				SELENIUM, Soil 3051/7740		10/13/02	10/16/02	7884
0210114-04A	NBH-202-1-SED			ICP METALS, 3051/6010		10/13/02	10/14/02	7884
				MERCURY, Soil		10/14/02	10/15/02	7894
				Percent Moisture			10/14/02	R15932
				SELENIUM, Soil 3051/7740		10/13/02	10/16/02	7884
0210114-05A	NBH-202-2-SED			ICP METALS, 3051/6010		10/13/02	10/14/02	7884
				MERCURY, Soil		10/14/02	10/15/02	7894
				Percent Moisture			10/14/02	R15932
				SELENIUM, Soil 3051/7740		10/13/02	10/16/02	7884
0210114-06A	NBH-202-3-SED			ICP METALS, 3051/6010		10/13/02	10/14/02	7884
				MERCURY, Soil		10/14/02	10/15/02	7894
				Percent Moisture			10/14/02	R15932
				SELENIUM, Soil 3051/7740		10/13/02	10/16/02	7884
0210114-07A	NBH-203-1-SED			ICP METALS, 3051/6010		10/13/02	10/14/02	7884
				MERCURY, Soil		10/14/02	10/15/02	7894
				Percent Moisture			10/14/02	R15932
				SELENIUM, Soil 3051/7740		10/13/02	10/16/02	7884

AMRO Environmental Laboratories Corp.

16-Oct-02

Lab Order: 0210114
Client: Maguire Group, Inc.
Project: 16421 NB Harbor FEIR

DATES REPORT

Sample ID	Client Sample ID	Collection Date	Matrix	Test Name	TCLP Date	Prep Date	Analysis Date	Batch ID
0210114-08A	NBH-203-2-SED	10/10/02	Sediment	ICP METALS, 3051/6010		10/13/02	10/14/02	7884
				MERCURY, Soil		10/14/02	10/15/02	7894
				Percent Moisture			10/14/02	R15932
				SELENIUM, Soil 3051/7740		10/13/02	10/16/02	7884
0210114-09A	NBH-203-3-SED			ICP METALS, 3051/6010		10/13/02	10/14/02	7884
				MERCURY, Soil		10/14/02	10/15/02	7894
				Percent Moisture			10/14/02	R15932
				SELENIUM, Soil 3051/7740		10/13/02	10/16/02	7884
0210114-10A	NBH-204-1-SED			ICP METALS, 3051/6010		10/13/02	10/14/02	7884
				MERCURY, Soil		10/14/02	10/15/02	7894
				Percent Moisture			10/14/02	R15932
				SELENIUM, Soil 3051/7740		10/13/02	10/16/02	7884
0210114-11A	NBH-204-2-SED			ICP METALS, 3051/6010		10/13/02	10/14/02	7884
				MERCURY, Soil		10/14/02	10/15/02	7894
				Percent Moisture			10/14/02	R15932
				SELENIUM, Soil 3051/7740		10/13/02	10/16/02	7884
0210114-12A	NBH-204-3-SED			ICP METALS, 3051/6010		10/13/02	10/14/02	7884
				MERCURY, Soil		10/14/02	10/15/02	7894
				Percent Moisture			10/14/02	R15932
				SELENIUM, Soil 3051/7740		10/13/02	10/16/02	7884
0210114-13A	NBH-205-1-SED			ICP METALS, 3051/6010		10/13/02	10/14/02	7884
				MERCURY, Soil		10/14/02	10/15/02	7894
				Percent Moisture			10/14/02	R15932
				SELENIUM, Soil 3051/7740		10/13/02	10/16/02	7884
0210114-14A	NBH-205-2-SED			ICP METALS, 3051/6010		10/13/02	10/14/02	7884
				MERCURY, Soil		10/14/02	10/15/02	7894
				Percent Moisture			10/14/02	R15932
				SELENIUM, Soil 3051/7740		10/13/02	10/16/02	7884

AMRO Environmental Laboratories Corp.

16-Oct-02

Lab Order: 0210114
Client: Maguire Group, Inc.
Project: 16421 NB Harbor FEIR

DATES REPORT

Sample ID	Client Sample ID	Collection Date	Matrix	Test Name	TCLP Date	Prep Date	Analysis Date	Batch ID
0210114-15A	NBH-205-3-SED	10/10/02	Sediment	ICP METALS, 3051/6010		10/13/02	10/14/02	7884
				MERCURY, Soil		10/14/02	10/15/02	7894
				Percent Moisture			10/14/02	R15932
				SELENIUM, Soil 3051/7740		10/13/02	10/16/02	7884
0210114-16A	NBH-205-4-SED			ICP METALS, 3051/6010		10/13/02	10/14/02	7884
				MERCURY, Soil		10/14/02	10/15/02	7894
				Percent Moisture			10/14/02	R15932
				SELENIUM, Soil 3051/7740		10/13/02	10/16/02	7884
0210114-17A	NBH-206-1-SED			ICP METALS, 3051/6010		10/13/02	10/14/02	7884
				MERCURY, Soil		10/14/02	10/15/02	7894
				Percent Moisture			10/14/02	R15932
				SELENIUM, Soil 3051/7740		10/13/02	10/16/02	7884
0210114-18A	NBH-206-2-SED			ICP METALS, 3051/6010		10/13/02	10/14/02	7884
				MERCURY, Soil		10/14/02	10/15/02	7894
				Percent Moisture			10/14/02	R15932
				SELENIUM, Soil 3051/7740		10/13/02	10/16/02	7884
0210114-19A	NBH-206-3-SED			ICP METALS, 3051/6010		10/13/02	10/14/02	7884
				MERCURY, Soil		10/14/02	10/15/02	7894
				Percent Moisture			10/14/02	R15932
				SELENIUM, Soil 3051/7740		10/13/02	10/16/02	7884
0210114-20A	NBH-206-4-SED			ICP METALS, 3051/6010		10/13/02	10/14/02	7884
				MERCURY, Soil		10/14/02	10/15/02	7894
				Percent Moisture			10/14/02	R15932
				SELENIUM, Soil 3051/7740		10/13/02	10/16/02	7884

AMRO Environmental Laboratories Corporation

SAMPLE RECEIPT CHECKLIST

111 Herrick Street
Merrimack, NH 03054
(603) 424-2022

Client: MAGUIRE GROUP INC
Project Name: NB HARBOR FEIR
Ship via: (circle one) Fed Ex., UPS, AMRO Courier, Hand Del., Other Courier, Other:

AMRO ID: 0210114
Date Rec.: 10-11-02
Date Due: 10-15-02

Items to be Checked Upon Receipt	Yes	No	NA	Comments
1. Army Samples received in individual plastic bags?			✓	
2. Custody Seals present?			✓	
3. Custody Seals Intact?			✓	
4. Air Bill included in folder if received?			✓	
5. Is COC included with samples?	✓			
6. Is COC signed and dated by client?	✓			
7. Laboratory receipt temperature. TEMP = 2°, 4.5°				
Samples rec. with ice ✓ ice packs___ neither___				
8. Were samples received the same day they were sampled?		✓		
Is client temperature 4°C ± 2°C?	✓			
If no obtain authorization from the client for the analyses.				
Client authorization from: Date: Obtained by:				
9. Is the COC filled out correctly and completely?	✓			
10. Does the info on the COC match the samples?	✓			
11. Were samples rec. within holding time?	✓			
12. Were all samples properly labeled?	✓			
13. Were all samples properly preserved?	✓			
14. Were proper sample containers used?	✓			
15. Were all samples received intact? (none broken or leaking)	✓			
16. Were VOA vials rec. with no air bubbles?			✓	
17. Were the sample volumes sufficient for requested analysis?	✓			
18. Were all samples received?	✓			
19. VPH and VOA Soils only:			✓	
Sampling Method VPH (circle one): M=Methanol, E=EnCore (air-tight container)				
Sampling Method VOA (circle one): M=Methanol, SB=Sodium Bisulfate, E=EnCore, B=Bulk				
If M or SB:				
Does preservative cover the soil?				
If NO then client must be faxed.				
Does preservation level come close to the fill line on the vial?				
If NO then client must be faxed.				
Were vials provided by AMRO?				
If NO then weights MUST be obtained from client				
Was dry weight aliquot provided?				
If NO then fax client and inform the VOA lab ASAP.				
20. Subcontracted Samples:			✓	
What samples sent:				
Where sent:				
Date:				
Analysis:				
TAT:				
21. Information entered into:				
Internal Tracking Log?	✓			
Dry Weight Log?	✓			
Client Log?			✓	
Composite Log?			✓	
Filtration Log?			✓	

Received By: CC Date: 10-11-02 Logged in By: CC Date: 10-12-02
Labeled By: CC Date: 10-12-02 Checked By: [illegible] Date: 10-14-02

NA= Not Applicable

qc/qcmemos/forms/samplerec Rev.18 06/00

AMRO Environmental Laboratories Corporation
111 Herrick Street
Merrimack, NH 03054

CHAIN-OF-CUSTODY RECORD

43451

Office: (603) 424-2022
Fax: (603) 429-8496

Project No.: 16421	Project Name: NB Harbor FEIR	Project Manager: TBH	Samplers (Signature): [signature]	AMRO Project No.: 0210114
	Project State:			

Sample ID	Date/Time Sampled	Matrix (A= Air, S= Soil, GW= Ground W., WW= Waste W., DW= Drinking W., O= Oil, Other= Specify)	Total # of Cont. & Size	Comp	Grab	PCRA(8) Metals	Dioxin/Furan	PCB Congeners	Pest.	PAH	TOC 9060	Water Content	Grain/Hydro	% total Solids					Remarks
NBH-206-1-SED	10/10/02	S	3x8oz	X		X													
NBH-206-2-SED	10/10/02	S	3x8oz	X		X													
NBH-206-3-SED	10/10/02	S	3x8oz	X		X													
NBH-206-4-SED	10/10/02	S	3x8oz	X		X													

Preservative: Cl-HCl, MeOH, N-HN03, S-H2SO4, Na-NaOH, O- Other

Container Type: P- Plastic, G-Glass, V-Vial, T-Teflon, O-Other

Send Results To:	FAX No.:	Seal Intact?	P.O. No:	GW-1* GW-2 GW-3
Tom Heuner Maguire Group, Inc.	508.543-5157	Yes No N/A Results Needed By:		MCP Level Needed: *= May require additional cost

Relinquished By	Date/ Time	Received By
[signature]	13:30 10-11-02	[signature]
[signature]	16:40 10-11-02	C Clearley

PRIORITY TURNAROUND TIME AUTHORIZATION

Before submitting samples for expedited TAT, you must have requested in advance and received a coded **AUTHORIZATION NUMBER.**

Samples arriving after 12:00 noon will be tracked and billed as received on the following day.

AUTHORIZATION No. _____ **BY:** _____

Please print clearly, legibly and completely. Samples can not be logged in and the turnaround time clock will not start until any ambiguities are resolved.

NOTES: Preservatives, Special reporting limits, Known Contamination, etc;

AMRO policy requires notification in writing to the laboratory in cases where the samples were collected from highly contaminated sites.

White: Lab Copy Yellow: Accompanies Report Pink: Client Copy

SHEET 3 **OF** 3

AMRO Environmental Laboratories Corporation
111 Herrick Street
Merrimack, NH 03054

HAND-CUSTODY RECORD

43450

Office: (603) 424-2022
Fax: (603) 429-8496

Project No.: 16421	Project Name: NB Harbor FEIR	Project Manager: TBH	Samplers (Signature): [signature]	AMRO Project No.: 0210114
	Project State:			

Sample ID	Date/Time Sampled	Matrix (A= Air, S= Soil, GW= Ground W., WW= Waste W., DW= Drinking W., O= Oil, Other= Specify)	Total # of Cont. & Size	Comp	Grab	Analysis Required: PCPA (8) Metals	Dioxin/Furans	PCB Congeners	Pest	PAH	TOC-9060	Water Content	Grain/Hydro	% Total Solids					Remarks
NBH-204-2-SED	10/10/02	Sed	3x8oz	X		X													
NBH-204-3-SED	10/10/02	Sed	3x8oz			X													
NBH-205-1-SED	10/10/02	Sed	3x8oz			X													
NBH-205-2-SED	10/10/02	Sed	3x8oz			X													
NBH-205-3-SED	10/10/02	Sed	3x8oz			X													
NBH-205-4-SED	10/10/02	Sed	3x8oz			X													
~~NBH-206-1-SED~~	~~10/10/02~~	~~S~~	~~3x8oz~~																
~~NBH-206-2-SED~~	~~10/10/02~~	~~S~~	~~3x8oz~~																
~~NBH-206-3-SED~~	~~10/10/02~~	~~S~~	~~3x8oz~~																

Preservative: Cl-HCl, MeOH, N-HN03, S-H2SO4, Na-NaOH, O- Other

Container Type: P- Plastic, G-Glass, V-Vial, T- Teflon, O-Other

Send Results To:	FAX No.:	Seal Intact?	P.O. No:	GW-1* GW-2 GW-3
Tom Hevner Maguire Group, Inc.	508.543-5157	Yes No N/A		MCP Level Needed:
		Results Needed By:		*= May require additional cost

Relinquished By	Date/ Time	Received By
[signature]	13:30 10-11-02	[signature]
[signature]	16:40 10-11-02	C Cearley

PRIORITY TURNAROUND TIME AUTHORIZATION

Before submitting samples for expedited TAT, you must have requested in advance and received a coded **AUTHORIZATION NUMBER.**

Samples arriving after 12:00 noon will be tracked and billed as received on the following day.

AUTHORIZATION No. _____ **BY:** _____

Please print clearly, legibly and completely. Samples can not be logged in and the turnaround time clock will not start until any ambiguities are resolved.

NOTES: Preservatives, Special reporting limits, Known Contamination, etc;

AMRO policy requires notification in writing to the laboratory in cases where the samples were collected from highly contaminated sites.

White: Lab Copy Yellow: Accompanies Report Pink: Client Copy

SHEET 2 OF 3

The Commonwealth of Massachusetts

Department of Environmental Protection

Division of Environmental Analysis
Senator William X. Wall Experiment Station

certifies

M- NH012

AMRO ENVIRONMENTAL LAB
111 HERRICK ST
MERRIMACK, NH 03054-0000

Laboratory Director: Nancy Stewart

for the analysis of NON POTABLE WATER (CHEMISTRY)
POTABLE WATER (CHEMISTRY)

pursuant to 310 CMR 42.00

This certificate supersedes all previous Massachusetts certificates issued to this laboratory. The laboratory is regulated by and shall be responsible for being in compliance with Massachusetts regulations at 310 CMR 42.00.

This certificate is valid only when accompanied by the latest dated Certified Parameter List as issued by the Massachusetts D.E.P. Contact the Division of Environmental Analysis to verify the current certification status of the laboratory.

Certification is no guarantee of the validity of the data. This certification is subject to unannounced laboratory inspections.

Issued: 01 JUL 2002
Expires: 30 JUN 2003

Director, Division of Environmental Analysis

COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Certified Parameter List as of: 15 OCT 2002

M- NH012 AMRO ENVIRONMENTAL LAB
MERRIMACK NH

NON POTABLE WATER (CHEMISTRY) Effective Date 15 OCT 2002 Expiration Date 30 JUN 2003

Analytes and Methods

ALUMINUM	EPA 200.7	ORTHOPHOSPHATE	EPA 300.0
ANTIMONY	EPA 200.7	TOTAL PHOSPHORUS	EPA 365.2
ANTIMONY	EPA 204.2	CHEMICAL OXYGEN DEMAND	EPA 410.4
ARSENIC	EPA 200.7	BIOCHEMICAL OXYGEN DEMAND	EPA 405.1
ARSENIC	EPA 206.2	TOTAL CYANIDE	EPA 335.2
ARSENIC	ASTM D2972-93(C)	NON-FILTERABLE RESIDUE	EPA 160.2
BERYLLIUM	EPA 200.7	OIL AND GREASE	EPA 413.1
CADMIUM	EPA 200.7	TOTAL PHENOLICS	EPA 420.1
CHROMIUM	EPA 200.7	VOLATILE HALOCARBONS	EPA 624
COBALT	EPA 200.7	VOLATILE AROMATICS	EPA 624
COPPER	EPA 200.7	CHLORDANE	EPA 608
IRON	EPA 200.7	ALDRIN	EPA 608
LEAD	EPA 200.7	DIELDRIN	EPA 608
LEAD	EPA 239.2	DDD	EPA 608
MANGANESE	EPA 200.7	DDT	EPA 608
MERCURY	EPA 245.1	HEPTACHLOR	EPA 608
MOLYBDENUM	EPA 200.7	HEPTACHLOR EPOXIDE	EPA 608
NICKEL	EPA 200.7	POLYCHLORINATED BIPHENYLS (WATER)	EPA 608
SELENIUM	EPA 200.7		
SELENIUM	EPA 270.2		
SILVER	EPA 200.7		
THALLIUM	EPA 279.2		
ZINC	EPA 200.7		
PH	EPA 150.1		
SPECIFIC CONDUCTIVITY	EPA 120.1		
TOTAL DISSOLVED SOLIDS	EPA 160.1		
TOTAL HARDNESS (CACO3)	EPA 200.7		
CALCIUM	EPA 200.7		
MAGNESIUM	EPA 200.7		
SODIUM	EPA 200.7		
POTASSIUM	EPA 200.7		
TOTAL ALKALINITY	EPA 310.1		
TOTAL ALKALINITY	EPA 310.2		
CHLORIDE	EPA 325.3		
CHLORIDE	EPA 300.0		
FLUORIDE	EPA 300.0		
SULFATE	EPA 300.0		
AMMONIA-N	EPA 350.2		
NITRATE-N	EPA 300.0		
NITRATE-N	EPA 353.2		
KJELDAHL-N	EPA 351.1		
ORTHOPHOSPHATE	EPA 365.2		

COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Certified Parameter List as of: 15 OCT 2002

M- NH012 AMRO ENVIRONMENTAL LAB
MERRIMACK NH

POTABLE WATER (CHEMISTRY) Effective Date 09 SEP 2002 Expiration Date 30 JUN 2003

Analytes and Methods	
ANTIMONY	EPA 200.9
ARSENIC	EPA 200.7
ARSENIC	EPA 200.9
BARIUM	EPA 200.7
BERYLLIUM	EPA 200.7
CADMIUM	EPA 200.7
CHROMIUM	EPA 200.7
COPPER	EPA 200.7
LEAD	EPA 200.9
MERCURY	EPA 245.1
NICKEL	EPA 200.7
SELENIUM	EPA 200.9
THALLIUM	EPA 200.9
NITRATE-N	EPA 353.2
NITRITE-N	EPA 353.2
FLUORIDE	EPA 300.0
SODIUM	EPA 200.7
SULFATE	EPA 300.0
CYANIDE	SM 4500-CN-C,E
TURBIDITY	EPA 180.1
CALCIUM	EPA 200.7
TOTAL ALKALINITY	SM 2320B
TOTAL DISSOLVED SOLIDS	SM 2540C
PH	EPA 150.1
1,2-DIBROMOETHANE	EPA 504.1
1,2-DIBROMO-3-CHLOROPROPANE	EPA 504.1

CASE NARRATIVE
0210114

GENERAL

1. No QC deviations were observed.

TRACE METALS
WATER

1. Selenium concentration in the following samples was determined by the Method of Standard Addition (MSA): NBH-201-2-SED (0210114-02) and NBH-204-3-SED (0210114-12).

2. No other QC deviations were observed.

WET CHEMISTRY
WATER

1. No QC deviations were observed.

AMRO Environmental Laboratories Corp.

Date: *16-Oct-02*

CLIENT: Maguire Group, Inc. **Lab Order:** 0210114
Project: 16421 NB Harbor FEIR

Lab ID: 0210114-01 **Collection Date:** 10/10/02
Client Sample ID: NBH-201-1-SED **Matrix:** SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
PERCENT MOISTURE		**D2216**				Analyst: **JEK**
Percent Moisture	56.9	0		wt%	1	10/14/02

Lab ID: 0210114-02 **Collection Date:** 10/10/02
Client Sample ID: NBH-201-2-SED **Matrix:** SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
PERCENT MOISTURE		**D2216**				Analyst: **JEK**
Percent Moisture	43.7	0		wt%	1	10/14/02

Lab ID: 0210114-03 **Collection Date:** 10/10/02
Client Sample ID: NBH-201-3-SED **Matrix:** SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
PERCENT MOISTURE		**D2216**				Analyst: **JEK**
Percent Moisture	8.1	0		wt%	1	10/14/02

Lab ID: 0210114-04 **Collection Date:** 10/10/02
Client Sample ID: NBH-202-1-SED **Matrix:** SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
PERCENT MOISTURE		**D2216**				Analyst: **JEK**
Percent Moisture	59.9	0		wt%	1	10/14/02

Lab ID: 0210114-05 **Collection Date:** 10/10/02
Client Sample ID: NBH-202-2-SED **Matrix:** SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
PERCENT MOISTURE		**D2216**				Analyst: **JEK**
Percent Moisture	57.0	0		wt%	1	10/14/02

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
* - Value exceeds Maximum Contaminant Level
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range

AMRO Environmental Laboratories Corp.

Date: *16-Oct-02*

CLIENT: Maguire Group, Inc.
Project: 16421 NB Harbor FEIR
Lab Order: 0210114

Lab ID: 0210114-06 **Collection Date:** 10/10/02
Client Sample ID: NBH-202-3-SED **Matrix:** SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
PERCENT MOISTURE		**D2216**				Analyst: **JEK**
Percent Moisture	36.3	0		wt%	1	10/14/02

Lab ID: 0210114-07 **Collection Date:** 10/10/02
Client Sample ID: NBH-203-1-SED **Matrix:** SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
PERCENT MOISTURE		**D2216**				Analyst: **JEK**
Percent Moisture	54.6	0		wt%	1	10/14/02

Lab ID: 0210114-08 **Collection Date:** 10/10/02
Client Sample ID: NBH-203-2-SED **Matrix:** SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
PERCENT MOISTURE		**D2216**				Analyst: **JEK**
Percent Moisture	36.7	0		wt%	1	10/14/02

Lab ID: 0210114-09 **Collection Date:** 10/10/02
Client Sample ID: NBH-203-3-SED **Matrix:** SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
PERCENT MOISTURE		**D2216**				Analyst: **JEK**
Percent Moisture	10.9	0		wt%	1	10/14/02

Lab ID: 0210114-10 **Collection Date:** 10/10/02
Client Sample ID: NBH-204-1-SED **Matrix:** SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
PERCENT MOISTURE		**D2216**				Analyst: **JEK**
Percent Moisture	19.7	0		wt%	1	10/14/02

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
* - Value exceeds Maximum Contaminant Level
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range

AMRO Environmental Laboratories Corp.

Date: *16-Oct-02*

CLIENT: Maguire Group, Inc. **Lab Order:** 0210114
Project: 16421 NB Harbor FEIR

Lab ID: 0210114-11 **Collection Date:** 10/10/02
Client Sample ID: NBH-204-2-SED **Matrix:** SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
PERCENT MOISTURE		**D2216**				Analyst: **JEK**
Percent Moisture	14.7	0		wt%	1	10/14/02

Lab ID: 0210114-12 **Collection Date:** 10/10/02
Client Sample ID: NBH-204-3-SED **Matrix:** SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
PERCENT MOISTURE		**D2216**				Analyst: **JEK**
Percent Moisture	20.0	0		wt%	1	10/14/02

Lab ID: 0210114-13 **Collection Date:** 10/10/02
Client Sample ID: NBH-205-1-SED **Matrix:** SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
PERCENT MOISTURE		**D2216**				Analyst: **JEK**
Percent Moisture	54.6	0		wt%	1	10/14/02

Lab ID: 0210114-14 **Collection Date:** 10/10/02
Client Sample ID: NBH-205-2-SED **Matrix:** SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
PERCENT MOISTURE		**D2216**				Analyst: **JEK**
Percent Moisture	43.5	0		wt%	1	10/14/02

Lab ID: 0210114-15 **Collection Date:** 10/10/02
Client Sample ID: NBH-205-3-SED **Matrix:** SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
PERCENT MOISTURE		**D2216**				Analyst: **JEK**
Percent Moisture	32.1	0		wt%	1	10/14/02

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
* - Value exceeds Maximum Contaminant Level
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range

AMRO Environmental Laboratories Corp.

Date: *16-Oct-02*

CLIENT: Maguire Group, Inc.
Project: 16421 NB Harbor FEIR
Lab Order: 0210114

Lab ID: 0210114-16 **Collection Date:** 10/10/02
Client Sample ID: NBH-205-4-SED **Matrix:** SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
PERCENT MOISTURE		**D2216**				Analyst: **JEK**
Percent Moisture	30.9	0		wt%	1	10/14/02

Lab ID: 0210114-17 **Collection Date:** 10/10/02
Client Sample ID: NBH-206-1-SED **Matrix:** SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
PERCENT MOISTURE		**D2216**				Analyst: **JEK**
Percent Moisture	62.5	0		wt%	1	10/14/02

Lab ID: 0210114-18 **Collection Date:** 10/10/02
Client Sample ID: NBH-206-2-SED **Matrix:** SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
PERCENT MOISTURE		**D2216**				Analyst: **JEK**
Percent Moisture	45.9	0		wt%	1	10/14/02

Lab ID: 0210114-19 **Collection Date:** 10/10/02
Client Sample ID: NBH-206-3-SED **Matrix:** SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
PERCENT MOISTURE		**D2216**				Analyst: **JEK**
Percent Moisture	46.2	0		wt%	1	10/14/02

Lab ID: 0210114-20 **Collection Date:** 10/10/02
Client Sample ID: NBH-206-4-SED **Matrix:** SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
PERCENT MOISTURE		**D2216**				Analyst: **JEK**
Percent Moisture	41.2	0		wt%	1	10/14/02

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
* - Value exceeds Maximum Contaminant Level
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range

AMRO Environmental Laboratories Corp.

Date: *16-Oct-02*

CLIENT: Maguire Group, Inc.
Project: 16421 NB Harbor FEIR

Lab Order: 0210114

Lab ID: 0210114-01
Client Sample ID: NBH-201-1-SED

Collection Date: 10/10/02
Matrix: SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
ICP METALS TOTAL SW-846 - 3051/6010		**SW6010B**				Analyst: **RK**
Arsenic	33	13		mg/Kg-dry	1	10/14/02 12:44:43 AM
Barium	50	52	J	mg/Kg-dry	1	10/14/02 12:44:43 AM
Cadmium	3.5	1.3		mg/Kg-dry	1	10/14/02 12:44:43 AM
Chromium	230	2.6		mg/Kg-dry	1	10/14/02 12:44:43 AM
Copper	430	6.5		mg/Kg-dry	1	10/14/02 12:44:43 AM
Lead	150	6.5		mg/Kg-dry	1	10/14/02 12:44:43 AM
Nickel	30	10		mg/Kg-dry	1	10/14/02 12:44:43 AM
Silver	4.1	3.6		mg/Kg-dry	1	10/14/02 12:44:43 AM
Zinc	330	5.2		mg/Kg-dry	1	10/14/02 12:44:43 AM
MERCURY, 7471A		**SW7471A**				Analyst: **RK**
Mercury	0.80	0.11		mg/Kg-dry	1	10/15/02 8:02:30 AM
SELENIUM, SOIL 3051/7740		**SW7740**				Analyst: **APL**
Selenium	ND	1.3		mg/Kg-dry	1	10/16/02

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
* - Value exceeds Maximum Contaminant Level
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range

AMRO Environmental Laboratories Corp.

Date: *16-Oct-02*

CLIENT: Maguire Group, Inc.
Project: 16421 NB Harbor FEIR

Lab Order: 0210114

Lab ID: 0210114-02
Collection Date: 10/10/02
Client Sample ID: NBH-201-2-SED
Matrix: SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
ICP METALS TOTAL SW-846 - 3051/6010		**SW6010B**				Analyst: **RK**
Arsenic	23	10		mg/Kg-dry	1	10/14/02 12:49:51 AM
Barium	32	41	J	mg/Kg-dry	1	10/14/02 12:49:51 AM
Cadmium	0.23	1.0	J	mg/Kg-dry	1	10/14/02 12:49:51 AM
Chromium	40	2.1		mg/Kg-dry	1	10/14/02 12:49:51 AM
Copper	180	5.1		mg/Kg-dry	1	10/14/02 12:49:51 AM
Lead	83	5.1		mg/Kg-dry	1	10/14/02 12:49:51 AM
Nickel	12	8.2		mg/Kg-dry	1	10/14/02 12:49:51 AM
Silver	0.80	2.9	J	mg/Kg-dry	1	10/14/02 12:49:51 AM
Zinc	140	4.1		mg/Kg-dry	1	10/14/02 12:49:51 AM
MERCURY, 7471A		**SW7471A**				Analyst: **RK**
Mercury	0.64	0.083		mg/Kg-dry	1	10/15/02 8:05:08 AM
SELENIUM, SOIL 3051/7740		**SW7740**				Analyst: **APL**
Selenium	2.0	1.0	MSA	mg/Kg-dry	1	10/16/02

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
* - Value exceeds Maximum Contaminant Level
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range

AMRO Environmental Laboratories Corp.

Date: *16-Oct-02*

CLIENT: Maguire Group, Inc.
Project: 16421 NB Harbor FEIR
Lab Order: 0210114

Lab ID: 0210114-03
Collection Date: 10/10/02
Client Sample ID: NBH-201-3-SED
Matrix: SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
ICP METALS TOTAL SW-846 - 3051/6010		**SW6010B**				Analyst: **RK**
Arsenic	11	6.8		mg/Kg-dry	1	10/14/02 12:19:13 AM
Barium	ND	27		mg/Kg-dry	1	10/14/02 12:19:13 AM
Cadmium	ND	0.68		mg/Kg-dry	1	10/14/02 12:19:13 AM
Chromium	3.3	1.4		mg/Kg-dry	1	10/14/02 12:19:13 AM
Copper	6.3	3.4		mg/Kg-dry	1	10/14/02 12:19:13 AM
Lead	2.2	3.4	J	mg/Kg-dry	1	10/14/02 12:19:13 AM
Nickel	1.7	5.4	J	mg/Kg-dry	1	10/14/02 12:19:13 AM
Silver	ND	1.9		mg/Kg-dry	1	10/14/02 12:19:13 AM
Zinc	9.6	2.7		mg/Kg-dry	1	10/14/02 12:19:13 AM
MERCURY, 7471A		**SW7471A**				Analyst: **RK**
Mercury	ND	0.053		mg/Kg-dry	1	10/15/02 7:49:34 AM
SELENIUM, SOIL 3051/7740		**SW7740**				Analyst: **APL**
Selenium	ND	0.68		mg/Kg-dry	1	10/16/02

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
* - Value exceeds Maximum Contaminant Level
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range

AMRO Environmental Laboratories Corp.

Date: *16-Oct-02*

CLIENT: Maguire Group, Inc.
Project: 16421 NB Harbor FEIR

Lab Order: 0210114

Lab ID: 0210114-04
Client Sample ID: NBH-202-1-SED

Collection Date: 10/10/02
Matrix: SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
ICP METALS TOTAL SW-846 - 3051/6010		**SW6010B**				Analyst: **RK**
Arsenic	35	14		mg/Kg-dry	1	10/14/02 12:54:56 AM
Barium	67	55		mg/Kg-dry	1	10/14/02 12:54:56 AM
Cadmium	3.9	1.4		mg/Kg-dry	1	10/14/02 12:54:56 AM
Chromium	280	2.8		mg/Kg-dry	1	10/14/02 12:54:56 AM
Copper	560	6.9		mg/Kg-dry	1	10/14/02 12:54:56 AM
Lead	180	6.9		mg/Kg-dry	1	10/14/02 12:54:56 AM
Nickel	33	11		mg/Kg-dry	1	10/14/02 12:54:56 AM
Silver	4.5	3.9		mg/Kg-dry	1	10/14/02 12:54:56 AM
Zinc	390	5.5		mg/Kg-dry	1	10/14/02 12:54:56 AM
MERCURY, 7471A		**SW7471A**				Analyst: **RK**
Mercury	1.0	0.12		mg/Kg-dry	1	10/15/02 8:07:45 AM
SELENIUM, SOIL 3051/7740		**SW7740**				Analyst: **APL**
Selenium	ND	1.4		mg/Kg-dry	1	10/16/02

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
* - Value exceeds Maximum Contaminant Level
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range

AMRO Environmental Laboratories Corp.

Date: *16-Oct-02*

CLIENT: Maguire Group, Inc.
Project: 16421 NB Harbor FEIR

Lab Order: 0210114

Lab ID: 0210114-05
Collection Date: 10/10/02
Client Sample ID: NBH-202-2-SED
Matrix: SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
ICP METALS TOTAL SW-846 - 3051/6010		**SW6010B**				Analyst: **RK**
Arsenic	37	14		mg/Kg-dry	1	10/14/02 1:00:03 AM
Barium	70	57		mg/Kg-dry	1	10/14/02 1:00:03 AM
Cadmium	5.7	1.4		mg/Kg-dry	1	10/14/02 1:00:03 AM
Chromium	270	2.9		mg/Kg-dry	1	10/14/02 1:00:03 AM
Copper	670	7.2		mg/Kg-dry	1	10/14/02 1:00:03 AM
Lead	240	7.2		mg/Kg-dry	1	10/14/02 1:00:03 AM
Nickel	30	11		mg/Kg-dry	1	10/14/02 1:00:03 AM
Silver	2.0	4.0	J	mg/Kg-dry	1	10/14/02 1:00:03 AM
Zinc	450	5.7		mg/Kg-dry	1	10/14/02 1:00:03 AM
MERCURY, 7471A		**SW7471A**				Analyst: **RK**
Mercury	1.7	0.11		mg/Kg-dry	1	10/15/02 8:15:37 AM
SELENIUM, SOIL 3051/7740		**SW7740**				Analyst: **APL**
Selenium	ND	1.4		mg/Kg-dry	1	10/16/02

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
* - Value exceeds Maximum Contaminant Level
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range

AMRO Environmental Laboratories Corp.

Date: *16-Oct-02*

CLIENT: Maguire Group, Inc.
Project: 16421 NB Harbor FEIR

Lab Order: 0210114

Lab ID: 0210114-06
Collection Date: 10/10/02
Client Sample ID: NBH-202-3-SED
Matrix: SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
ICP METALS TOTAL SW-846 - 3051/6010		**SW6010B**				Analyst: **RK**
Arsenic	20	9.2		mg/Kg-dry	1	10/14/02 1:13:37 AM
Barium	31	37	J	mg/Kg-dry	1	10/14/02 1:13:37 AM
Cadmium	ND	0.92		mg/Kg-dry	1	10/14/02 1:13:37 AM
Chromium	40	1.8		mg/Kg-dry	1	10/14/02 1:13:37 AM
Copper	170	4.6		mg/Kg-dry	1	10/14/02 1:13:37 AM
Lead	78	4.6		mg/Kg-dry	1	10/14/02 1:13:37 AM
Nickel	11	7.4		mg/Kg-dry	1	10/14/02 1:13:37 AM
Silver	0.66	2.6	J	mg/Kg-dry	1	10/14/02 1:13:37 AM
Zinc	130	3.7		mg/Kg-dry	1	10/14/02 1:13:37 AM
MERCURY, 7471A		**SW7471A**				Analyst: **RK**
Mercury	0.47	0.077		mg/Kg-dry	1	10/15/02 8:18:14 AM
SELENIUM, SOIL 3051/7740		**SW7740**				Analyst: **APL**
Selenium	ND	0.92		mg/Kg-dry	1	10/16/02

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
* - Value exceeds Maximum Contaminant Level
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range

AMRO Environmental Laboratories Corp.

Date: *16-Oct-02*

CLIENT: Maguire Group, Inc.
Project: 16421 NB Harbor FEIR

Lab Order: 0210114

Lab ID: 0210114-07
Client Sample ID: NBH-203-1-SED

Collection Date: 10/10/02
Matrix: SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
ICP METALS TOTAL SW-846 - 3051/6010		**SW6010B**				Analyst: **RK**
Arsenic	29	13		mg/Kg-dry	1	10/14/02 1:18:44 AM
Barium	50	52	J	mg/Kg-dry	1	10/14/02 1:18:44 AM
Cadmium	3.5	1.3		mg/Kg-dry	1	10/14/02 1:18:44 AM
Chromium	260	2.6		mg/Kg-dry	1	10/14/02 1:18:44 AM
Copper	460	6.6		mg/Kg-dry	1	10/14/02 1:18:44 AM
Lead	200	6.6		mg/Kg-dry	1	10/14/02 1:18:44 AM
Nickel	27	10		mg/Kg-dry	1	10/14/02 1:18:44 AM
Silver	5.7	3.7		mg/Kg-dry	1	10/14/02 1:18:44 AM
Zinc	360	5.2		mg/Kg-dry	1	10/14/02 1:18:44 AM
MERCURY, 7471A		**SW7471A**				Analyst: **RK**
Mercury	0.90	0.10		mg/Kg-dry	1	10/15/02 8:20:53 AM
SELENIUM, SOIL 3051/7740		**SW7740**				Analyst: **APL**
Selenium	1.8	1.3		mg/Kg-dry	1	10/16/02

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
* - Value exceeds Maximum Contaminant Level
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range

AMRO Environmental Laboratories Corp.

Date: *16-Oct-02*

CLIENT: Maguire Group, Inc.
Project: 16421 NB Harbor FEIR
Lab Order: 0210114

Lab ID: 0210114-08
Collection Date: 10/10/02
Client Sample ID: NBH-203-2-SED
Matrix: SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
ICP METALS TOTAL SW-846 - 3051/6010		**SW6010B**				Analyst: **RK**
Arsenic	22	9.7		mg/Kg-dry	1	10/14/02 1:23:54 AM
Barium	29	39	J	mg/Kg-dry	1	10/14/02 1:23:54 AM
Cadmium	ND	0.97		mg/Kg-dry	1	10/14/02 1:23:54 AM
Chromium	36	1.9		mg/Kg-dry	1	10/14/02 1:23:54 AM
Copper	150	4.8		mg/Kg-dry	1	10/14/02 1:23:54 AM
Lead	84	4.8		mg/Kg-dry	1	10/14/02 1:23:54 AM
Nickel	12	7.7		mg/Kg-dry	1	10/14/02 1:23:54 AM
Silver	0.65	2.7	J	mg/Kg-dry	1	10/14/02 1:23:54 AM
Zinc	140	3.9		mg/Kg-dry	1	10/14/02 1:23:54 AM
MERCURY, 7471A		**SW7471A**				Analyst: **RK**
Mercury	0.60	0.077		mg/Kg-dry	1	10/15/02 8:23:32 AM
SELENIUM, SOIL 3051/7740		**SW7740**				Analyst: **APL**
Selenium	1.0	0.97		mg/Kg-dry	1	10/16/02

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
* - Value exceeds Maximum Contaminant Level
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range

AMRO Environmental Laboratories Corp.

Date: *16-Oct-02*

CLIENT: Maguire Group, Inc.
Project: 16421 NB Harbor FEIR

Lab Order: 0210114

Lab ID: 0210114-09
Client Sample ID: NBH-203-3-SED

Collection Date: 10/10/02
Matrix: SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
ICP METALS TOTAL SW-846 - 3051/6010		**SW6010B**				Analyst: **RK**
Arsenic	4.8	6.8	J	mg/Kg-dry	1	10/14/02 1:28:57 AM
Barium	2.3	27	J	mg/Kg-dry	1	10/14/02 1:28:57 AM
Cadmium	ND	0.68		mg/Kg-dry	1	10/14/02 1:28:57 AM
Chromium	4.3	1.4		mg/Kg-dry	1	10/14/02 1:28:57 AM
Copper	11	3.4		mg/Kg-dry	1	10/14/02 1:28:57 AM
Lead	6.3	3.4		mg/Kg-dry	1	10/14/02 1:28:57 AM
Nickel	1.7	5.4	J	mg/Kg-dry	1	10/14/02 1:28:57 AM
Silver	ND	1.9		mg/Kg-dry	1	10/14/02 1:28:57 AM
Zinc	13	2.7		mg/Kg-dry	1	10/14/02 1:28:57 AM
MERCURY, 7471A		**SW7471A**				Analyst: **RK**
Mercury	0.058	0.055		mg/Kg-dry	1	10/15/02 8:26:12 AM
SELENIUM, SOIL 3051/7740		**SW7740**				Analyst: **APL**
Selenium	0.48	0.68	J	mg/Kg-dry	1	10/16/02

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
* - Value exceeds Maximum Contaminant Level
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range

AMRO Environmental Laboratories Corp.

Date: *16-Oct-02*

CLIENT: Maguire Group, Inc.
Project: 16421 NB Harbor FEIR

Lab Order: 0210114

Lab ID: 0210114-10
Client Sample ID: NBH-204-1-SED

Collection Date: 10/10/02
Matrix: SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
ICP METALS TOTAL SW-846 - 3051/6010		**SW6010B**				Analyst: **RK**
Arsenic	6.7	7.7	J	mg/Kg-dry	1	10/14/02 1:33:55 AM
Barium	4.3	31	J	mg/Kg-dry	1	10/14/02 1:33:55 AM
Cadmium	ND	0.77		mg/Kg-dry	1	10/14/02 1:33:55 AM
Chromium	19	1.5		mg/Kg-dry	1	10/14/02 1:33:55 AM
Copper	50	3.8		mg/Kg-dry	1	10/14/02 1:33:55 AM
Lead	24	3.8		mg/Kg-dry	1	10/14/02 1:33:55 AM
Nickel	3.0	6.1	J	mg/Kg-dry	1	10/14/02 1:33:55 AM
Silver	ND	2.1		mg/Kg-dry	1	10/14/02 1:33:55 AM
Zinc	33	3.1		mg/Kg-dry	1	10/14/02 1:33:55 AM
MERCURY, 7471A		**SW7471A**				Analyst: **RK**
Mercury	0.17	0.058		mg/Kg-dry	1	10/15/02 8:28:47 AM
SELENIUM, SOIL 3051/7740		**SW7740**				Analyst: **APL**
Selenium	0.55	0.77	J	mg/Kg-dry	1	10/16/02

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
* - Value exceeds Maximum Contaminant Level
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range

AMRO Environmental Laboratories Corp.

Date: *16-Oct-02*

CLIENT: Maguire Group, Inc.
Project: 16421 NB Harbor FEIR

Lab Order: 0210114

Lab ID: 0210114-11
Client Sample ID: NBH-204-2-SED

Collection Date: 10/10/02
Matrix: SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
ICP METALS TOTAL SW-846 - 3051/6010		**SW6010B**				Analyst: **RK**
Arsenic	6.0	7.0	J	mg/Kg-dry	1	10/14/02 1:39:09 AM
Barium	2.7	28	J	mg/Kg-dry	1	10/14/02 1:39:09 AM
Cadmium	ND	0.70		mg/Kg-dry	1	10/14/02 1:39:09 AM
Chromium	4.5	1.4		mg/Kg-dry	1	10/14/02 1:39:09 AM
Copper	4.7	3.5		mg/Kg-dry	1	10/14/02 1:39:09 AM
Lead	3.9	3.5		mg/Kg-dry	1	10/14/02 1:39:09 AM
Nickel	2.4	5.6	J	mg/Kg-dry	1	10/14/02 1:39:09 AM
Silver	ND	2.0		mg/Kg-dry	1	10/14/02 1:39:09 AM
Zinc	8.4	2.8		mg/Kg-dry	1	10/14/02 1:39:09 AM
MERCURY, 7471A		**SW7471A**				Analyst: **RK**
Mercury	ND	0.056		mg/Kg-dry	1	10/15/02 8:31:20 AM
SELENIUM, SOIL 3051/7740		**SW7740**				Analyst: **APL**
Selenium	ND	0.70		mg/Kg-dry	1	10/16/02

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
* - Value exceeds Maximum Contaminant Level
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range

AMRO Environmental Laboratories Corp.

Date: *16-Oct-02*

CLIENT: Maguire Group, Inc.
Project: 16421 NB Harbor FEIR

Lab Order: 0210114

Lab ID: 0210114-12
Client Sample ID: NBH-204-3-SED

Collection Date: 10/10/02
Matrix: SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
ICP METALS TOTAL SW-846 - 3051/6010		**SW6010B**				Analyst: **RK**
Arsenic	11	7.3		mg/Kg-dry	1	10/14/02 1:44:08 AM
Barium	2.6	29	J	mg/Kg-dry	1	10/14/02 1:44:08 AM
Cadmium	ND	0.73		mg/Kg-dry	1	10/14/02 1:44:08 AM
Chromium	8.7	1.5		mg/Kg-dry	1	10/14/02 1:44:08 AM
Copper	5.6	3.6		mg/Kg-dry	1	10/14/02 1:44:08 AM
Lead	4.0	3.6		mg/Kg-dry	1	10/14/02 1:44:08 AM
Nickel	8.0	5.8		mg/Kg-dry	1	10/14/02 1:44:08 AM
Silver	ND	2.0		mg/Kg-dry	1	10/14/02 1:44:08 AM
Zinc	20	2.9		mg/Kg-dry	1	10/14/02 1:44:08 AM
MERCURY, 7471A		**SW7471A**				Analyst: **RK**
Mercury	ND	0.061		mg/Kg-dry	1	10/15/02 8:33:54 AM
SELENIUM, SOIL 3051/7740		**SW7740**				Analyst: **APL**
Selenium	2.1	0.73	MSA	mg/Kg-dry	1	10/16/02

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
* - Value exceeds Maximum Contaminant Level
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range

AMRO Environmental Laboratories Corp.

Date: *16-Oct-02*

CLIENT: Maguire Group, Inc.
Project: 16421 NB Harbor FEIR

Lab Order: 0210114

Lab ID: 0210114-13
Client Sample ID: NBH-205-1-SED

Collection Date: 10/10/02
Matrix: SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
ICP METALS TOTAL SW-846 - 3051/6010		**SW6010B**				Analyst: **RK**
Arsenic	28	12		mg/Kg-dry	1	10/14/02 1:49:11 AM
Barium	49	49	J	mg/Kg-dry	1	10/14/02 1:49:11 AM
Cadmium	ND	1.2		mg/Kg-dry	1	10/14/02 1:49:11 AM
Chromium	52	2.5		mg/Kg-dry	1	10/14/02 1:49:11 AM
Copper	290	6.2		mg/Kg-dry	1	10/14/02 1:49:11 AM
Lead	140	6.2		mg/Kg-dry	1	10/14/02 1:49:11 AM
Nickel	18	9.9		mg/Kg-dry	1	10/14/02 1:49:11 AM
Silver	0.79	3.5	J	mg/Kg-dry	1	10/14/02 1:49:11 AM
Zinc	180	4.9		mg/Kg-dry	1	10/14/02 1:49:11 AM
MERCURY, 7471A		**SW7471A**				Analyst: **RK**
Mercury	0.62	0.11		mg/Kg-dry	1	10/15/02 8:36:27 AM
SELENIUM, SOIL 3051/7740		**SW7740**				Analyst: **APL**
Selenium	0.76	1.2	J	mg/Kg-dry	1	10/16/02

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
* - Value exceeds Maximum Contaminant Level
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range

AMRO Environmental Laboratories Corp.

Date: *16-Oct-02*

CLIENT: Maguire Group, Inc.
Project: 16421 NB Harbor FEIR

Lab Order: 0210114

Lab ID: 0210114-14
Collection Date: 10/10/02
Client Sample ID: NBH-205-2-SED
Matrix: SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
ICP METALS TOTAL SW-846 - 3051/6010		**SW6010B**				Analyst: **RK**
Arsenic	25	10		mg/Kg-dry	1	10/14/02 1:54:15 AM
Barium	16	41	J	mg/Kg-dry	1	10/14/02 1:54:15 AM
Cadmium	ND	1.0		mg/Kg-dry	1	10/14/02 1:54:15 AM
Chromium	23	2.0		mg/Kg-dry	1	10/14/02 1:54:15 AM
Copper	9.7	5.1		mg/Kg-dry	1	10/14/02 1:54:15 AM
Lead	7.7	5.1		mg/Kg-dry	1	10/14/02 1:54:15 AM
Nickel	12	8.1		mg/Kg-dry	1	10/14/02 1:54:15 AM
Silver	ND	2.8		mg/Kg-dry	1	10/14/02 1:54:15 AM
Zinc	35	4.1		mg/Kg-dry	1	10/14/02 1:54:15 AM
MERCURY, 7471A		**SW7471A**				Analyst: **RK**
Mercury	ND	0.083		mg/Kg-dry	1	10/15/02 8:39:01 AM
SELENIUM, SOIL 3051/7740		**SW7740**				Analyst: **APL**
Selenium	ND	1.0		mg/Kg-dry	1	10/16/02

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
* - Value exceeds Maximum Contaminant Level
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range

AMRO Environmental Laboratories Corp.

Date: *16-Oct-02*

CLIENT: Maguire Group, Inc.
Project: 16421 NB Harbor FEIR

Lab Order: 0210114

Lab ID: 0210114-15
Collection Date: 10/10/02
Client Sample ID: NBH-205-3-SED
Matrix: SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
ICP METALS TOTAL SW-846 - 3051/6010		**SW6010B**				Analyst: **RK**
Arsenic	15	9.1		mg/Kg-dry	1	10/14/02 1:59:41 AM
Barium	9.8	36	J	mg/Kg-dry	1	10/14/02 1:59:41 AM
Cadmium	ND	0.91		mg/Kg-dry	1	10/14/02 1:59:41 AM
Chromium	17	1.8		mg/Kg-dry	1	10/14/02 1:59:41 AM
Copper	6.4	4.5		mg/Kg-dry	1	10/14/02 1:59:41 AM
Lead	5.3	4.5		mg/Kg-dry	1	10/14/02 1:59:41 AM
Nickel	9.2	7.3		mg/Kg-dry	1	10/14/02 1:59:41 AM
Silver	ND	2.5		mg/Kg-dry	1	10/14/02 1:59:41 AM
Zinc	27	3.6		mg/Kg-dry	1	10/14/02 1:59:41 AM
MERCURY, 7471A		**SW7471A**				Analyst: **RK**
Mercury	ND	0.070		mg/Kg-dry	1	10/15/02 8:46:49 AM
SELENIUM, SOIL 3051/7740		**SW7740**				Analyst: **APL**
Selenium	ND	0.91		mg/Kg-dry	1	10/16/02

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
* - Value exceeds Maximum Contaminant Level
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range

AMRO Environmental Laboratories Corp.

Date: *16-Oct-02*

CLIENT: Maguire Group, Inc.
Project: 16421 NB Harbor FEIR
Lab Order: 0210114

Lab ID: 0210114-16
Collection Date: 10/10/02
Client Sample ID: NBH-205-4-SED
Matrix: SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
ICP METALS TOTAL SW-846 - 3051/6010		**SW6010B**				Analyst: **RK**
Arsenic	17	8.8		mg/Kg-dry	1	10/14/02 2:13:09 AM
Barium	9.4	35	J	mg/Kg-dry	1	10/14/02 2:13:09 AM
Cadmium	ND	0.88		mg/Kg-dry	1	10/14/02 2:13:09 AM
Chromium	16	1.8		mg/Kg-dry	1	10/14/02 2:13:09 AM
Copper	6.2	4.4		mg/Kg-dry	1	10/14/02 2:13:09 AM
Lead	4.8	4.4		mg/Kg-dry	1	10/14/02 2:13:09 AM
Nickel	8.8	7.1		mg/Kg-dry	1	10/14/02 2:13:09 AM
Silver	ND	2.5		mg/Kg-dry	1	10/14/02 2:13:09 AM
Zinc	32	3.5		mg/Kg-dry	1	10/14/02 2:13:09 AM
MERCURY, 7471A		**SW7471A**				Analyst: **RK**
Mercury	ND	0.069		mg/Kg-dry	1	10/15/02 8:49:24 AM
SELENIUM, SOIL 3051/7740		**SW7740**				Analyst: **APL**
Selenium	ND	0.88		mg/Kg-dry	1	10/16/02

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
* - Value exceeds Maximum Contaminant Level
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range

AMRO Environmental Laboratories Corp.

Date: *16-Oct-02*

CLIENT: Maguire Group, Inc.
Project: 16421 NB Harbor FEIR

Lab Order: 0210114

Lab ID: 0210114-17
Client Sample ID: NBH-206-1-SED

Collection Date: 10/10/02
Matrix: SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
ICP METALS TOTAL SW-846 - 3051/6010		**SW6010B**				Analyst: **RK**
Arsenic	35	16		mg/Kg-dry	1	10/14/02 2:18:13 AM
Barium	65	64		mg/Kg-dry	1	10/14/02 2:18:13 AM
Cadmium	0.84	1.6	J	mg/Kg-dry	1	10/14/02 2:18:13 AM
Chromium	250	3.2		mg/Kg-dry	1	10/14/02 2:18:13 AM
Copper	610	8.0		mg/Kg-dry	1	10/14/02 2:18:13 AM
Lead	250	8.0		mg/Kg-dry	1	10/14/02 2:18:13 AM
Nickel	32	13		mg/Kg-dry	1	10/14/02 2:18:13 AM
Silver	2.3	4.5	J	mg/Kg-dry	1	10/14/02 2:18:13 AM
Zinc	290	6.4		mg/Kg-dry	1	10/14/02 2:18:13 AM
MERCURY, 7471A		**SW7471A**				Analyst: **RK**
Mercury	2.0	0.13		mg/Kg-dry	1	10/15/02 8:52:00 AM
SELENIUM, SOIL 3051/7740		**SW7740**				Analyst: **APL**
Selenium	1.4	1.6	J	mg/Kg-dry	1	10/16/02

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
* - Value exceeds Maximum Contaminant Level
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range

AMRO Environmental Laboratories Corp.

Date: *16-Oct-02*

CLIENT: Maguire Group, Inc.
Project: 16421 NB Harbor FEIR
Lab Order: 0210114

Lab ID: 0210114-18
Collection Date: 10/10/02
Client Sample ID: NBH-206-2-SED
Matrix: SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
ICP METALS TOTAL SW-846 - 3051/6010		**SW6010B**				Analyst: **RK**
Arsenic	25	11		mg/Kg-dry	1	10/14/02 2:23:18 AM
Barium	18	44	J	mg/Kg-dry	1	10/14/02 2:23:18 AM
Cadmium	ND	1.1		mg/Kg-dry	1	10/14/02 2:23:18 AM
Chromium	27	2.2		mg/Kg-dry	1	10/14/02 2:23:18 AM
Copper	19	5.5		mg/Kg-dry	1	10/14/02 2:23:18 AM
Lead	17	5.5		mg/Kg-dry	1	10/14/02 2:23:18 AM
Nickel	14	8.8		mg/Kg-dry	1	10/14/02 2:23:18 AM
Silver	ND	3.1		mg/Kg-dry	1	10/14/02 2:23:18 AM
Zinc	47	4.4		mg/Kg-dry	1	10/14/02 2:23:18 AM
MERCURY, 7471A		**SW7471A**				Analyst: **RK**
Mercury	0.043	0.089	J	mg/Kg-dry	1	10/15/02 8:54:35 AM
SELENIUM, SOIL 3051/7740		**SW7740**				Analyst: **APL**
Selenium	0.64	1.1	J	mg/Kg-dry	1	10/16/02

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
* - Value exceeds Maximum Contaminant Level
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range

AMRO Environmental Laboratories Corp.

Date: *16-Oct-02*

CLIENT: Maguire Group, Inc.
Project: 16421 NB Harbor FEIR

Lab Order: 0210114

Lab ID: 0210114-19
Collection Date: 10/10/02
Client Sample ID: NBH-206-3-SED
Matrix: SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
ICP METALS TOTAL SW-846 - 3051/6010		**SW6010B**				Analyst: **RK**
Arsenic	29	11		mg/Kg-dry	1	10/14/02 2:28:23 AM
Barium	17	45	J	mg/Kg-dry	1	10/14/02 2:28:23 AM
Cadmium	ND	1.1		mg/Kg-dry	1	10/14/02 2:28:23 AM
Chromium	28	2.3		mg/Kg-dry	1	10/14/02 2:28:23 AM
Copper	9.0	5.6		mg/Kg-dry	1	10/14/02 2:28:23 AM
Lead	8.1	5.6		mg/Kg-dry	1	10/14/02 2:28:23 AM
Nickel	15	9.0		mg/Kg-dry	1	10/14/02 2:28:23 AM
Silver	ND	3.2		mg/Kg-dry	1	10/14/02 2:28:23 AM
Zinc	43	4.5		mg/Kg-dry	1	10/14/02 2:28:23 AM
MERCURY, 7471A		**SW7471A**				Analyst: **RK**
Mercury	ND	0.091		mg/Kg-dry	1	10/15/02 8:57:12 AM
SELENIUM, SOIL 3051/7740		**SW7740**				Analyst: **APL**
Selenium	0.52	1.1	J	mg/Kg-dry	1	10/16/02

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
* - Value exceeds Maximum Contaminant Level
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range

AMRO Environmental Laboratories Corp.

Date: *16-Oct-02*

CLIENT: Maguire Group, Inc.
Project: 16421 NB Harbor FEIR

Lab Order: 0210114

Lab ID: 0210114-20
Collection Date: 10/10/02
Client Sample ID: NBH-206-4-SED
Matrix: SEDIMENT

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
ICP METALS TOTAL SW-846 - 3051/6010		**SW6010B**				Analyst: **RK**
Arsenic	28	10		mg/Kg-dry	1	10/14/02 2:33:29 AM
Barium	15	40	J	mg/Kg-dry	1	10/14/02 2:33:29 AM
Cadmium	ND	1.0		mg/Kg-dry	1	10/14/02 2:33:29 AM
Chromium	26	2.0		mg/Kg-dry	1	10/14/02 2:33:29 AM
Copper	8.0	5.0		mg/Kg-dry	1	10/14/02 2:33:29 AM
Lead	7.2	5.0		mg/Kg-dry	1	10/14/02 2:33:29 AM
Nickel	14	8.0		mg/Kg-dry	1	10/14/02 2:33:29 AM
Silver	ND	2.8		mg/Kg-dry	1	10/14/02 2:33:29 AM
Zinc	39	4.0		mg/Kg-dry	1	10/14/02 2:33:29 AM
MERCURY, 7471A		**SW7471A**				Analyst: **RK**
Mercury	ND	0.083		mg/Kg-dry	1	10/15/02 8:59:49 AM
SELENIUM, SOIL 3051/7740		**SW7740**				Analyst: **APL**
Selenium	0.69	1.0	J	mg/Kg-dry	1	10/16/02

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
* - Value exceeds Maximum Contaminant Level
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range

AMRO Environmental Laboratories Corp.

Date: *01-Nov-02*

CLIENT: Maguire Group, Inc.
Work Order: 0210114
Project: 16421 NB Harbor FEIR

QC SUMMARY REPORT

Method Blank

Sample ID **MB-7884** Batch ID: **7884** Test Code: **SW6010B** Units: **mg/Kg** Analysis Date **10/14/02 12:02:34 AM** Prep Date **10/13/02**
Client ID: Run ID: **ICP-OPTIMA_021013A** SeqNo: **249542**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Arsenic	ND	5.0	mg/Kg	0	0	0	0	0	0			
Barium	ND	20	mg/Kg	0	0	0	0	0	0			
Cadmium	ND	0.50	mg/Kg	0	0	0	0	0	0			
Chromium	ND	1.0	mg/Kg	0	0	0	0	0	0			
Copper	ND	2.5	mg/Kg	0	0	0	0	0	0			
Lead	ND	2.5	mg/Kg	0	0	0	0	0	0			
Nickel	ND	4.0	mg/Kg	0	0	0	0	0	0			
Silver	ND	1.4	mg/Kg	0	0	0	0	0	0			
Zinc	ND	2.0	mg/Kg	0	0	0	0	0	0			

Sample ID **MB-7894** Batch ID: **7894** Test Code: **SW7471A** Units: **mg/Kg** Analysis Date **10/15/02 7:44:28 AM** Prep Date **10/14/02**
Client ID: Run ID: **HG-FIMS_021015A** SeqNo: **250064**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Mercury	ND	0.050	mg/Kg									

Sample ID **MB-7884** Batch ID: **7884** Test Code: **SW7740** Units: **mg/Kg** Analysis Date **10/16/02** Prep Date **10/13/02**
Client ID: Run ID: **GFAA-4100_021015A** SeqNo: **250595**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Selenium	ND	0.50	mg/Kg									

Qualifiers: ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank
NA - Not applicable where J values or ND results occur

AMRO Environmental Laboratories Corp.

Date: *01-Nov-02*

CLIENT: Maguire Group, Inc.
Work Order: 0210114
Project: 16421 NB Harbor FEIR

QC SUMMARY REPORT

Sample Matrix Spike

Sample ID **0210114-03AMS** Batch ID: **7884** Test Code: **SW6010B** Units: **mg/Kg-dry** Analysis Date **10/14/02 12:34:15 AM** Prep Date **10/13/02**
Client ID: **NBH-201-3-SED** Run ID: **ICP-OPTIMA_021013A** SeqNo: **249549**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Arsenic	250.9	6.5	mg/Kg-dry	260.9	10.77	92	75	125	0			
Barium	514.5	26	mg/Kg-dry	521.9	0	98.6	75	125	0			
Cadmium	102.5	0.65	mg/Kg-dry	104.4	0	98.2	75	125	0			
Chromium	518	1.3	mg/Kg-dry	521.9	3.317	98.6	75	125	0			
Copper	254.3	3.3	mg/Kg-dry	260.9	6.328	95	75	125	0			
Lead	253.8	3.3	mg/Kg-dry	260.9	2.249	96.4	75	125	0			
Nickel	512.5	5.2	mg/Kg-dry	521.9	1.74	97.9	75	125	0			
Silver	47.57	1.8	mg/Kg-dry	52.19	0	91.2	75	125	0			
Zinc	524.5	2.6	mg/Kg-dry	521.9	9.571	98.7	75	125	0			

Sample ID **0210114-03AMSD** Batch ID: **7884** Test Code: **SW6010B** Units: **mg/Kg-dry** Analysis Date **10/14/02 12:39:30 AM** Prep Date **10/13/02**
Client ID: **NBH-201-3-SED** Run ID: **ICP-OPTIMA_021013A** SeqNo: **249550**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Arsenic	255.2	6.5	mg/Kg-dry	259.7	10.77	94.1	75	125	250.9	1.71	20	
Barium	523.5	26	mg/Kg-dry	519.4	0	101	75	125	514.5	1.74	20	
Cadmium	104.7	0.65	mg/Kg-dry	103.9	0	101	75	125	102.5	2.12	20	
Chromium	527	1.3	mg/Kg-dry	519.4	3.317	101	75	125	518	1.72	20	
Copper	258	3.2	mg/Kg-dry	259.7	6.328	96.9	75	125	254.3	1.47	20	
Lead	257	3.2	mg/Kg-dry	259.7	2.249	98.1	75	125	253.8	1.26	20	
Nickel	522.9	5.2	mg/Kg-dry	519.4	1.74	100	75	125	512.5	2.02	20	
Silver	48.76	1.8	mg/Kg-dry	51.94	0	93.9	75	125	47.57	2.46	20	
Zinc	533.2	2.6	mg/Kg-dry	519.4	9.571	101	75	125	524.5	1.65	20	

Qualifiers: ND - Not Detected at the Reporting Limit
S - Spike Recovery outside accepted recovery limits
B - Analyte detected in the associated Method Blank
J - Analyte detected below quantitation limits
R - RPD outside accepted recovery limits
NA - Not applicable where J values or ND results occur
RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.

AMRO Environmental Laboratories Corp.

Date: *01-Nov-02*

CLIENT: Maguire Group, Inc.
Work Order: 0210114
Project: 16421 NB Harbor FEIR

QC SUMMARY REPORT

Sample Matrix Spike

Sample ID **0210114-03AMS** Batch ID: **7894** Test Code: **SW7471A** Units: **mg/Kg-dry** Analysis Date **10/15/02 7:57:19 AM** Prep Date **10/14/02**
Client ID: **NBH-201-3-SED** Run ID: **HG-FIMS_021015A** SeqNo: **250069**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Mercury	0.8701	0.051	mg/Kg-dry	0.848	0	103	75	125	0			

Sample ID **0210114-03AMSD** Batch ID: **7894** Test Code: **SW7471A** Units: **mg/Kg-dry** Analysis Date **10/15/02 7:59:54 AM** Prep Date **10/14/02**
Client ID: **NBH-201-3-SED** Run ID: **HG-FIMS_021015A** SeqNo: **250070**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Mercury	0.8837	0.051	mg/Kg-dry	0.8428	0	105	75	125	0.8701	1.56	20	

Sample ID **0210114-03AMS** Batch ID: **7884** Test Code: **SW7740** Units: **mg/Kg-dry** Analysis Date **10/16/02** Prep Date **10/13/02**
Client ID: **NBH-201-3-SED** Run ID: **GFAA-4100_021015A** SeqNo: **250596**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Selenium	236.5	33	mg/Kg-dry	208.8	0	113	75	125	0			

Sample ID **0210114-03AMSD** Batch ID: **7884** Test Code: **SW7740** Units: **mg/Kg-dry** Analysis Date **10/16/02** Prep Date **10/13/02**
Client ID: **NBH-201-3-SED** Run ID: **GFAA-4100_021015A** SeqNo: **250597**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Selenium	232.6	32	mg/Kg-dry	207.8	0	112	75	125	236.5	1.65	20	

Qualifiers: ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank
NA - Not applicable where J values or ND results occur

AMRO Environmental Laboratories Corp.

Date: *01-Nov-02*

CLIENT: Maguire Group, Inc.
Work Order: 0210114
Project: 16421 NB Harbor FEIR

QC SUMMARY REPORT

Laboratory Control Spike

Sample ID **LCS-7884** Batch ID: **7884** Test Code: **SW6010B** Units: **mg/Kg** Analysis Date **10/14/02 12:14:07 AM** Prep Date **10/13/02**
Client ID: Run ID: **ICP-OPTIMA_021013A** SeqNo: **249545**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Arsenic	189.4	5.0	mg/Kg	200	0	94.7	80	120	0			
Barium	400.7	20	mg/Kg	400	0	100	80	120	0			
Cadmium	80.08	0.50	mg/Kg	80	0	100	80	120	0			
Chromium	411.6	1.0	mg/Kg	400	0	103	80	120	0			
Copper	185.9	2.5	mg/Kg	200	0	92.9	80	120	0			
Lead	195.7	2.5	mg/Kg	200	0	97.8	80	120	0			
Nickel	400.8	4.0	mg/Kg	400	0	100	80	120	0			
Silver	37.28	1.4	mg/Kg	40	0	93.2	80	120	0			
Zinc	393.7	2.0	mg/Kg	400	0	98.4	80	120	0			

Sample ID **LCS-7894** Batch ID: **7894** Test Code: **SW7471A** Units: **mg/Kg** Analysis Date **10/15/02 7:47:01 AM** Prep Date **10/14/02**
Client ID: Run ID: **HG-FIMS_021015A** SeqNo: **250065**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Mercury	0.8723	0.050	mg/Kg	0.833	0	105	80	120	0			

Sample ID **LCS-7884** Batch ID: **7884** Test Code: **SW7740** Units: **mg/Kg** Analysis Date **10/16/02** Prep Date **10/13/02**
Client ID: Run ID: **GFAA-4100_021015A** SeqNo: **250598**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Selenium	192.2	25	mg/Kg	160	0	120	80	120	0			

Qualifiers: ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank
NA - Not applicable where J values or ND results occur

AMRO Environmental Laboratories Corporation

111 Herrick Street, Merrimack, NH 03054
TEL: (603) 424-2022 · FAX: (603) 429-8496

December 06, 2002

Tom Hevner
Maguire Group, Inc.
225 Foxborough Boulevard
Foxborough, MA 02035
TEL: (508) 543-1700
FAX: (508) 543-5157

RE: 16421 NBH FEIR DMMP

Workorder No.: 0210204

Dear Tom Hevner:

AMRO Environmental Laboratories Corp. received 1 sample on 10/22/02 for the analyses presented in the following report.

AMRO operates a Quality Assurance Program which meets or exceeds National Environmental Laboratory Accreditation Conference (NELAC), state, and EPA requirements. A copy of the appropriate state and/or NELAC Certificate is attached.

The enclosed Sample Receipt Checklist details the condition of your sample(s) upon receipt. Please be advised that any unused sample volume and sample extracts will be stored for a period of 60 days from sample receipt date (90 days for samples from New York). After this time, AMRO will properly dispose of the remaining sample(s). If you require further analysis, or need the samples held for a longer period, please contact us immediately.

This report consists of a total of 69 pages. This letter is an integral part of your data report. All results in this project relate only to the sample(s) as received by the laboratory and documented in the Chain-of-Custody. This report shall not be reproduced except in full, without the written approval of the laboratory. If you have any questions regarding this project in the future, please refer to the Workorder Number above.

Sincerely,

Nancy Stewart
Vice President/LabDirector

AMRO Environmental Laboratories Corp.

Date: *21-Nov-02*

CLIENT: Maguire Group, Inc.
Project: 16421 NBH FEIR DMMP
Lab Order: 0210204
Date Received: 10/22/02

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Collection Date
0210204-01A	NBH-208-WATER	10/22/02
0210204-01B	NBH-208-WATER	10/22/02
0210204-01C	NBH-208-WATER	10/22/02
0210204-01D	NBH-208-WATER	10/22/02
0210204-01E	NBH-208-WATER	10/22/02
0210204-01F	NBH-208-WATER	10/22/02
0210204-01G	NBH-208-WATER	10/22/02
0210204-01H	NBH-208-WATER	10/22/02
0210204-01I	NBH-208-WATER	10/22/02

AMRO Environmental Laboratories Corp.

21-Nov-02

Lab Order: 0210204
Client: Maguire Group, Inc.
Project: 16421 NBH FEIR DMMP

DATES REPORT

Sample ID	Client Sample ID	Collection Date	Matrix	Test Name	TCLP Date	Prep Date	Analysis Date	Batch ID
0210204-01A	NBH-208-WATER	10/22/02	Surface Water	COD, High Level			10/31/02	R16191
0210204-01B				BOD			10/23/02	R16140
0210204-01C				Solids, Total (Aqueous)			10/29/02	R16180
0210204-01D				PAH BY EPA 8270C		10/29/02	10/31/02	7977
0210204-01E				ORGANOCHLORINE PESTICIDES		10/29/02	10/30/02	7982
0210204-01F				ARSENIC, Total		10/28/02	10/28/02	7969
				ARSENIC, Total		10/28/02	10/28/02	7969
				ICP METALS, TOTAL		10/28/02	10/29/02	7969
				LEAD, Total		10/28/02	10/28/02	7969
				LEAD, Total		10/28/02	10/28/02	7969
				MERCURY, Total		10/25/02	10/28/02	7965
				SELENIUM, Total		10/28/02	10/28/02	7969
				SELENIUM, Total		10/28/02	10/28/02	7969

AMRO Environmental Laboratories Corporation
111 Herrick Street
Merrimack, NH 03054

CHAIN-OF-CUSTODY RECORD

42957

Office: (603) 424-2022
Fax: (603) 429-8496

Project No.: 16421	Project Name: NBH FEIR DMMP	Project Manager: TBH	Samplers (Signature): TBH/HM	AMRO Project No.: 0210204.
	Project State: MA			

Sample ID	Date/Time Sampled	Matrix (A= Air, S= Soil, GW= Ground W., WW= Waste W., DW= Drinking W., O= Oil, Other= Specify)	Total # of Cont. & Size	Comp	Grab	Dioxin/Furans 8280	RCRA(8) Metals	Ni, Zn, Cu	PCBs Congeners	Pest 8081	PAH 8270	TOC	% Total Solids	BOD	COD				Remarks
NBH-208-Water	10/22/02	SW	18		X	X	X	X	X	X	X	X	X	X	X				11:20AM
																			Std TAT

Preservative: Cl-HCl, MeOH, N-HN03, S-H2SO4, Na-NaOH, O- Other
Container Type: P- Plastic, G-Glass, V-Vial, T- Teflon, O-Other

Send Results To:	FAX No.:	Seal Intact?	P.O. No:	GW-1* GW-2 GW-3
Tom Hevner, Maguire Group, Inc., Foxboro, MA	508-543-5157	Yes No N/A		MCP Level Needed:
		Results Needed By:		*= May require additional cost

Relinquished By	Date/ Time	Received By
TBH	10/22/02 1420	[illegible]
[illegible]	10/23/02 1630	[illegible]

PRIORITY TURNAROUND TIME AUTHORIZATION
Before submitting samples for expedited TAT, you must have requested in advance and received a coded **AUTHORIZATION NUMBER.**
Samples arriving after 12:00 noon will be tracked and billed as received on the following day.
AUTHORIZATION No. _____ **BY:** _____

Please print clearly, legibly and completely. Samples can not be logged in and the turnaround time clock will not start until any ambiguities are resolved.

NOTES: Preservatives, Special reporting limits, Known Contamination, etc;
SW - Surface Water

AMRO policy requires notification in writing to the laboratory in cases where the samples were collected from highly contaminated sites.

White: Lab Copy Yellow: Accompanies Report Pink: Client Copy **SHEET** **OF**

AMRO Environmental Laboratories Corporation

SAMPLE RECEIPT CHECKLIST

111 Herrick Street
Merrimack, NH 03054
(603) 424-2022

Client: Maguire
Project Name: 16421 NBH Fair DMMP
Ship via: (circle one) Fed Ex., UPS, AMRO Courier, Hand Del., Other Courier, Other:

AMRO ID: 02102204.
Date Rec.: 10-22-02
Date Due: 11-01-02

Items to be Checked Upon Receipt	Yes	No	NA	Comments
1. Army Samples received in individual plastic bags?			✓	
2. Custody Seals present?			✓	
3. Custody Seals Intact?			✓	
4. Air Bill included in folder if received?			✓	
5. Is COC included with samples?	✓			
6. Is COC signed and dated by client?	✓			
7. Laboratory receipt temperature. TEMP = 4°				
Samples rec. with ice ✓ ice packs___ neither___				
8. Were samples received the same day they were sampled?	✓			
Is client temperature 4°C ± 2°C?	✓			
If no obtain authorization from the client for the analyses.				
Client authorization from: Date: Obtained by:				
9. Is the COC filled out correctly and completely?	✓			
10. Does the info on the COC match the samples?	✓	✓		No Date on bottles.
11. Were samples rec. within holding time?	✓			No Date on bottles.
* 12. Were all samples properly labeled?		✓		4x1LGAL for Dioxin - None for PCB-cong using 2x1L for PC
13. Were all samples properly preserved?	✓			
14. Were proper sample containers used?	✓			
15. Were all samples received intact? (none broken or leaking)	✓			
16. Were VOA vials rec. with no air bubbles?	✓			
* 17. Were the sample volumes sufficient for requested analysis?		✓		
* 18. Were all samples received?	✓			
19. VPH and VOA Soils only:			✓	
Sampling Method VPH (circle one): M=Methanol, E=EnCore (air-tight container)				
Sampling Method VOA (circle one): M=Methanol, SB=Sodium Bisulfate, E=EnCore, B=Bulk				
If M or SB:				
Does preservative cover the soil?				
If NO then client must be faxed.				
Does preservation level come close to the fill line on the vial?				
If NO then client must be faxed.				
Were vials provided by AMRO?				
If NO then weights MUST be obtained from client				
Was dry weight aliquot provided?				
If NO then fax client and inform the VOA lab ASAP.				
20. Subcontracted Samples:	✓			
What samples sent: 01G, 01H, 01I				
Where sent: STL Billerica.				
Date: 10/23/02 AMRO courier.				
Analysis: 01G = TOC, 01H PCBcong, 01I Dioxin.				
TAT: STD				
21. Information entered into:				
Internal Tracking Log?	✓			
Dry Weight Log?			✓	
Client Log?			✓	
Composite Log?			✓	
Filtration Log?			✓	

Received By: GG Date: 10-22-02 Logged in By: GE Date: 10-23-02
Labeled By: GC Date: 10-23-02 Checked By: [illegible] Date: 10-24-02

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NA= Not Applicable

AMRO Environmental
Laboratories Corporation

111 Herrick Street
Merrimack, NH 03054
(603) 424-2022

Please Circle if:
Sample= Soil
Sample= Waste

AMRO ID: 0210204-

Sample ID	Analysis	Volume Sample	Preserv. Listed	Initial pH	Acceptable? Y or N	List Preserv. Added by AMRO	Solution ID # of Preserv.	Volume Preservative Added	Final adjusted pH
01A	COD	2x250ml	H_2SO_4	<2	Y				
B	BOD.	1x1LPU.	—	7	Y				
C	TS	1x250ml	—	7	Y				
D	8270 PAH	3x1LGAU.	—	7	Y				
E	Post 8081.	3x1LGAU	—	7	Y				
F	RCRA 8.	1x500ml	HNO_3	<2	Y				
G	TOC.	2x40ml.	H_2SO_4	—	Y				
H	PCB Congeners	2x1LGAU	—	7	Y				
I	Dioxin.	2x1LGAU	—	7	Y				

pH Checked By: GG Date: 10/23/02 pH adjusted By: Date:

The Commonwealth of Massachusetts

Department of Environmental Protection

Division of Environmental Analysis
Senator William X. Wall Experiment Station

certifies

M- NH012

AMRO ENVIRONMENTAL LAB
111 HERRICK ST
MERRIMACK, NH 03054-0000

Laboratory Director: **Nancy Stewart**

for the analysis of **NON POTABLE WATER (CHEMISTRY)**
POTABLE WATER (CHEMISTRY)

pursuant to 310 CMR 42.00

This certificate supersedes all previous Massachusetts certificates issued to this laboratory. The laboratory is regulated by and shall be responsible for being in compliance with Massachusetts regulations at 310 CMR 42.00.

This certificate is valid only when accompanied by the latest dated Certified Parameter List as issued by the Massachusetts D.E.P. Contact the Division of Environmental Analysis to verify the current certification status of the laboratory.

Certification is no guarantee of the validity of the data. This certification is subject to unannounced laboratory inspections.

Issued: **01 JUL 2002**
Expires: **30 JUN 2003**

Director, Division of Environmental Analysis

COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Certified Parameter List as of: 15 OCT 2002

M- NH012 AMRO ENVIRONMENTAL LAB
MERRIMACK NH

NON POTABLE WATER (CHEMISTRY) Effective Date 15 OCT 2002 Expiration Date 30 JUN 2003

Analytes and Methods

ALUMINUM	EPA 200.7	ORTHOPHOSPHATE	EPA 300.0
ANTIMONY	EPA 200.7	TOTAL PHOSPHORUS	EPA 365.2
ANTIMONY	EPA 204.2	CHEMICAL OXYGEN DEMAND	EPA 410.4
ARSENIC	EPA 200.7	BIOCHEMICAL OXYGEN DEMAND	EPA 405.1
ARSENIC	EPA 206.2	TOTAL CYANIDE	EPA 335.2
ARSENIC	ASTM D2972-93(C)	NON-FILTERABLE RESIDUE	EPA 160.2
BERYLLIUM	EPA 200.7	OIL AND GREASE	EPA 413.1
CADMIUM	EPA 200.7	TOTAL PHENOLICS	EPA 420.1
CHROMIUM	EPA 200.7	VOLATILE HALOCARBONS	EPA 624
COBALT	EPA 200.7	VOLATILE AROMATICS	EPA 624
COPPER	EPA 200.7	CHLORDANE	EPA 608
IRON	EPA 200.7	ALDRIN	EPA 608
LEAD	EPA 200.7	DIELDRIN	EPA 608
LEAD	EPA 239.2	DDD	EPA 608
MANGANESE	EPA 200.7	DDT	EPA 608
MERCURY	EPA 245.1	HEPTACHLOR	EPA 608
MOLYBDENUM	EPA 200.7	HEPTACHLOR EPOXIDE	EPA 608
NICKEL	EPA 200.7	POLYCHLORINATED BIPHENYLS (WATER)	EPA 608
SELENIUM	EPA 200.7		
SELENIUM	EPA 270.2		
SILVER	EPA 200.7		
THALLIUM	EPA 279.2		
ZINC	EPA 200.7		
PH	EPA 150.1		
SPECIFIC CONDUCTIVITY	EPA 120.1		
TOTAL DISSOLVED SOLIDS	EPA 160.1		
TOTAL HARDNESS (CACO3)	EPA 200.7		
CALCIUM	EPA 200.7		
MAGNESIUM	EPA 200.7		
SODIUM	EPA 200.7		
POTASSIUM	EPA 200.7		
TOTAL ALKALINITY	EPA 310.1		
TOTAL ALKALINITY	EPA 310.2		
CHLORIDE	EPA 325.3		
CHLORIDE	EPA 300.0		
FLUORIDE	EPA 300.0		
SULFATE	EPA 300.0		
AMMONIA-N	EPA 350.2		
NITRATE-N	EPA 300.0		
NITRATE-N	EPA 353.2		
KJELDAHL-N	EPA 351.1		
ORTHOPHOSPHATE	EPA 365.2		

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COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Certified Parameter List as of: 15 OCT 2002

M- NH012 AMRO ENVIRONMENTAL LAB
MERRIMACK NH

POTABLE WATER (CHEMISTRY) Effective Date 09 SEP 2002 Expiration Date 30 JUN 2003

Analytes and Methods	
ANTIMONY	EPA 200.9
ARSENIC	EPA 200.7
ARSENIC	EPA 200.9
BARIUM	EPA 200.7
BERYLLIUM	EPA 200.7
CADMIUM	EPA 200.7
CHROMIUM	EPA 200.7
COPPER	EPA 200.7
LEAD	EPA 200.9
MERCURY	EPA 245.1
NICKEL	EPA 200.7
SELENIUM	EPA 200.9
THALLIUM	EPA 200.9
NITRATE-N	EPA 353.2
NITRITE-N	EPA 353.2
FLUORIDE	EPA 300.0
SODIUM	EPA 200.7
SULFATE	EPA 300.0
CYANIDE	SM 4500-CN-C,E
TURBIDITY	EPA 180.1
CALCIUM	EPA 200.7
TOTAL ALKALINITY	SM 2320B
TOTAL DISSOLVED SOLIDS	SM 2540C
PH	EPA 150.1
1,2-DIBROMOETHANE	EPA 504.1
1,2-DIBROMO-3-CHLOROPROPANE	EPA 504.1

CASE NARRATIVE
0210204

GENERAL

1. No QC deviations were observed.

GC/MS-SEMIVOLATILES-PAH
WATER

1. The surrogate Nitrobenzene-d5 recovered slightly below the laboratory control limits (38-118%) in sample NBH-208-WATER (0210204-01D) at 36.8%.

2. No Matrix Spike Duplicate (MSD) was performed due to insufficient sample volume. A batch Laboratory Control Sample (LCS-7977) and Laboratory Control Duplicate Sample (LCSD-7977) were performed.

3. No other QC deviations were observed.

GC/ECD-PESTICIDES
WATER

1. The %difference (%D) for Delta-BHC in the opening and closing Continuing Calibration Verification (CCV) standards analyzed on 10/30/02 (T22 + T23) on instrument Trent exceeded the ±15% limit. The laboratory used the average percent difference for all analytes as per SW-846 Method 8081A Section 7.5. All results were reported from the rear column (CLP Pesticide 2, 0.32mm). Please refer to the Continuing Calibration Summary Form in the Pesticide Section. This analyte was not detected in any associated samples.

2. No batch Matrix Spike (MS) or Matrix Spike Duplicate (MSD) was performed due to insufficient sample volume. A full list Laboratory Control Sample (LCS) and Laboratory Control Duplicate Sample (LCSD) were analyzed for Batch ID: 7982 per client request. All %REC's and %RPD's were within laboratory control limits with the following exceptions:

   2.1 Endrin ketone and Endosulfan sulfate recovered above the laboratory control limits in both the LCS and LCSD. These analytes were not detected in any associated samples.

3. No other QC deviations were observed.

TRACE METALS AND WET CHEMISTRY
WATER

1. Lead was detected in the batch Method Blank (MB-7969) at 1.244 µg/L below the laboratory reporting limit 5.0 µg/L.

2. No other QC deviations were observed.

AMRO Environmental Laboratories Corp.

Date: *21-Nov-02*

CLIENT:	Maguire Group, Inc.	**Client Sample ID:**	NBH-208-WATER
Lab Order:	0210204		
Project:	16421 NBH FEIR DMMP	**Collection Date:**	10/22/02
Lab ID:	0210204-01D	**Matrix:**	SURFACE WATER

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
PAH BY EPA 8270C		**SW8270C**				Analyst: **KD**
Naphthalene	ND	10		µg/L	1	10/31/02 11:07:00 PM
2-Methylnaphthalene	ND	10		µg/L	1	10/31/02 11:07:00 PM
Acenaphthylene	ND	10		µg/L	1	10/31/02 11:07:00 PM
Acenaphthene	ND	10		µg/L	1	10/31/02 11:07:00 PM
Fluorene	ND	10		µg/L	1	10/31/02 11:07:00 PM
Phenanthrene	ND	10		µg/L	1	10/31/02 11:07:00 PM
Anthracene	ND	10		µg/L	1	10/31/02 11:07:00 PM
Fluoranthene	ND	10		µg/L	1	10/31/02 11:07:00 PM
Pyrene	ND	10		µg/L	1	10/31/02 11:07:00 PM
Benz(a)anthracene	ND	10		µg/L	1	10/31/02 11:07:00 PM
Chrysene	ND	10		µg/L	1	10/31/02 11:07:00 PM
Benzo(b)fluoranthene	ND	10		µg/L	1	10/31/02 11:07:00 PM
Benzo(k)fluoranthene	ND	10		µg/L	1	10/31/02 11:07:00 PM
Benzo(a)pyrene	ND	10		µg/L	1	10/31/02 11:07:00 PM
Dibenz(a,h)anthracene	ND	10		µg/L	1	10/31/02 11:07:00 PM
Indeno(1,2,3-cd)pyrene	ND	10		µg/L	1	10/31/02 11:07:00 PM
Benzo(g,h,i)perylene	ND	10		µg/L	1	10/31/02 11:07:00 PM
Surr: Nitrobenzene-d5	36.8	38-118	S	%REC	1	10/31/02 11:07:00 PM
Surr: 2-Fluorobiphenyl	39.8	39-109		%REC	1	10/31/02 11:07:00 PM
Surr: 4-Terphenyl-d14	47.4	39-128		%REC	1	10/31/02 11:07:00 PM

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
H - Method prescribed holding time exceeded
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range
- See Case Narrative
RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.

AMRO Environmental Laboratories Corp.

Date: *02-Dec-02*

CLIENT: Maguire Group, Inc.
Work Order: 0210204
Project: 16421 NBH FEIR DMMP

QC SUMMARY REPORT

Method Blank

Sample ID **MB-7977** Batch ID: **7977** Test Code: **SW8270C** Units: **µg/L** Analysis Date **10/31/02 6:27:00 PM** Prep Date **10/29/02**

Client ID: Run ID: **SV-3_021031A** SeqNo: **254822**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Naphthalene	ND	5.0	µg/L									
2-Methylnaphthalene	ND	5.0	µg/L									
Acenaphthylene	ND	5.0	µg/L									
Acenaphthene	ND	5.0	µg/L									
Fluorene	ND	5.0	µg/L									
Phenanthrene	ND	5.0	µg/L									
Anthracene	ND	5.0	µg/L									
Fluoranthene	ND	5.0	µg/L									
Pyrene	ND	5.0	µg/L									
Benz(a)anthracene	ND	5.0	µg/L									
Chrysene	ND	5.0	µg/L									
Benzo(b)fluoranthene	ND	5.0	µg/L									
Benzo(k)fluoranthene	ND	5.0	µg/L									
Benzo(a)pyrene	ND	5.0	µg/L									
Dibenz(a,h)anthracene	ND	5.0	µg/L									
Indeno(1,2,3-cd)pyrene	ND	5.0	µg/L									
Benzo(g,h,i)perylene	ND	5.0	µg/L									
Surr: Nitrobenzene-d5	48.63	1.0	µg/L	50	0	97.3	38	118	0			
Surr: 2-Fluorobiphenyl	49.07	1.0	µg/L	50	0	98.1	39	109	0			
Surr: 4-Terphenyl-d14	50.73	1.0	µg/L	50	0	101	39	128	0			

Qualifiers: ND - Not Detected at the Reporting Limit; S - Spike Recovery outside accepted recovery limits; B - Analyte detected in the associated Method Blank; J - Analyte detected below quantitation limits; R - RPD outside accepted recovery limits; NA - Not applicable where J values or ND results occur; RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.

AMRO Environmental Laboratories Corp.

Date: *02-Dec-02*

CLIENT: Maguire Group, Inc.
Work Order: 0210204
Project: 16421 NBH FEIR DMMP

QC SUMMARY REPORT

Sample Matrix Spike

Sample ID **0210204-01DMS** Batch ID: **7977** Test Code: **SW8270C** Units: **µg/L** Analysis Date **10/31/02 11:38:00 PM** Prep Date **10/29/02**

Client ID: **NBH-208-WATER** Run ID: **SV-3_021031A** SeqNo: **255670**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Acenaphthene	45.33	10	µg/L	50.51	0	89.8	31	115	0			
Pyrene	49.23	10	µg/L	50.51	0	97.5	40	116	0			
Surr: Nitrobenzene-d5	47.68	1.0	µg/L	50.51	0	94.4	38	118	0			
Surr: 2-Fluorobiphenyl	48.46	1.0	µg/L	50.51	0	96	39	109	0			
Surr: 4-Terphenyl-d14	50.59	1.0	µg/L	50.51	0	100	39	128	0			

Qualifiers: ND - Not Detected at the Reporting Limit; S - Spike Recovery outside accepted recovery limits; B - Analyte detected in the associated Method Blank; J - Analyte detected below quantitation limits; R - RPD outside accepted recovery limits; NA - Not applicable where J values or ND results occur; RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.

AMRO Environmental Laboratories Corp.

Date: *02-Dec-02*

CLIENT: Maguire Group, Inc.
Work Order: 0210204
Project: 16421 NBH FEIR DMMP

QC SUMMARY REPORT

Laboratory Control Spike - Full List

Sample ID **LCSF-7977** Batch ID: **7977** Test Code: **SW8270C** Units: **µg/L** Analysis Date **10/31/02 6:58:00 PM** Prep Date **10/29/02**

Client ID: Run ID: **SV-3_021031A** SeqNo: **254824**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Naphthalene	42.75	10	µg/L	50	0	85.5	29	106	0			
2-Methylnaphthalene	44.43	10	µg/L	50	0	88.9	35	100	0			
Acenaphthylene	44.48	10	µg/L	50	0	89	40	111	0			
Acenaphthene	45.87	10	µg/L	50	0	91.7	46	103	0			
Fluorene	46.86	10	µg/L	50	0	93.7	45	114	0			
Phenanthrene	46.1	10	µg/L	50	0	92.2	49	115	0			
Anthracene	46.1	10	µg/L	50	0	92.2	51	118	0			
Fluoranthene	45.87	10	µg/L	50	0	91.7	64	109	0			
Pyrene	45.08	10	µg/L	50	0	90.2	55	109	0			
Benz(a)anthracene	45.61	10	µg/L	50	0	91.2	50	117	0			
Chrysene	45.42	10	µg/L	50	0	90.8	63	107	0			
Benzo(b)fluoranthene	44.14	10	µg/L	50	0	88.3	60	105	0			
Benzo(k)fluoranthene	49.91	10	µg/L	50	0	99.8	58	116	0			
Benzo(a)pyrene	46.49	10	µg/L	50	0	93	62	110	0			
Dibenz(a,h)anthracene	48.5	10	µg/L	50	0	97	62	113	0			
Indeno(1,2,3-cd)pyrene	46.86	10	µg/L	50	0	93.7	58	112	0			
Benzo(g,h,i)perylene	48.39	10	µg/L	50	0	96.8	61	109	0			
Surr: Nitrobenzene-d5	51.33	1.0	µg/L	50	0	103	38	118	0			
Surr: 2-Fluorobiphenyl	51.82	1.0	µg/L	50	0	104	39	109	0			
Surr: 4-Terphenyl-d14	50.06	1.0	µg/L	50	0	100	39	128	0			

Qualifiers: ND - Not Detected at the Reporting Limit; S - Spike Recovery outside accepted recovery limits; B - Analyte detected in the associated Method Blank; J - Analyte detected below quantitation limits; R - RPD outside accepted recovery limits; NA - Not applicable where J values or ND results occur; RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.

AMRO Environmental Laboratories Corp.

Date: *02-Dec-02*

CLIENT: Maguire Group, Inc.
Work Order: 0210204
Project: 16421 NBH FEIR DMMP

QC SUMMARY REPORT

Laboratory Control Spike Duplicate - Full List

Sample ID **LCSDF-7977** Batch ID: **7977** Test Code: **SW8270C** Units: **µg/L** Analysis Date **10/31/02 7:29:00 PM** Prep Date **10/29/02**

Client ID: Run ID: **SV-3_021031A** SeqNo: **254826**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Naphthalene	36.26	10	µg/L	50	0	72.5	29	106	42.75	16.4	50	
2-Methylnaphthalene	37.69	10	µg/L	50	0	75.4	35	100	44.43	16.4	50	
Acenaphthylene	38.29	10	µg/L	50	0	76.6	40	111	44.48	15	50	
Acenaphthene	39.98	10	µg/L	50	0	80	46	103	45.87	13.7	50	
Fluorene	41.13	10	µg/L	50	0	82.3	45	114	46.86	13	50	
Phenanthrene	40.05	10	µg/L	50	0	80.1	49	115	46.1	14	50	
Anthracene	39.62	10	µg/L	50	0	79.2	51	118	46.1	15.1	50	
Fluoranthene	40.04	10	µg/L	50	0	80.1	64	109	45.87	13.6	50	
Pyrene	38.76	10	µg/L	50	0	77.5	55	109	45.08	15.1	50	
Benz(a)anthracene	40.21	10	µg/L	50	0	80.4	50	117	45.61	12.6	50	
Chrysene	39.78	10	µg/L	50	0	79.6	63	107	45.42	13.2	50	
Benzo(b)fluoranthene	38.84	10	µg/L	50	0	77.7	60	105	44.14	12.8	50	
Benzo(k)fluoranthene	42.65	10	µg/L	50	0	85.3	58	116	49.91	15.7	50	
Benzo(a)pyrene	41.23	10	µg/L	50	0	82.5	62	110	46.49	12	50	
Dibenz(a,h)anthracene	41.26	10	µg/L	50	0	82.5	62	113	48.5	16.1	50	
Indeno(1,2,3-cd)pyrene	40.1	10	µg/L	50	0	80.2	58	112	46.86	15.5	50	
Benzo(g,h,i)perylene	40.42	10	µg/L	50	0	80.8	61	109	48.39	17.9	50	
Surr: Nitrobenzene-d5	41.85	1.0	µg/L	50	0	83.7	38	118	0	0	0	
Surr: 2-Fluorobiphenyl	43.64	1.0	µg/L	50	0	87.3	39	109	0	0	0	
Surr: 4-Terphenyl-d14	42.35	1.0	µg/L	50	0	84.7	39	128	0	0	0	

Qualifiers: ND - Not Detected at the Reporting Limit
S - Spike Recovery outside accepted recovery limits
B - Analyte detected in the associated Method Blank
J - Analyte detected below quantitation limits
R - RPD outside accepted recovery limits
NA - Not applicable where J values or ND results occur
RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.

AMRO Environmental Laboratories Corp.

Date: *21-Nov-02*

CLIENT:	Maguire Group, Inc.	**Client Sample ID:**	NBH-208-WATER
Lab Order:	0210204		
Project:	16421 NBH FEIR DMMP	**Collection Date:**	10/22/02
Lab ID:	0210204-01E	**Matrix:**	SURFACE WATER

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
ORGANOCHLORINE PESTICIDES		**SW8081A**				Analyst: **RAP**
alpha-BHC	ND	0.0065		µg/L	1	10/30/02 1:05:00 PM
beta-BHC	ND	0.0065		µg/L	1	10/30/02 1:05:00 PM
delta-BHC	ND	0.0065		µg/L	1	10/30/02 1:05:00 PM
gamma-BHC	ND	0.0065		µg/L	1	10/30/02 1:05:00 PM
Heptachlor	ND	0.0065		µg/L	1	10/30/02 1:05:00 PM
Aldrin	ND	0.0065		µg/L	1	10/30/02 1:05:00 PM
Heptachlor epoxide	ND	0.0065		µg/L	1	10/30/02 1:05:00 PM
Endosulfan I	ND	0.0065		µg/L	1	10/30/02 1:05:00 PM
alpha-Chlordane	ND	0.0065		µg/L	1	10/30/02 1:05:00 PM
gamma-Chlordane	ND	0.0065		µg/L	1	10/30/02 1:05:00 PM
Dieldrin	ND	0.013		µg/L	1	10/30/02 1:05:00 PM
4,4´-DDE	ND	0.013		µg/L	1	10/30/02 1:05:00 PM
Endrin	ND	0.013		µg/L	1	10/30/02 1:05:00 PM
Endosulfan II	ND	0.013		µg/L	1	10/30/02 1:05:00 PM
4,4´-DDD	ND	0.013		µg/L	1	10/30/02 1:05:00 PM
Endrin aldehyde	ND	0.013		µg/L	1	10/30/02 1:05:00 PM
Endrin ketone	ND	0.013		µg/L	1	10/30/02 1:05:00 PM
Endosulfan sulfate	ND	0.013		µg/L	1	10/30/02 1:05:00 PM
4,4´-DDT	ND	0.013		µg/L	1	10/30/02 1:05:00 PM
Methoxychlor	ND	0.065		µg/L	1	10/30/02 1:05:00 PM
Toxaphene	ND	0.20		µg/L	1	10/30/02 1:05:00 PM
Technical Chlordane	ND	0.20		µg/L	1	10/30/02 1:05:00 PM
Surr: Tetrachloro-m-xylene	65.6	29-124		%REC	1	10/30/02 1:05:00 PM
Surr: Decachlorobiphenyl	81.6	20-135		%REC	1	10/30/02 1:05:00 PM

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
H - Method prescribed holding time exceeded
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range
- See Case Narrative
RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.

CONTINUING CALIBRATION SUMMARY

Analysis Date: 30 Oct 2002 Analyst: rap

Instrument ID: TRENT

COLUMN ID: **FRONT** CLP Pesticide 1; 0.32mm **BACK** CLP Pesticide 2; 0.32mm

BREAKDOWN (1):

	Front		Back
DDT	1.4	DDT	2.7
ENDRIN	3.1	ENDRIN	2.5

Initial CCV: T22 Term. CCV: T23

INDA

	Front	Back	Front	Back
TCX	-13.4	-8.7	-12.8	-4.7
ALPHA-BHC	-9.8	-6.7	-9.2	-4.1
GAMMA-BHC	-6.7	-5.8	-5.9	-3.2
HEPTACHLOR	-9.2	-12.1	-11.4	-13.3
ENDOSULFAN I	-10.5	-7.4	-7.8	-7.9
DIELDRIN	-12.2	-2.5	-13.9	-10.8
ENDRIN	-5.3	-4.4	-3.9	-4.2
DDD	-6.4	-5.4	-1.9	-2.1
DDT	-2.7	1.8	-4.0	-3.7
METHOXYCHLOR	-2.1	6.1	2.1	7.0
DCB	-2.4	0.6	-5.8	-0.5

INDB

	Front		Back		Front		Back	
TCX	-14.0		-9.8		-13.5		-10.4	
ALDRIN	-14.4		-8.5		-14.8		-10.3	
BETA-BHC	-12.2		-11.3		-8.6		-9.1	
DELTA-BHC	54.1	*	17.3	*	52.7	*	20.3	*
HEPTACHLOR EPOXIDE	-12.4		-13.0		-11.4		-11.3	
GAMMA-CHLORDANE	-18.6	*	-10.2		-12.5		-9.9	
ALPHA-CHLORDANE	-13.1		-10.0		-11.8		-9.8	
DDE	-19.4	*	-12.8		-15.5	*	-8.4	
ENDOSULFAN II	-9.3		-4.0		-9.3		-2.9	
ENDRIN ALDEHYDE	-13.2		-4.9		-3.7		2.2	
ENDOSULFAN SULFATE	69.8	*	8.9		76.1	*	6.9	
ENDRIN KETONE	95.8	*	7.7		112.9	*	9.0	
DCB	0.4		5.7		-2.9		-2.7	
Ave. %Drift for all analytes (2):	17.8		7.7		17.7		7.3	

Data Files		PEM:	C:\HPCHEM\1\DATA\02OCT30\T30OCT03.D
1st INDA:	C:\HPCHEM\1\DATA\02OCT30\T30OCT01.D	2nd INDA:	C:\HPCHEM\1\DATA\02OCT30\T30OCT08.D
1st INDB:	C:\HPCHEM\1\DATA\02OCT30\T30OCT02.D	2nd INDB:	C:\HPCHEM\1\DATA\02OCT30\T30OCT09.D

Notes:
1. 4,4' DDT and Endrin maximum degradation = 15%
2. Ave %Drift maximum = 15%

AMRO Environmental Laboratories Corp.

Date: *02-Dec-02*

CLIENT: Maguire Group, Inc.
Work Order: 0210204
Project: 16421 NBH FEIR DMMP

QC SUMMARY REPORT

Method Blank

Sample ID **MB-7982** Batch ID: **7982** Test Code: **SW8081A** Units: **µg/L** Analysis Date **10/30/02 11:42:00 AM** Prep Date **10/29/02**

Client ID: Run ID: **GC-TRENT_021030A** SeqNo: **254264**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
alpha-BHC	ND	0.0064	µg/L									
beta-BHC	ND	0.0064	µg/L									
delta-BHC	ND	0.0064	µg/L									
gamma-BHC	ND	0.0064	µg/L									
Heptachlor	ND	0.0064	µg/L									
Aldrin	ND	0.0064	µg/L									
Heptachlor epoxide	ND	0.0064	µg/L									
Endosulfan I	ND	0.0064	µg/L									
alpha-Chlordane	ND	0.0064	µg/L									
gamma-Chlordane	ND	0.0064	µg/L									
Dieldrin	ND	0.013	µg/L									
4,4´-DDE	ND	0.013	µg/L									
Endrin	ND	0.013	µg/L									
Endosulfan II	ND	0.013	µg/L									
4,4´-DDD	ND	0.013	µg/L									
Endrin aldehyde	ND	0.013	µg/L									
Endrin ketone	ND	0.013	µg/L									
Endosulfan sulfate	ND	0.013	µg/L									
4,4´-DDT	ND	0.013	µg/L									
Methoxychlor	ND	0.064	µg/L									
Toxaphene	ND	0.20	µg/L									
Technical Chlordane	ND	0.20	µg/L									
Surr: Tetrachloro-m-xylene	0.04645	0	µg/L	0.064	0	72.6	29	124	0			
Surr: Decachlorobiphenyl	0.0632	0	µg/L	0.064	0	98.8	20	135	0			

Qualifiers: ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank
NA - Not applicable where J values or ND results occur

AMRO Environmental Laboratories Corp.

Date: *02-Dec-02*

CLIENT: Maguire Group, Inc.
Work Order: 0210204
Project: 16421 NBH FEIR DMMP

QC SUMMARY REPORT

Laboratory Control Spike - Full List

Sample ID **LCSF-7982** Batch ID: **7982** Test Code: **SW8081A** Units: **µg/L** Analysis Date **10/30/02 12:10:00 PM** Prep Date **10/29/02**

Client ID: Run ID: **GC-TRENT_021030A** SeqNo: **254266**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
alpha-BHC	0.0934	0.0064	µg/L	0.08	0	117	50	130	0			
beta-BHC	0.07724	0.0064	µg/L	0.08	0	96.6	50	130	0			
delta-BHC	0.07703	0.0064	µg/L	0.08	0	96.3	50	130	0			
gamma-BHC	0.09051	0.0064	µg/L	0.08	0	113	44	152	0			
Heptachlor	0.0605	0.0064	µg/L	0.08	0	75.6	41	113	0			
Aldrin	0.08308	0.0064	µg/L	0.08	0	104	33	126	0			
Heptachlor epoxide	0.08113	0.0064	µg/L	0.08	0	101	50	130	0			
Endosulfan I	0.07882	0.0064	µg/L	0.08	0	98.5	50	130	0			
alpha-Chlordane	0.07181	0.0064	µg/L	0.08	0	89.8	50	130	0			
gamma-Chlordane	0.07244	0.0064	µg/L	0.08	0	90.6	50	130	0			
Dieldrin	0.08215	0.013	µg/L	0.08	0	103	53	125	0			
4,4´-DDE	0.08262	0.013	µg/L	0.08	0	103	50	130	0			
Endrin	0.09337	0.013	µg/L	0.08	0	117	55	145	0			
Endosulfan II	0.08603	0.013	µg/L	0.08	0	108	50	130	0			
4,4´-DDD	0.0882	0.013	µg/L	0.08	0	110	50	130	0			
Endrin aldehyde	0.08546	0.013	µg/L	0.08	0	107	50	130	0			
Endrin ketone	0.1163	0.013	µg/L	0.08	0	145	50	130	0			S
Endosulfan sulfate	0.1061	0.013	µg/L	0.08	0	133	50	130	0			S
4,4´-DDT	0.09325	0.013	µg/L	0.08	0	117	47	150	0			
Methoxychlor	0.09955	0.064	µg/L	0.08	0	124	50	130	0			
Surr: Tetrachloro-m-xylene	0.05019	0	µg/L	0.064	0	78.4	29	124	0			
Surr: Decachlorobiphenyl	0.06378	0	µg/L	0.064	0	99.7	20	135	0			

Qualifiers: ND - Not Detected at the Reporting Limit; S - Spike Recovery outside accepted recovery limits; B - Analyte detected in the associated Method Blank; J - Analyte detected below quantitation limits; R - RPD outside accepted recovery limits; NA - Not applicable where J values or ND results occur; RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.

AMRO Environmental Laboratories Corp.

Date: *02-Dec-02*

CLIENT: Maguire Group, Inc.
Work Order: 0210204
Project: 16421 NBH FEIR DMMP

QC SUMMARY REPORT

Laboratory Control Spike Duplicate - Full List

Sample ID **LCSDF-7982** Batch ID: **7982** Test Code: **SW8081A** Units: **µg/L** Analysis Date **10/30/02 12:38:00 PM** Prep Date **10/29/02**

Client ID: Run ID: **GC-TRENT_021030A** SeqNo: **254268**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
alpha-BHC	0.08066	0.0064	µg/L	0.08	0	101	50	130	0.0934	14.6	25	
beta-BHC	0.0695	0.0064	µg/L	0.08	0	86.9	50	130	0.07724	10.6	25	
delta-BHC	0.06852	0.0064	µg/L	0.08	0	85.7	50	130	0.07703	11.7	25	
gamma-BHC	0.0796	0.0064	µg/L	0.08	0	99.5	44	152	0.09051	12.8	25	
Heptachlor	0.05399	0.0064	µg/L	0.08	0	67.5	41	113	0.0605	11.4	25	
Aldrin	0.07394	0.0064	µg/L	0.08	0	92.4	33	126	0.08308	11.6	25	
Heptachlor epoxide	0.07533	0.0064	µg/L	0.08	0	94.2	50	130	0.08113	7.41	25	
Endosulfan I	0.07084	0.0064	µg/L	0.08	0	88.6	50	130	0.07882	10.7	25	
alpha-Chlordane	0.06736	0.0064	µg/L	0.08	0	84.2	50	130	0.07181	6.4	25	
gamma-Chlordane	0.06375	0.0064	µg/L	0.08	0	79.7	50	130	0.07244	12.8	25	
Dieldrin	0.07463	0.013	µg/L	0.08	0	93.3	53	125	0.08215	9.59	25	
4,4´-DDE	0.07706	0.013	µg/L	0.08	0	96.3	50	130	0.08262	6.97	25	
Endrin	0.08718	0.013	µg/L	0.08	0	109	55	145	0.09337	6.86	25	
Endosulfan II	0.07957	0.013	µg/L	0.08	0	99.5	50	130	0.08603	7.8	25	
4,4´-DDD	0.0814	0.013	µg/L	0.08	0	102	50	130	0.0882	8.02	25	
Endrin aldehyde	0.09218	0.013	µg/L	0.08	0	115	50	130	0.08546	7.57	25	
Endrin ketone	0.1092	0.013	µg/L	0.08	0	136	50	130	0.1163	6.27	25	S
Endosulfan sulfate	0.1043	0.013	µg/L	0.08	0	130	50	130	0.1061	1.69	25	S
4,4´-DDT	0.08699	0.013	µg/L	0.08	0	109	47	150	0.09325	6.95	25	
Methoxychlor	0.09802	0.064	µg/L	0.08	0	123	50	130	0.09955	1.54	25	
Surr: Tetrachloro-m-xylene	0.04271	0	µg/L	0.064	0	66.7	29	124	0	0	0	
Surr: Decachlorobiphenyl	0.05604	0	µg/L	0.064	0	87.6	20	135	0	0	0	

Qualifiers: ND - Not Detected at the Reporting Limit; S - Spike Recovery outside accepted recovery limits; B - Analyte detected in the associated Method Blank; J - Analyte detected below quantitation limits; R - RPD outside accepted recovery limits; NA - Not applicable where J values or ND results occur; RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.

AMRO Environmental Laboratories Corp.

Date: *21-Nov-02*

CLIENT: Maguire Group, Inc.
Project: 16421 NBH FEIR DMMP

Lab Order: 0210204

Lab ID: 0210204-01
Collection Date: 10/22/02
Client Sample ID: NBH-208-WATER
Matrix: SURFACE WATER

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
ICP METALS TOTAL SW-846		**SW6010B**				Analyst: **SJC**
Barium	ND	1,000		µg/L	5	10/29/02 1:19:30 PM
Cadmium	ND	25		µg/L	5	10/29/02 1:19:30 PM
Chromium	ND	50		µg/L	5	10/29/02 1:19:30 PM
Copper	ND	120		µg/L	5	10/29/02 1:19:30 PM
Nickel	ND	200		µg/L	5	10/29/02 1:19:30 PM
Silver	ND	35		µg/L	5	10/29/02 1:19:30 PM
Zinc	53	100	J	µg/L	5	10/29/02 1:19:30 PM
ARSENIC, TOTAL		**SW7060A**				Analyst: **APL**
Arsenic	4.2	5.0	J	µg/L	1	10/28/02 6:23:52 PM
MERCURY, TOTAL		**SW7470A**				Analyst: **RK**
Mercury	ND	0.20		µg/L	1	10/28/02 12:08:29 PM
LEAD, TOTAL		**SW7421**				Analyst: **APL**
Lead	4.7	5.0	J	µg/L	1	10/28/02 6:23:52 PM
SELENIUM, TOTAL		**SW7740**				Analyst: **APL**
Selenium	2.3	5.0	J	µg/L	1	10/28/02 6:23:52 PM

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
* - Value exceeds Maximum Contaminant Level
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range

AMRO Environmental Laboratories Corp.

Date: *21-Nov-02*

CLIENT: Maguire Group, Inc.
Project: 16421 NBH FEIR DMMP

Lab Order: 0210204

Lab ID: 0210204-01
Collection Date: 10/22/02
Client Sample ID: NBH-208-WATER
Matrix: SURFACE WATER

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
TOTAL SOLIDS		**E160.3**				Analyst: **GM**
Residue, Total	3.6	0.0010		%	1	10/29/02
BOD		**E405.1**				Analyst: **GM**
Biochemical Oxygen Demand	3.6	2.0		mg/L	1	10/23/02
COD, HIGH LEVEL		**E410.4**				Analyst: **GM**
Chemical Oxygen Demand	4,200	500		mg/L	10	10/31/02

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
* - Value exceeds Maximum Contaminant Level
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range

AMRO Environmental Laboratories Corp.

Date: *03-Dec-02*

CLIENT: Maguire Group, Inc.
Work Order: 0210204
Project: 16421 NBH FEIR DMMP

QC SUMMARY REPORT

Method Blank

Sample ID **MB-7969** Batch ID: **7969** Test Code: **SW6010B** Units: **µg/L** Analysis Date **10/29/02 11:37:52 AM** Prep Date **10/28/02**

Client ID: Run ID: **ICP-OPTIMA_021029A** SeqNo: **254029**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Barium	ND	200	µg/L									
Cadmium	ND	5.0	µg/L									
Chromium	ND	10	µg/L									
Copper	ND	25	µg/L									
Nickel	ND	40	µg/L									
Silver	ND	7.0	µg/L									
Zinc	ND	20	µg/L									

Qualifiers: ND - Not Detected at the Reporting Limit; S - Spike Recovery outside accepted recovery limits; B - Analyte detected in the associated Method Blank; J - Analyte detected below quantitation limits; R - RPD outside accepted recovery limits; NA - Not applicable where J values or ND results occur; RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.

AMRO Environmental Laboratories Corp.

Date: *03-Dec-02*

CLIENT: Maguire Group, Inc.
Work Order: 0210204
Project: 16421 NBH FEIR DMMP

QC SUMMARY REPORT

Method Blank

Sample ID **MB-7969** Batch ID: **7969** Test Code: **SW7060A** Units: **µg/L** Analysis Date **10/28/02 5:04:10 PM** Prep Date **10/28/02**
Client ID: Run ID: **GFAA-6000_021028A** SeqNo: **253754**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Arsenic	ND	5.0	µg/L									

Sample ID **MB-R16180** Batch ID: **R16180** Test Code: **E160.3** Units: **%** Analysis Date **10/29/02** Prep Date
Client ID: Run ID: **ING-WET_021029F** SeqNo: **254429**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Residue, Total	ND	0.0010	%									

Sample ID **MB-R16140** Batch ID: **R16140** Test Code: **E405.1** Units: **mg/L** Analysis Date **10/23/02** Prep Date
Client ID: Run ID: **ING-WET_021023B** SeqNo: **253623**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Biochemical Oxygen Demand	ND	2.0	mg/L									

Sample ID **MB-R16191** Batch ID: **R16191** Test Code: **E410.4** Units: **mg/L** Analysis Date **10/31/02** Prep Date
Client ID: Run ID: **ING-WET_021031A** SeqNo: **254546**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Chemical Oxygen Demand	ND	50	mg/L									

Qualifiers: ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank
NA - Not applicable where J values or ND results occur

AMRO Environmental Laboratories Corp.

Date: *03-Dec-02*

CLIENT: Maguire Group, Inc.
Work Order: 0210204
Project: 16421 NBH FEIR DMMP

QC SUMMARY REPORT

Method Blank

Sample ID **MB-7965** Batch ID: **7965** Test Code: **SW7470A** Units: **µg/L** Analysis Date **10/28/02 10:49:12 AM** Prep Date **10/25/02**
Client ID: Run ID: **HG-FIMS_021028A** SeqNo: **253632**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Mercury	ND	0.20	µg/L									

Sample ID **MB-7969** Batch ID: **7969** Test Code: **SW7421** Units: **µg/L** Analysis Date **10/28/02 5:04:10 PM** Prep Date **10/28/02**
Client ID: Run ID: **GFAA-6000_021028B** SeqNo: **253831**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Lead	1.244	5.0	µg/L									J

Sample ID **MB-7969** Batch ID: **7969** Test Code: **SW7740** Units: **µg/L** Analysis Date **10/28/02 5:04:10 PM** Prep Date **10/28/02**
Client ID: Run ID: **GFAA-6000_021028C** SeqNo: **253904**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Selenium	ND	5.0	µg/L									

Qualifiers: ND - Not Detected at the Reporting Limit; S - Spike Recovery outside accepted recovery limits; B - Analyte detected in the associated Method Blank; J - Analyte detected below quantitation limits; R - RPD outside accepted recovery limits; NA - Not applicable where J values or ND results occur; RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.

AMRO Environmental Laboratories Corp.

Date: *03-Dec-02*

CLIENT: Maguire Group, Inc.
Work Order: 0210204
Project: 16421 NBH FEIR DMMP

QC SUMMARY REPORT

Sample Duplicate

Sample ID **0210204-01CD** Batch ID: **R16180** Test Code: **E160.3** Units: **%** Analysis Date **10/29/02** Prep Date

Client ID: **NBH-208-WATER** Run ID: **ING-WET_021029F** SeqNo: **254432**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Residue, Total	3.945	0.0010	%	0	0	0	0	0	3.576	9.83	0	

Qualifiers: ND - Not Detected at the Reporting Limit
S - Spike Recovery outside accepted recovery limits
B - Analyte detected in the associated Method Blank
J - Analyte detected below quantitation limits
R - RPD outside accepted recovery limits
NA - Not applicable where J values or ND results occur
RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.

AMRO Environmental Laboratories Corp.

Date: *03-Dec-02*

CLIENT: Maguire Group, Inc.
Work Order: 0210204
Project: 16421 NBH FEIR DMMP

QC SUMMARY REPORT

Sample Matrix Spike

Sample ID **0210199-01AMS** Batch ID: **7969** Test Code: **SW6010B** Units: **µg/L** Analysis Date **10/29/02 11:58:02 AM** Prep Date **10/28/02**

Client ID: Run ID: **ICP-OPTIMA_021029A** SeqNo: **254034**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Barium	4047	200	µg/L	4000	0	101	75	125	0			
Cadmium	806.7	5.0	µg/L	800	0	101	75	125	0			
Chromium	4033	10	µg/L	4000	0	101	75	125	0			
Copper	1953	25	µg/L	2000	0	97.7	75	125	0			
Nickel	4070	40	µg/L	4000	0	102	75	125	0			
Silver	399.4	7.0	µg/L	400	0	99.8	75	125	0			
Zinc	4030	20	µg/L	4000	25.38	100	75	125	0			

Sample ID **0210199-01AMSD** Batch ID: **7969** Test Code: **SW6010B** Units: **µg/L** Analysis Date **10/29/02 12:02:56 PM** Prep Date **10/28/02**

Client ID: Run ID: **ICP-OPTIMA_021029A** SeqNo: **254035**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Barium	4064	200	µg/L	4000	0	102	75	125	4047	0.425	20	
Cadmium	805.9	5.0	µg/L	800	0	101	75	125	806.7	0.0919	20	
Chromium	4004	10	µg/L	4000	0	100	75	125	4033	0.723	20	
Copper	1970	25	µg/L	2000	0	98.5	75	125	1953	0.88	20	
Nickel	4063	40	µg/L	4000	0	102	75	125	4070	0.177	20	
Silver	398	7.0	µg/L	400	0	99.5	75	125	399.4	0.338	20	
Zinc	4039	20	µg/L	4000	25.38	100	75	125	4030	0.225	20	

Qualifiers: ND - Not Detected at the Reporting Limit; S - Spike Recovery outside accepted recovery limits; B - Analyte detected in the associated Method Blank; J - Analyte detected below quantitation limits; R - RPD outside accepted recovery limits; NA - Not applicable where J values or ND results occur; RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.

AMRO Environmental Laboratories Corp.

Date: *03-Dec-02*

CLIENT: Maguire Group, Inc.
Work Order: 0210204
Project: 16421 NBH FEIR DMMP

QC SUMMARY REPORT

Sample Matrix Spike

Sample ID **0210199-01AMS** Batch ID: **7969** Test Code: **SW7060A** Units: **µg/L** Analysis Date **10/28/02 5:33:22 PM** Prep Date **10/28/02**
Client ID: Run ID: **GFAA-6000_021028A** SeqNo: **253761**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Arsenic	54.68	5.0	µg/L	50	0	109	75	125	0			

Sample ID **0210199-01AMSD** Batch ID: **7969** Test Code: **SW7060A** Units: **µg/L** Analysis Date **10/28/02 5:37:23 PM** Prep Date **10/28/02**
Client ID: Run ID: **GFAA-6000_021028A** SeqNo: **253762**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Arsenic	53.86	5.0	µg/L	50	0	108	75	125	54.68	1.51	20	

Sample ID **0210236-01BMS** Batch ID: **R16191** Test Code: **E410.4** Units: **mg/L** Analysis Date **10/31/02** Prep Date
Client ID: Run ID: **ING-WET_021031A** SeqNo: **254551**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Chemical Oxygen Demand	558	50	mg/L	500	119.8	87.6	80	120	0			

Sample ID **0210236-01BMSD** Batch ID: **R16191** Test Code: **E410.4** Units: **mg/L** Analysis Date **10/31/02** Prep Date
Client ID: Run ID: **ING-WET_021031A** SeqNo: **254552**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Chemical Oxygen Demand	567	50	mg/L	500	119.8	89.4	80	120	558	1.61	20	

Qualifiers: ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank
NA - Not applicable where J values or ND results occur

AMRO Environmental Laboratories Corp.

Date: *03-Dec-02*

CLIENT: Maguire Group, Inc.
Work Order: 0210204
Project: 16421 NBH FEIR DMMP

QC SUMMARY REPORT

Sample Matrix Spike

Sample ID **0210224-01CMS** Batch ID: **7965** Test Code: **SW7470A** Units: **µg/L** Analysis Date **10/28/02 11:08:52 AM** Prep Date **10/25/02**
Client ID: Run ID: **HG-FIMS_021028A** SeqNo: **253637**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Mercury	4.452	0.20	µg/L	4	0	111	80	120	0			

Sample ID **0210224-01CMSD** Batch ID: **7965** Test Code: **SW7470A** Units: **µg/L** Analysis Date **10/28/02 11:12:50 AM** Prep Date **10/25/02**
Client ID: Run ID: **HG-FIMS_021028A** SeqNo: **253638**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Mercury	4.437	0.20	µg/L	4	0	111	80	120	4.452	0.343	20	

Sample ID **0210199-01AMS** Batch ID: **7969** Test Code: **SW7421** Units: **µg/L** Analysis Date **10/28/02 5:33:22 PM** Prep Date **10/28/02**
Client ID: Run ID: **GFAA-6000_021028B** SeqNo: **253838**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Lead	54.86	5.0	µg/L	50	2.379	105	75	125	0			

Sample ID **0210199-01AMSD** Batch ID: **7969** Test Code: **SW7421** Units: **µg/L** Analysis Date **10/28/02 5:37:23 PM** Prep Date **10/28/02**
Client ID: Run ID: **GFAA-6000_021028B** SeqNo: **253839**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Lead	52.8	5.0	µg/L	50	2.379	101	75	125	54.86	3.82	20	

Qualifiers: ND - Not Detected at the Reporting Limit
S - Spike Recovery outside accepted recovery limits
B - Analyte detected in the associated Method Blank
J - Analyte detected below quantitation limits
R - RPD outside accepted recovery limits
NA - Not applicable where J values or ND results occur
RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.

AMRO Environmental Laboratories Corp.

Date: *03-Dec-02*

CLIENT: Maguire Group, Inc.
Work Order: 0210204
Project: 16421 NBH FEIR DMMP

QC SUMMARY REPORT

Sample Matrix Spike

Sample ID **0210199-01AMS** Batch ID: **7969** Test Code: **SW7740** Units: **µg/L** Analysis Date **10/28/02 5:33:22 PM** Prep Date **10/28/02**
Client ID: Run ID: **GFAA-6000_021028C** SeqNo: **253911**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Selenium	40.05	5.0	µg/L	40	0	100	75	125	0			

Sample ID **0210199-01AMSD** Batch ID: **7969** Test Code: **SW7740** Units: **µg/L** Analysis Date **10/28/02 5:37:23 PM** Prep Date **10/28/02**
Client ID: Run ID: **GFAA-6000_021028C** SeqNo: **253912**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Selenium	39.14	5.0	µg/L	40	0	97.9	75	125	40.05	2.3	20	

Qualifiers: ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank
NA - Not applicable where J values or ND results occur

AMRO Environmental Laboratories Corp.

Date: *03-Dec-02*

CLIENT: Maguire Group, Inc.
Work Order: 0210204
Project: 16421 NBH FEIR DMMP

QC SUMMARY REPORT

Laboratory Control Spike

Sample ID **LCS-7969** Batch ID: **7969** Test Code: **SW6010B** Units: **µg/L** Analysis Date **10/29/02 11:40:47 AM** Prep Date **10/28/02**

Client ID: Run ID: **ICP-OPTIMA_021029A** SeqNo: **254030**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Barium	3980	200	µg/L	4000	0	99.5	80	120	0			
Cadmium	802.2	5.0	µg/L	800	0	100	80	120	0			
Chromium	4021	10	µg/L	4000	0	101	80	120	0			
Copper	1927	25	µg/L	2000	0	96.4	80	120	0			
Nickel	4038	40	µg/L	4000	0	101	80	120	0			
Silver	396.1	7.0	µg/L	400	0	99	80	120	0			
Zinc	4013	20	µg/L	4000	0	100	80	120	0			

Qualifiers: ND - Not Detected at the Reporting Limit
S - Spike Recovery outside accepted recovery limits
B - Analyte detected in the associated Method Blank
J - Analyte detected below quantitation limits
R - RPD outside accepted recovery limits
NA - Not applicable where J values or ND results occur
RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.

AMRO Environmental Laboratories Corp.

Date: *03-Dec-02*

CLIENT: Maguire Group, Inc.
Work Order: 0210204
Project: 16421 NBH FEIR DMMP

QC SUMMARY REPORT

Laboratory Control Spike

Sample ID **LCS-7969** Batch ID: **7969** Test Code: **SW7060A** Units: **µg/L** Analysis Date **10/28/02 5:12:17 PM** Prep Date **10/28/02**
Client ID: Run ID: **GFAA-6000_021028A** SeqNo: **253756**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Arsenic	52.96	5.0	µg/L	50	0	106	80	120	0			

Sample ID **LCS-R16180** Batch ID: **R16180** Test Code: **E160.3** Units: **%** Analysis Date **10/29/02** Prep Date
Client ID: Run ID: **ING-WET_021029F** SeqNo: **254430**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Residue, Total	0.2162	0.0010	%	0.2136	0	101	80	120	0			

Sample ID **LCS-R16140** Batch ID: **R16140** Test Code: **E405.1** Units: **mg/L** Analysis Date **10/23/02** Prep Date
Client ID: Run ID: **ING-WET_021023B** SeqNo: **253624**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Biochemical Oxygen Demand	222.4	2.0	mg/L	198	0	112	80	120	0			

Sample ID **LCSD** Batch ID: **R16140** Test Code: **E405.1** Units: **mg/L** Analysis Date **10/23/02** Prep Date
Client ID: Run ID: **ING-WET_021023B** SeqNo: **253626**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Biochemical Oxygen Demand	215.8	2.0	mg/L	198	0	109	80	120	222.4	3.01	20	

Qualifiers: ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank
NA - Not applicable where J values or ND results occur

AMRO Environmental Laboratories Corp.

Date: *03-Dec-02*

CLIENT: Maguire Group, Inc.
Work Order: 0210204
Project: 16421 NBH FEIR DMMP

QC SUMMARY REPORT

Laboratory Control Spike

Sample ID **LCS-R16191** Batch ID: **R16191** Test Code: **E410.4** Units: **mg/L** Analysis Date **10/31/02** Prep Date
Client ID: Run ID: **ING-WET_021031A** SeqNo: **254547**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Chemical Oxygen Demand	492.5	50	mg/L	500	0	98.5	80	120	0			

Sample ID **LCS-7965** Batch ID: **7965** Test Code: **SW7470A** Units: **µg/L** Analysis Date **10/28/02 10:53:07 AM** Prep Date **10/25/02**
Client ID: Run ID: **HG-FIMS_021028A** SeqNo: **253633**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Mercury	4.066	0.20	µg/L	4	0	102	80	120	0			

Sample ID **LCS-7969** Batch ID: **7969** Test Code: **SW7421** Units: **µg/L** Analysis Date **10/28/02 5:12:17 PM** Prep Date **10/28/02**
Client ID: Run ID: **GFAA-6000_021028B** SeqNo: **253833**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Lead	56.95	5.0	µg/L	50	1.244	111	80	120	0			

Sample ID **LCS-7969** Batch ID: **7969** Test Code: **SW7740** Units: **µg/L** Analysis Date **10/28/02 5:12:17 PM** Prep Date **10/28/02**
Client ID: Run ID: **GFAA-6000_021028C** SeqNo: **253906**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Selenium	39.28	5.0	µg/L	40	0	98.2	80	120	0			

Qualifiers: ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank
NA - Not applicable where J values or ND results occur

SEVERN TRENT SERVICES

STL Sacramento
880 Riverside Parkway
West Sacramento, CA 95605-1500

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November 20, 2002

STL SACRAMENTO PROJECT NUMBER: G2J240176

Nancy Stewart
Amro Environmental Laboratories
111 Herrick Street
Merrimack, NH 03054

Dear Ms. Stewart,

This report contains the analytical results for the sample received under chain of custody by STL Sacramento on October 24, 2002. This sample is associated with your NBH FEIR DMMP project.

The test results in this report meet all NELAC requirements for parameters that accreditation is required or available. Any exceptions to NELAC requirements are noted in the case narrative. The case narrative is an integral part of this report.

If you have any questions, please feel free to call me at (916) 374-4402.

Sincerely,

Jill Kellmann

Jill Kellmann
Project Manager

CASE NARRATIVE

STL SACRAMENTO PROJECT NUMBER G2J240176

There were no anomalies associated with this project.

STL Sacramento

Quality Control Definitions

QC Parameter	Definition
QC Batch	A set of up to 20 field samples plus associated laboratory QC samples that are similar in composition (matrix) and that are processed within the same time period with the same reagent and standard lots.
Duplicate Control Sample (DCS)	Consist of a pair of LCSs analyzed within the same QC batch to monitor precision and accuracy independent of sample matrix effects. This QC is performed only if required by client or when insufficient sample is available to perform MS/MSD.
Duplicate Sample (DU)	A second aliquot of an environmental sample, taken from the same sample container when possible, that is processed independently with the first sample aliquot. The results are used to assess the effect of the sample matrix on the precision of the analytical process. The precision estimated using this sample is not necessarily representative of the precision for other samples in the batch.
Laboratory Control Sample (LCS)	A volume of reagent water for aqueous samples or a contaminant-free solid matrix (Ottawa sand) for soil and sediment samples which is spiked with known amounts of representative target analytes and required surrogates. An LCS is carried through the entire analytical process and is used to monitor the accuracy of the analytical process independent of potential matrix effects.
Matrix Spike and Matrix Spike Duplicate (MS/MSD)	A field sample fortified with known quantities of target analytes that are also added to the LCS. Matrix spike duplicate is a second matrix spike sample. MSs/MSDs are carried through the entire analytical process and are used to determine sample matrix effect on accuracy of the measurement system. The accuracy and precision estimated using MS/MSD is only representative of the precision of the sample that was spiked.
Method Blank (MB)	A sample composed of all the reagents (in the same quantities) in reagent water carried through the entire analytical process. The method blank is used to monitor the level of contamination introduced during sample preparation steps.
Surrogate Spike	Organic constituents not expected to be detected in environmental media and are added to every sample and QC at a known concentration. Surrogates are used to determine the efficiency of the sample preparation and the analytical process.

Source: STL Sacramento Laboratory Quality Manual

STL Sacramento Certifications:
Alaska (UST-055), Arizona (#AZ00616), Arkansas, California (NELAP # 01119CA) (ELAP #I-2439), Connecticut (#PH-0691), Florida (E87570), Hawaii, Louisiana (AI # 30612), New Jersey (Lab ID 44005), Nevada (#CA 044), New York (LAB ID 11666 serial # 107407), Oregon (LAB ID CA 044), South Carolina (LAB ID 87014, Cert. # 870140), Utah (E-168), Virginia (#00178), Washington (# C087), West Virginia (# 9930C), Wisconsin (Lab 998204680), USNAVY, USACE, USDA Foreign Plant (Permit # 37-82605), USDA Foreign Soil (Permit # S-46613)..

SAMPLE SUMMARY

G2J240176

WO #	SAMPLE#	CLIENT SAMPLE ID	SAMPLED DATE	SAM TIM
FANL4	001	-01G/H/I NBH-208-water	10/22/02	

NOTE(S):

- The analytical results of the samples listed above are presented on the following pages.
- All calculations are performed before rounding to avoid round-off errors in calculated results.
- Results noted as "ND" were not detected at or above the stated limit.
- This report must not be reproduced, except in full, without the written approval of the laboratory.
- Results for the following parameters are never reported on a dry weight basis: color, corrosivity, density, flashpoint, ignitability, layers, odor, paint filter test, pH, porosity pressure, reactivity, redox potential, specific gravity, spot tests, solids, solubility, temperature, viscosity, and weight.

AMRO Environmental Laboratories Corporation
111 Herrick Street
Merrimack, NH 03054

CHAIN-OF-CUSTODY RECORD

43641

Office: (603) 424-2022
Fax: (603) 429-8496

39 4 of 9

Project No.: 16421	Project Name: NBH FEIR DMMP	Project Manager:	Samplers (Signature): Grace Ghiraldi, Graciela Ghiraldi	AMRO Project No.: 0210204.
	Project State: MA			

Sample ID	Date/Time Sampled	Matrix (A= Air, S= Soil, GW= Ground W., WW= Waste W., DW= Drinking W., O= Oil, Other= Specify)	Total # of Cont. & Size	Comp	Grab	TOC	PCB Congeners	Dioxin/Furan 8280	Remarks
-01G NBH-208-water	10/22/02	SW	2x40ml		X	✓			
-01H NBH-208-water	↓	↓	2x1LGAU		↓		✓		
-01I NBH-208-water	↓	↓	2x1LGAU		↓			✓	
Preservative: Cl-HCl, MeOH, N-HN03, S-H2SO4, Na-NaOH, O- Other						S	—	—	
Container Type: P- Plastic, G-Glass, V-Vial, T- Teflon, O-Other						V	G	G	

RECEIVED IN GOOD CONDITION UNDER COC
OCT 24 2002
INI: GC

Send Results To:	FAX No.:	Seal Intact?	P.O. No:	GW-1* GW-2 GW-3
AMRO Environmental. 111 Herrick St Merrimack, NH 03054.	603-429-8496.	Yes No N/A		MCP Level Needed:
		Results Needed By: STD		*= May require additional cost

Relinquished By	Date/ Time	Received By
Grace Ghiraldi	15:30 10/23/02.	Bob Hawkes
Bob Hawkes	16:10 10-23-02	[signature] 10/23/02

PRIORITY TURNAROUND TIME AUTHORIZATION
Before submitting samples for expedited TAT, you must have requested in advance and received a coded **AUTHORIZATION NUMBER.**
Samples arriving after 12:00 noon will be tracked and billed as received on the following day.
AUTHORIZATION No. _____ BY: _____

Please print clearly, legibly and completely. Samples can not be logged in and the turnaround time clock will not start until any ambiguities are resolved.

NOTES: Preservatives, Special reporting limits, Known Contamination, etc; H_2SO_4.

AMRO policy requires notification in writing to the laboratory in cases where the samples were collected from highly contaminated sites.

White: Lab Copy Yellow: Accompanies Report Pink: Client Copy SHEET 1 OF 1

Fedx Dioxens to Sacramento / TOC & PCB Fedex to Burlington (RS)

qc/qcmemos/forms/amrococ/Rev.2 04/01/02

G2J240176 DEN (a) STL-SAC 10-24-02 0930

AMRO ENVIRONMENTAL LABORATORIES

Client Sample ID: -01G/H/I NBH-208-water

Trace Level Organic Compounds

Lot-Sample #...: G2J240176-001 Work Order #...: FANL41AA Matrix.....: WATER
Date Sampled...: 10/22/02 Date Received..: 10/24/02
Prep Date.....: 11/08/02 Analysis Date..: 11/13/02
Prep Batch #...: 2312242
Dilution Factor: 1

PARAMETER	RESULT	DETECTION LIMIT	UNITS	METHOD
2,3,7,8-TCDD	ND	0.42	ng/L	SW846 8280A
Total TCDD	ND	0.42	ng/L	SW846 8280A
1,2,3,7,8-PeCDD	ND	3.1	ng/L	SW846 8280A
Total PeCDD	ND	3.2	ng/L	SW846 8280A
1,2,3,4,7,8-HxCDD	ND	0.14	ng/L	SW846 8280A
1,2,3,6,7,8-HxCDD	ND	0.72	ng/L	SW846 8280A
1,2,3,7,8,9-HxCDD	ND	0.88	ng/L	SW846 8280A
Total HxCDD	ND	0.88	ng/L	SW846 8280A
1,2,3,4,6,7,8-HpCDD	ND	0.28	ng/L	SW846 8280A
Total HpCDD	ND	0.28	ng/L	SW846 8280A
OCDD	ND	1.3	ng/L	SW846 8280A
2,3,7,8-TCDF	ND	0.34	ng/L	SW846 8280A
Total TCDF	ND	1.0	ng/L	SW846 8280A
1,2,3,7,8-PeCDF	ND	0.96	ng/L	SW846 8280A
2,3,4,7,8-PeCDF	ND	0.63	ng/L	SW846 8280A
Total PeCDF	ND	1.4	ng/L	SW846 8280A
1,2,3,4,7,8-HxCDF	ND	0.40	ng/L	SW846 8280A
1,2,3,6,7,8-HxCDF	ND	0.38	ng/L	SW846 8280A
2,3,4,6,7,8-HxCDF	ND	0.41	ng/L	SW846 8280A
1,2,3,7,8,9-HxCDF	ND	0.55	ng/L	SW846 8280A
Total HxCDF	ND	0.77	ng/L	SW846 8280A
1,2,3,4,6,7,8-HpCDF	ND	2.9	ng/L	SW846 8280A
1,2,3,4,7,8,9-HpCDF	ND	1.6	ng/L	SW846 8280A
Total HpCDF	ND	2.9	ng/L	SW846 8280A
OCDF	ND	1.6	ng/L	SW846 8280A

INTERNAL STANDARDS	PERCENT RECOVERY	RECOVERY LIMITS
13C-2,3,7,8-TCDD	47	(25 - 150)
13C-2,3,7,8-TCDF	37	(25 - 150)
13C-1,2,3,6,7,8-HxCDD	89	(25 - 150)
13C-1,2,3,4,6,7,8-HpCDF	86	(25 - 150)
13C-OCDD	80	(25 - 150)

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
37Cl4-2,3,7,8-TCDD	90	(25 - 150)

QC DATA ASSOCIATION SUMMARY

G2J240176

Sample Preparation and Analysis Control Numbers

SAMPLE#	MATRIX	ANALYTICAL METHOD	LEACH BATCH #	PREP BATCH #	MS RUN#
001	WATER	SW846 8280A		2312242	

METHOD BLANK REPORT

Trace Level Organic Compounds

Client Lot #...: G2J240176 Work Order #...: FCNKP1AA Matrix.....: WATER
MB Lot-Sample #: G2K080000-242
Prep Date.....: 11/08/02
Analysis Date..: 11/13/02 Prep Batch #...: 2312242
Dilution Factor: 1

PARAMETER	RESULT	DETECTION LIMIT	UNITS	METHOD
2,3,7,8-TCDD	ND	0.27	ng/L	SW846 8280A
Total TCDD	ND	0.27	ng/L	SW846 8280A
1,2,3,7,8-PeCDD	ND	1.1	ng/L	SW846 8280A
Total PeCDD	ND	2.1	ng/L	SW846 8280A
1,2,3,4,7,8-HxCDD	ND	0.16	ng/L	SW846 8280A
1,2,3,6,7,8-HxCDD	ND	0.84	ng/L	SW846 8280A
1,2,3,7,8,9-HxCDD	ND	0.48	ng/L	SW846 8280A
Total HxCDD	ND	0.84	ng/L	SW846 8280A
1,2,3,4,6,7,8-HpCDD	ND	0.25	ng/L	SW846 8280A
Total HpCDD	ND	0.25	ng/L	SW846 8280A
OCDD	ND	1.1	ng/L	SW846 8280A
2,3,7,8-TCDF	ND	0.18	ng/L	SW846 8280A
Total TCDF	ND	0.84	ng/L	SW846 8280A
1,2,3,7,8-PeCDF	ND	0.49	ng/L	SW846 8280A
2,3,4,7,8-PeCDF	ND	0.42	ng/L	SW846 8280A
Total PeCDF	ND	0.85	ng/L	SW846 8280A
1,2,3,4,7,8-HxCDF	ND	0.25	ng/L	SW846 8280A
1,2,3,6,7,8-HxCDF	ND	0.27	ng/L	SW846 8280A
2,3,4,6,7,8-HxCDF	ND	0.30	ng/L	SW846 8280A
1,2,3,7,8,9-HxCDF	ND	0.47	ng/L	SW846 8280A
Total HxCDF	ND	0.61	ng/L	SW846 8280A
1,2,3,4,6,7,8-HpCDF	ND	0.91	ng/L	SW846 8280A
1,2,3,4,7,8,9-HpCDF	ND	1.1	ng/L	SW846 8280A
Total HpCDF	ND	1.6	ng/L	SW846 8280A
OCDF	ND	1.4	ng/L	SW846 8280A

INTERNAL STANDARDS	PERCENT RECOVERY	RECOVERY LIMITS
13C-2,3,7,8-TCDD	51	(25 - 150)
13C-2,3,7,8-TCDF	48	(25 - 150)
13C-1,2,3,6,7,8-HxCDD	80	(25 - 150)
13C-1,2,3,4,6,7,8-HpCDF	77	(25 - 150)
13C-OCDD	73	(25 - 150)

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
37Cl4-2,3,7,8-TCDD	93	(25 - 150)

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

LABORATORY CONTROL SAMPLE EVALUATION REPORT

Trace Level Organic Compounds

Client Lot #...: G2J240176 Work Order #...: FCNKP1AC Matrix.....: WATER
LCS Lot-Sample#: G2K080000-242
Prep Date.....: 11/08/02 Analysis Date..: 11/13/02
Prep Batch #...: 2312242
Dilution Factor: 1

PARAMETER	PERCENT RECOVERY	RECOVERY LIMITS	METHOD
2,3,7,8-TCDD	97	(79 - 125)	SW846 8280A
1,2,3,7,8-PeCDD	113	(72 - 137)	SW846 8280A
1,2,3,6,7,8-HxCDD	103	(71 - 130)	SW846 8280A
1,2,3,4,6,7,8-HpCDD	95	(54 - 153)	SW846 8280A
OCDD	98	(69 - 127)	SW846 8280A
2,3,7,8-TCDF	93	(78 - 123)	SW846 8280A
1,2,3,7,8-PeCDF	117	(75 - 133)	SW846 8280A
1,2,3,6,7,8-HxCDF	91	(70 - 128)	SW846 8280A
1,2,3,4,6,7,8-HpCDF	93	(76 - 129)	SW846 8280A
OCDF	102	(66 - 130)	SW846 8280A

INTERNAL STANDARD	PERCENT RECOVERY	RECOVERY LIMITS
13C-2,3,7,8-TCDD	48	(25 - 150)
13C-2,3,7,8-TCDF	43	(25 - 150)
13C-1,2,3,6,7,8-HxCDD	61	(25 - 150)
13C-1,2,3,4,6,7,8-HpCDF	60	(25 - 150)
13C-OCDD	57	(25 - 150)

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
37Cl4-2,3,7,8-TCDD	98	(25 - 150)

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

Bold print denotes control parameters

LABORATORY CONTROL SAMPLE DATA REPORT

Trace Level Organic Compounds

Client Lot #...: G2J240176 Work Order #...: FCNKP1AC Matrix.....: WATER
LCS Lot-Sample#: G2K080000-242
Prep Date.....: 11/08/02 Analysis Date..: 11/13/02
Prep Batch #...: 2312242
Dilution Factor: 1

PARAMETER	SPIKE AMOUNT	MEASURED AMOUNT	UNITS	PERCENT RECOVERY	METHOD
2,3,7,8-TCDD	25.0	24.3	ng/L	97	SW846 8280A
1,2,3,7,8-PeCDD	62.5	70.5	ng/L	113	SW846 8280A
1,2,3,6,7,8-HxCDD	62.5	64.2	ng/L	103	SW846 8280A
1,2,3,4,6,7,8-HpCDD	62.5	59.5	ng/L	95	SW846 8280A
OCDD	125	122	ng/L	98	SW846 8280A
2,3,7,8-TCDF	25.0	23.2	ng/L	93	SW846 8280A
1,2,3,7,8-PeCDF	62.5	73.3	ng/L	117	SW846 8280A
1,2,3,6,7,8-HxCDF	62.5	57.1	ng/L	91	SW846 8280A
1,2,3,4,6,7,8-HpCDF	62.5	57.8	ng/L	93	SW846 8280A
OCDF	125	128	ng/L	102	SW846 8280A

INTERNAL STANDARD	PERCENT RECOVERY	RECOVERY LIMITS
13C-2,3,7,8-TCDD	48	(25 - 150)
13C-2,3,7,8-TCDF	43	(25 - 150)
13C-1,2,3,6,7,8-HxCDD	61	(25 - 150)
13C-1,2,3,4,6,7,8-HpCDF	60	(25 - 150)
13C-OCDD	57	(25 - 150)

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
37Cl4-2,3,7,8-TCDD	98	(25 - 150)

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

Bold print denotes control parameters

SEVERN
TRENT
SERVICES

STL Burlington
208 South Park Drive
Suite 1
Colchester, VT 05446

Tel: 802 655 1203
Fax: 802 655 1248
www.stl-inc.com

November 19, 2002

Ms. Mary Ann Steen
AMRO Environmental
111 Herrick Street
Merrimack, NH 03054

Re: Laboratory Project No.: 22000
ETR: 90550

Dear Ms. Steen:

Enclosed are the analytical results of samples received intact by Severn Trent Laboratories on October 24, 2002. Laboratory numbers have been assigned and designated as follows:

Lab ID	Client Sample ID	Sample Date	Sample Matrix
	Received: 10/24/02 ETR No: 90550		
507125	NBH-208-WATER	10/22/02	Water
507126	0210204-01H	10/22/02	Water

In order to accommodate field length limitations in processing the data summary forms, the laboratory did, in certain instances, abbreviate the sample identifiers

PCB Congeners by Method 8082:
Please note that the original extraction of the two field samples in this delivery group were inadvertently accomplished using a total PCB Method 8082 extraction procedure rather than that for Method 8082 PCB Congeners. As a result, only the surrogate monitoring compound Tetrachloro-meta-xylene was spiked into field samples and quality control samples of this delivery group. Since BZ#198 was not spiked into the samples, no percent recoveries are available. Additionally, the original blank spike and duplicate sample analysis is not presented in this case submittal since the Aroclor 1260 spike was used rather than the appropriate fortified congeners.

These samples were subsequently re-extracted outside the method specified holding time, yielding the appropriate surrogate percent recoveries and blank spike and duplicate percent recoveries that were within the control limits. The PCB Congener analysis of the blank spike and blank spike duplicate sample identified as A1LCS/LCSD exhibited percent recoveries of the target congener BZ#87 that exceeded the control criteria due to coelution with BZ#81. This exceedence can be found on the associated form IIIs. Both sets of data have been presented in this case submittal. The re-extracted and re-analyzed samples have been assigned a suffix RE to discern them from the original set.

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PCB Congeners by Method 8082 (cont.):
Select target congeners coeluted with non-target congeners on both the RTX-5 and RTX-CLP II and analytical columns. Please refer to the following table for a detailed listing:

RTX-5 analytical column		*RTX-CLP II analytical column*	
Target congener	Coelutes with congener	Target congener	Coelutes with congener(s)
BZ#87	BZ#81	BZ#87	BZ#81
BZ#153	BZ#184	BZ#126	BZ#187

Select continuing calibration standards exhibited percent difference relative to the nominal concentrations that exceeded the established 15 percent difference criteria for the target congeners BZ#77, BZ#126, BZ#153, BZ#105, BZ#118, BZ#206 and BZ#209. These congeners were not detected in the field samples of this case submittal.

The PCB congener BZ#209 reported in the preparatory blank PBLKV5 and the field sample NHB-208-WATER was actually the PCB surrogate monitoring compound Decachlorobiphenyl, which was inadvertently spiked into that extraction batch. Consequently, a "B" flag was applied to the field sample for this compound.

Please note that due to a low response and chromatographic tailing, the retention time windows for congeners BZ#77 and BZ 126 were extended to 0.06 rather than the normal 0.05 minutes.

Total Organic Carbon by the Lloyd Kahn Method:
No exceptions to the method prescribed quality control criteria were observed during the analyses of the samples in this delivery group.

Particle Size by ASTM Method D422:
No exceptions to the method prescribed quality control criteria were observed during the analyses of the samples in this delivery group.

Moisture Content by ASTM Method D2216:
No exceptions to the method prescribed quality control criteria were observed during the analyses of the samples in this delivery group.

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Client specified matrix spike/matrix spike duplicate samples were not analyzed or requested with the above samples. However, routine method quality control analyses were performed.

Total Organic Carbon Method 415.1:
No exceptions to the method prescribed quality control criteria were observed during the analyses of the samples in this delivery group.

Client specified matrix spike/matrix spike duplicate samples were not analyzed or requested with the above samples. However, routine method quality control analyses were performed.

If there are any questions regarding this submittal, please contact Ron Pentkowski on at (802) 655-1203.

This report shall not be reproduced, except in full, without the written approval of the laboratory.
This report is sequentially numbered starting with page 0001 and ending with page _____.

I certify that this package is in compliance with the NELAC requirements, both technically and for completeness, for other than the conditions detailed above. The release of the data contained in this hardcopy data package and the computer readable data submitted on diskette has been authorized by the Laboratory Director or his designee, as verified by the following signature.

Sincerely,

Michael F. Wheeler, Ph.D.
Laboratory Director

Enclosure

SEVERN TRENT SERVICES

STL Burlington

Wet Chemistry

Data Qualifiers

N- Matrix spiked sample recovery not within control limits.

*- Duplicate analysis not within control limits.

Concentration Qualifiers

U- Result less than reporting limit.

Result Qualifiers

RL- Reporting Limit, includes dilution and preparation information.

DF- Dilution factor performed on sample.

WET CHEMISTRY

Sample Report Summary

Client Sample No.

NBH-208-WATER

Lab Name: STL BURLINGTON

Lab Code: STLVT

Matrix: WATER

% Solids:

Contract:

Case No.:

Client: AMRO

SDG No.: 90550

Lab Sample ID: 507125

Date Received: 10/24/02

Method	Parameter	Analytical Run Date	Analytical Run Time	Analytical Batch	Units	DF	RL	Conc.	Qual.
9060	Total Organic Carbon	10/25/02	08:52	BLKTO1025A	mg/L	1	1.0	1.6	

WET CHEMISTRY

Method Blank Report Summary

SDG No.: 90550

Lab Name: STL BURLINGTON

Contract:

Lab Code: STLVT

Case No.:

Matrix: WATER

Client: AMRO

% Solids:

Lab Sample ID	Method	Parameter	Conc.	Units	Qual.	DF	RL	Analytical Run Date	Analytical Run Time	Analytical Batch
BLKTO1025A	9060	Total Organic Carbon	1.0	mg/L	U	1	1.0	10/25/02	08:52	BLKTO1025A

WET CHEMISTRY

Laboratory Control Sample Report Summary

Lab Name: STL BURLINGTON

Contract:

SDG No.: 90550

Lab Code: STLVT

Case No.:

Matrix: WATER

Client: AMRO

% Solids:

Lab Sample ID	Method	Parameter	Analytical Run Date	Analytical Run Time	Analytical Batch	Units	LCS Conc.	True Value	% Recovery*
LCSTO1025A	9060	Total Organic Carbon	10/25/02	08:52	BLKTO1025A	mg/L	32.5	31.2000	104.2

** Control Limit for Percent Recovery is 80-120%, unless otherwise specified.*

WET CHEMISTRY

Laboratory Control Sample Duplicate Report Summary

Lab Name: STL BURLINGTON

Contract:

SDG No.: 90550

Lab Code: STLVT

Case No.:

Matrix: WATER

Client: AMRO

% Solids:

Lab Sample ID	Method	Parameter	Analytical Run Date	Analytical Run Time	Analytical Batch	Units	LCSD Conc.	True Value	% Recovery*	RPD**
LCSDTO1025A	9060	Total Organic Carbon	10/25/02	08:52	BLKTO1025A	mg/L	31.7	31.2000	101.6	2

** Control Limit for Percent Recovery is 80-120%, unless otherwise specified.*
*** Control Limit for RPD is +/- 20%, unless otherwise specified.*

SEVERN TRENT SERVICES

STL Burlington

PCB CONGENER ANALYSIS

Qualifier Definitions:

U= Compound not detected above reporting limit.

J= Compound reported at an estimated concentration below the reporting limit.

E= Compound reported at an estimated concentration which exceeds the calibration range.

S= Specific column result used for quantitation due to confirmation column coelution.

T= Tentative identification, specific column result used with no confirmation information.

X= Estimated concentration due to coelution on both columns.

P= Confirmation column result exceeds reported result by more than 25%.

H= Specific column or estimated result exceeds confirmation result by more than 25% despite expected confirmation coelution.

B= Compound detected above reporting limit in method blank.

N= Compound does not comply with initial and/or ongoing calibration criteria.

FORM 1
OTHER ORGANICS ANALYSIS DATA SHEET

AMRO SAMPLE NO.

BH208WATER

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90550

Matrix: (soil/water) WATER Lab Sample ID: 507125

Sample wt/vol: 900.0 (g/mL) ML Lab File ID: 07NOV021728-R281

% Moisture: _____ decanted: (Y/N)___ Date Received: 10/24/02

Extraction: (SepF/Cont/Sonc) SEPF Date Extracted: 10/26/02

Concentrated Extract Volume: 10(mL) Date Analyzed: 11/08/02

Injection Volume: _____(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) N.

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
34883-43-7------	BZ#8	0.056	U
37680-65-2------	BZ#18	0.056	U
7012-37-5-------	BZ#28	0.056	U
41464-39-5------	BZ#44	0.056	U
41464-40-8------	BZ#49	0.056	U
35693-99-3------	BZ#52	0.056	U
32598-10-0------	BZ#66	0.056	U
32598-13-3------	BZ#77	0.056	U
70362-50-4------	BZ#81	0.056	U
38380-02-8------	BZ#87	0.056	U
37680-73-2------	BZ#101	0.056	U
32598-14-4------	BZ#105	0.056	U
74472-37-0------	BZ#114	0.056	U
31508-00-6------	BZ#118	0.056	U
65510-44-3------	BZ#123	0.056	U
57465-28-8------	BZ#126	0.056	U
38380-07-3------	BZ#128	0.056	U
35065-28-2------	BZ#138	0.056	U
35065-27-1------	BZ#153	0.056	U
38380-08-4------	BZ#156	0.056	U
69782-90-7------	BZ#157	0.056	U
52663-72-6------	BZ#167	0.056	U
32774-16-6------	BZ#169	0.056	U
35065-30-6------	BZ#170	0.056	U
35065-29-3------	BZ#180	0.056	U
52663-69-1------	BZ#183	0.056	U
74472-48-3------	BZ#184	0.056	U
52663-68-0------	BZ#187	0.056	U

FORM I OTHER

FORM 1
OTHER ORGANICS ANALYSIS DATA SHEET

AMRO SAMPLE NO.

BH208WATER

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90550

Matrix: (soil/water) WATER Lab Sample ID: 507125

Sample wt/vol: 900.0 (g/mL) ML Lab File ID: 07NOV021728-R281

% Moisture: _____ decanted: (Y/N)___ Date Received: 10/24/02

Extraction: (SepF/Cont/Sonc) SEPF Date Extracted: 10/26/02

Concentrated Extract Volume: 10(mL) Date Analyzed: 11/08/02

Injection Volume: _____(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) N

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
39635-31-9------	BZ#189	0.056	U
52663-78-2------	BZ#195	0.056	U
40186-72-9------	BZ#206	0.056	U
2051-24-3-------	BZ#209	0.45	B

FORM I OTHER

FORM 1
OTHER ORGANICS ANALYSIS DATA SHEET

AMRO SAMPLE NO.

BH208WATERRE

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90550

Matrix: (soil/water) WATER Lab Sample ID: 507125R1

Sample wt/vol: 970.0 (g/mL) ML Lab File ID: 07NOV021728-R331

% Moisture: _____ decanted: (Y/N)___ Date Received: 10/24/02

Extraction: (SepF/Cont/Sonc) SEPF Date Extracted: 11/05/02

Concentrated Extract Volume: 10(mL) Date Analyzed: 11/08/02

Injection Volume: _____(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) Y.

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
34883-43-7	BZ#8	0.052	U
37680-65-2	BZ#18	0.052	U
7012-37-5	BZ#28	0.052	U
41464-39-5	BZ#44	0.052	U
41464-40-8	BZ#49	0.052	U
35693-99-3	BZ#52	0.052	U
32598-10-0	BZ#66	0.052	U
32598-13-3	BZ#77	0.052	U
70362-50-4	BZ#81	0.052	U
38380-02-8	BZ#87	0.052	U
37680-73-2	BZ#101	0.052	U
32598-14-4	BZ#105	0.052	U
74472-37-0	BZ#114	0.052	U
31508-00-6	BZ#118	0.052	U
65510-44-3	BZ#123	0.052	U
57465-28-8	BZ#126	0.052	U
38380-07-3	BZ#128	0.052	U
35065-28-2	BZ#138	0.052	U
35065-27-1	BZ#153	0.052	U
38380-08-4	BZ#156	0.052	U
69782-90-7	BZ#157	0.052	U
52663-72-6	BZ#167	0.052	U
32774-16-6	BZ#169	0.052	U
35065-30-6	BZ#170	0.052	U
35065-29-3	BZ#180	0.052	U
52663-69-1	BZ#183	0.052	U
74472-48-3	BZ#184	0.052	U
52663-68-0	BZ#187	0.052	U

FORM I OTHER

FORM 1
OTHER ORGANICS ANALYSIS DATA SHEET

AMRO SAMPLE NO.

BH208WATERRE

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90550

Matrix: (soil/water) WATER Lab Sample ID: 507125R1

Sample wt/vol: 970.0 (g/mL) ML Lab File ID: 07NOV021728-R331

% Moisture: _____ decanted: (Y/N)___ Date Received: 10/24/02

Extraction: (SepF/Cont/Sonc) SEPF Date Extracted: 11/05/02

Concentrated Extract Volume: 10(mL) Date Analyzed: 11/08/02

Injection Volume: _____(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) Y

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
39635-31-9------	BZ#189	0.052	U
52663-78-2------	BZ#195	0.052	U
40186-72-9------	BZ#206	0.052	U
2051-24-3-------	BZ#209	0.052	U

FORM I OTHER

FORM 1
OTHER ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

PBLKV5

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90550

Matrix: (soil/water) WATER Lab Sample ID: PBLKV5

Sample wt/vol: 1000 (g/mL) ML Lab File ID: 07NOV021728-R251

% Moisture: _____ decanted: (Y/N)___ Date Received: _____

Extraction: (SepF/Cont/Sonc) SEPF Date Extracted: 10/26/02

Concentrated Extract Volume: 10(mL) Date Analyzed: 11/08/02

Injection Volume: _____(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) N.

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
34883-43-7------	BZ#8	0.050	U
37680-65-2------	BZ#18	0.050	U
7012-37-5-------	BZ#28	0.050	U
41464-39-5------	BZ#44	0.050	U
41464-40-8------	BZ#49	0.050	U
35693-99-3------	BZ#52	0.050	U
32598-10-0------	BZ#66	0.050	U
32598-13-3------	BZ#77	0.050	U
70362-50-4------	BZ#81	0.050	U
38380-02-8------	BZ#87	0.050	U
37680-73-2------	BZ#101	0.050	U
32598-14-4------	BZ#105	0.050	U
74472-37-0------	BZ#114	0.050	U
31508-00-6------	BZ#118	0.050	U
65510-44-3------	BZ#123	0.050	U
57465-28-8------	BZ#126	0.050	U
38380-07-3------	BZ#128	0.050	U
35065-28-2------	BZ#138	0.050	U
35065-27-1------	BZ#153	0.050	U
38380-08-4------	BZ#156	0.050	U
69782-90-7------	BZ#157	0.050	U
52663-72-6------	BZ#167	0.050	U
32774-16-6------	BZ#169	0.050	U
35065-30-6------	BZ#170	0.050	U
35065-29-3------	BZ#180	0.050	U
52663-69-1------	BZ#183	0.050	U
74472-48-3------	BZ#184	0.050	U
52663-68-0------	BZ#187	0.050	U

FORM I OTHER

FORM 1
OTHER ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

PBLKV5

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90550

Matrix: (soil/water) WATER Lab Sample ID: PBLKV5

Sample wt/vol: 1000 (g/mL) ML Lab File ID: 07NOV021728-R251

% Moisture: _____ decanted: (Y/N)___ Date Received: _____

Extraction: (SepF/Cont/Sonc) SEPF Date Extracted: 10/26/02

Concentrated Extract Volume: 10(mL) Date Analyzed: 11/08/02

Injection Volume: _____(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) N

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
39635-31-9------	BZ#189	0.050	U
52663-78-2------	BZ#195	0.050	U
40186-72-9------	BZ#206	0.050	U
2051-24-3-------	BZ#209	0.38	

FORM I OTHER

FORM 1
OTHER ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

PBLKZ5

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90550

Matrix: (soil/water) WATER Lab Sample ID: PBLKZ5

Sample wt/vol: 1000 (g/mL) ML Lab File ID: 07NOV021728-R301

% Moisture: _____ decanted: (Y/N)___ Date Received: _____

Extraction: (SepF/Cont/Sonc) SEPF Date Extracted: 11/05/02

Concentrated Extract Volume: 10(mL) Date Analyzed: 11/08/02

Injection Volume: _____(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) Y

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
34883-43-7	BZ#8	0.050	U
37680-65-2	BZ#18	0.050	U
7012-37-5	BZ#28	0.050	U
41464-39-5	BZ#44	0.050	U
41464-40-8	BZ#49	0.050	U
35693-99-3	BZ#52	0.050	U
32598-10-0	BZ#66	0.050	U
32598-13-3	BZ#77	0.050	U
70362-50-4	BZ#81	0.050	U
38380-02-8	BZ#87	0.050	U
37680-73-2	BZ#101	0.050	U
32598-14-4	BZ#105	0.050	U
74472-37-0	BZ#114	0.050	U
31508-00-6	BZ#118	0.050	U
65510-44-3	BZ#123	0.050	U
57465-28-8	BZ#126	0.050	U
38380-07-3	BZ#128	0.050	U
35065-28-2	BZ#138	0.050	U
35065-27-1	BZ#153	0.050	U
38380-08-4	BZ#156	0.050	U
69782-90-7	BZ#157	0.050	U
52663-72-6	BZ#167	0.050	U
32774-16-6	BZ#169	0.050	U
35065-30-6	BZ#170	0.050	U
35065-29-3	BZ#180	0.050	U
52663-69-1	BZ#183	0.050	U
74472-48-3	BZ#184	0.050	U
52663-68-0	BZ#187	0.050	U

FORM I OTHER

FORM 1
OTHER ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

PBLKZ5

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90550

Matrix: (soil/water) WATER Lab Sample ID: PBLKZ5

Sample wt/vol: 1000 (g/mL) ML Lab File ID: 07NOV021728-R301

% Moisture: _____ decanted: (Y/N)___ Date Received: _____

Extraction: (SepF/Cont/Sonc) SEPF Date Extracted: 11/05/02

Concentrated Extract Volume: 10(mL) Date Analyzed: 11/08/02

Injection Volume: _____(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) Y.

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
39635-31-9------	BZ#189	0.050	U
52663-78-2------	BZ#195	0.050	U
40186-72-9------	BZ#206	0.050	U
2051-24-3-------	BZ#209	0.050	U

FORM 1
OTHER ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

Z5LCS

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90550

Matrix: (soil/water) WATER Lab Sample ID: Z5LCS

Sample wt/vol: 1000 (g/mL) ML Lab File ID: 07NOV021728-R311

% Moisture: _____ decanted: (Y/N)___ Date Received: _____

Extraction: (SepF/Cont/Sonc) SEPF Date Extracted: 11/05/02

Concentrated Extract Volume: 10(mL) Date Analyzed: 11/08/02

Injection Volume: _____(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) Y

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
34883-43-7	BZ#8	0.48	
37680-65-2	BZ#18	0.50	
7012-37-5	BZ#28	0.45	
41464-39-5	BZ#44	0.49	
41464-40-8	BZ#49	0.50	
35693-99-3	BZ#52	0.51	
32598-10-0	BZ#66	0.44	
32598-13-3	BZ#77	0.40	
70362-50-4	BZ#81	0.90	
38380-02-8	BZ#87	0.90	
37680-73-2	BZ#101	0.50	
32598-14-4	BZ#105	0.42	
74472-37-0	BZ#114	0.43	
31508-00-6	BZ#118	0.46	
65510-44-3	BZ#123	0.46	
57465-28-8	BZ#126	0.40	P
38380-07-3	BZ#128	0.47	
35065-28-2	BZ#138	0.48	
35065-27-1	BZ#153	0.50	P
38380-08-4	BZ#156	0.43	
69782-90-7	BZ#157	0.44	
52663-72-6	BZ#167	0.46	
32774-16-6	BZ#169	0.43	
35065-30-6	BZ#170	0.48	
35065-29-3	BZ#180	0.48	
52663-69-1	BZ#183	0.49	
74472-48-3	BZ#184	0.51	P
52663-68-0	BZ#187	0.52	P

FORM I OTHER

FORM 1
OTHER ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

Z5LCS

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90550

Matrix: (soil/water) WATER Lab Sample ID: Z5LCS

Sample wt/vol: 1000 (g/mL) ML Lab File ID: 07NOV021728-R311

% Moisture: _____ decanted: (Y/N)___ Date Received: _____

Extraction: (SepF/Cont/Sonc) SEPF Date Extracted: 11/05/02

Concentrated Extract Volume: 10(mL) Date Analyzed: 11/08/02

Injection Volume: _____(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) Y.

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
39635-31-9------	BZ#189	0.45	
52663-78-2------	BZ#195	0.48	
40186-72-9------	BZ#206	0.50	
2051-24-3-------	BZ#209	0.53	

FORM I OTHER

FORM 1
OTHER ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

Z5LCSD

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90550

Matrix: (soil/water) WATER Lab Sample ID: Z5LCSD

Sample wt/vol: 1000 (g/mL) ML Lab File ID: 07NOV021728-R321

% Moisture: _____ decanted: (Y/N)___ Date Received: _____

Extraction: (SepF/Cont/Sonc) SEPF Date Extracted: 11/05/02

Concentrated Extract Volume: 10(mL) Date Analyzed: 11/08/02

Injection Volume: _____(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) Y

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
34883-43-7	BZ#8	0.50	
37680-65-2	BZ#18	0.52	
7012-37-5	BZ#28	0.46	
41464-39-5	BZ#44	0.51	
41464-40-8	BZ#49	0.52	
35693-99-3	BZ#52	0.52	
32598-10-0	BZ#66	0.45	
32598-13-3	BZ#77	0.42	
70362-50-4	BZ#81	0.94	
38380-02-8	BZ#87	0.94	
37680-73-2	BZ#101	0.51	
32598-14-4	BZ#105	0.44	
74472-37-0	BZ#114	0.45	
31508-00-6	BZ#118	0.47	
65510-44-3	BZ#123	0.48	
57465-28-8	BZ#126	0.43	P
38380-07-3	BZ#128	0.48	
35065-28-2	BZ#138	0.50	
35065-27-1	BZ#153	0.52	P
38380-08-4	BZ#156	0.44	
69782-90-7	BZ#157	0.46	
52663-72-6	BZ#167	0.48	
32774-16-6	BZ#169	0.45	
35065-30-6	BZ#170	0.50	
35065-29-3	BZ#180	0.49	
52663-69-1	BZ#183	0.51	
74472-48-3	BZ#184	0.52	P
52663-68-0	BZ#187	0.52	P

FORM I OTHER

FORM 1
OTHER ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

Z5LCSD

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90550

Matrix: (soil/water) WATER Lab Sample ID: Z5LCSD

Sample wt/vol: 1000 (g/mL) ML Lab File ID: 07NOV021728-R321

% Moisture: _____ decanted: (Y/N)___ Date Received: _____

Extraction: (SepF/Cont/Sonc) SEPF Date Extracted: 11/05/02

Concentrated Extract Volume: 10(mL) Date Analyzed: 11/08/02

Injection Volume: _____(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) Y

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
39635-31-9------	BZ#189	0.46	
52663-78-2------	BZ#195	0.50	
40186-72-9------	BZ#206	0.52	
2051-24-3-------	BZ#209	0.54	

FORM I OTHER

FORM 2
WATER OTHER SURROGATE RECOVERY

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90550

GC Column(1): RTX-5 ID: 0.25 (mm) GC Column(2): RTX-CLPII ID: 0.25 (mm)

	CLIENT SAMPLE NO.	S1 1 %REC #	S1 2 %REC #	S2 1 %REC #	S2 2 %REC #	OTHER (1)	OTHER (2)	TOT OUT
01	PBLKV5	53	53	-	-			2
02	BH208WATER	64	64	-	-			2
03	PBLKZ5	93	93	87	80			0
04	Z5LCS	93	93	87	87			0
05	Z5LCSD	93	93	80	80			0
06	BH208WATERRE	100	100	93	93			0
07								
08								
09								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								

ADVISORY
QC LIMITS

S1 = Tetrachloro-meta-xylen (30-150)
S2 = BZ#198 (30-150)

Column to be used to flag recovery values
* Values outside of QC limits
D Surrogate diluted out

FORM 3
WATER OTHER LAB CONTROL SAMPLE

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90550

Matrix Spike - Sample No.: Z5LCS

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONCENTRATION (ug/L)	LCS CONCENTRATION (ug/L)	LCS % REC #	QC. LIMITS REC.
BZ#8	0.50		0.48	96	40-150
BZ#18	0.50		0.50	100	40-150
BZ#28	0.50		0.45	90	40-150
BZ#44	0.50		0.49	98	40-150
BZ#49	0.50		0.50	100	40-150
BZ#52	0.50		0.51	102	40-150
BZ#66	0.50		0.44	88	40-150
BZ#77	0.50		0.40	80	40-150
BZ#81	0.50		0.90	180*	40-150
BZ#87	0.50		0.90	180*	40-150
BZ#101	0.50		0.50	100	40-150
BZ#105	0.50		0.42	84	40-150
BZ#114	0.50		0.43	86	40-150
BZ#118	0.50		0.46	92	40-150
BZ#123	0.50		0.46	92	40-150
BZ#126	0.50		0.40	80	40-150
BZ#128	0.50		0.47	94	40-150
BZ#138	0.50		0.48	96	40-150
BZ#153	0.50		0.50	100	40-150
BZ#156	0.50		0.43	86	40-150
BZ#157	0.50		0.44	88	40-150
BZ#167	0.50		0.46	92	40-150
BZ#169	0.50		0.43	86	40-150
BZ#170	0.50		0.48	96	40-150
BZ#180	0.50		0.48	96	40-150
BZ#183	0.50		0.49	98	40-150
BZ#184	0.50		0.51	102	40-150
BZ#187	0.50		0.52	104	40-150

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

COMMENTS: _____

FORM 3
WATER OTHER LAB CONTROL SAMPLE

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90550

Matrix Spike - Sample No.: Z5LCS

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONCENTRATION (ug/L)	LCS CONCENTRATION (ug/L)	LCS % REC #	QC. LIMITS REC.
BZ#189	0.50		0.45	90	40-150
BZ#195	0.50		0.48	96	40-150
BZ#206	0.50		0.50	100	40-150
BZ#209	0.50		0.53	106	40-150

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

COMMENTS: _____

111 Merrick Street
Merrimack, NH 03054

Fax: (603) 429-8496

Project No.: 16421	Project Name: NBH FEIR DMMP	Project Manager:	Samplers (Signature): Gracie Gherardi	AMRO Project No.: 0210204
	Project State: MA			

Sample ID	Date/Time Sampled	Matrix (A= Air, S= Soil, GW= Ground W., WW= Waste W., DW= Drinking W., O= Oil, Other= Specify)	Total # of Cont. & Size	Comp	Grab	TOC	PCB Congeners	Dioxin/Furan 1280	Remarks
-01G NBH-208-water	10/22/02	SW	2x40ml		X	✓			
-01H NBH-208-water	↓	↓	2x1LGAL		↓		✓		
-01I NBH-208-water	↓	↓	2x1LGAL		↓			✓	
Preservative: Cl-HCl, MeOH, N-HN03, S-H2SO4, Na-NaOH, O- Other						S	—	—	
Container Type: P- Plastic, G-Glass, V-Vial, T- Teflon, O-Other						V	G	G	

Send Results To:	FAX No.:	Seal Intact? Yes No N/A	P.O. No:	GW-1* ___ GW-2 ___ GW-3 ___
AMRO Environmental 111 Merrick St Merrimack, NH 03054	603-429-8496	Results Needed By: STD		MCP Level Needed: ICE *= May require additional cost

Relinquished By	Date/ Time	Received By
Gracie Gherardi	15:30 10/23/02	Bob Hawkes
Bob Hawkes	16:10 10-23-02	[illegible] 10/23/02

PRIORITY TURNAROUND TIME AUTHORIZATION
Before submitting samples for expedited TAT, you must have requested in advance and received a coded **AUTHORIZATION NUMBER.**
Samples arriving after 12:00 noon will be tracked and billed as received on the following day.
AUTHORIZATION No. _____ BY: _____

Please print clearly, legibly and completely. Samples can not be logged in and the turnaround time clock will not start until any ambiguities are resolved.

NOTES: Preservatives, Special reporting limits, Known Contamination, etc; H_2SO_4

AMRO policy requires notification in writing to the laboratory in cases where the samples were collected from highly contaminated sites.

White: Lab Copy Yellow: Accompanies Report Pink: Client Copy SHEET 1 OF 1

Fedex Dioxins to Sacramento / TOC & PCB FEDEX to Burlington

AMRO Environmental Laboratories Corporation

111 Herrick Street, Merrimack, NH 03054
TEL: (603) 424-2022 · FAX: (603) 429-8496

December 06, 2002

Tom Hevner
Maguire Group, Inc.
225 Foxborough Boulevard
Foxborough, MA 02035
TEL: (508) 543-1700
FAX: (508) 543-5157

RE: 16421 NB Harbor FEIR Workorder No.: 0210141

Dear Tom Hevner:

AMRO Environmental Laboratories Corp. received 2 samples on 10/15/02 for the analyses presented in the following report.

AMRO operates a Quality Assurance Program which meets or exceeds National Environmental Laboratory Accreditation Conference (NELAC), state, and EPA requirements. A copy of the appropriate state and/or NELAC Certificate is attached.

The enclosed Sample Receipt Checklist details the condition of your sample(s) upon receipt. Please be advised that any unused sample volume and sample extracts will be stored for a period of 60 days from sample receipt date (90 days for samples from New York). After this time, AMRO will properly dispose of the remaining sample(s). If you require further analysis, or need the samples held for a longer period, please contact us immediately.

This report consists of a total of 79 pages. This letter is an integral part of your data report. All results in this project relate only to the sample(s) as received by the laboratory and documented in the Chain-of-Custody. This report shall not be reproduced except in full, without the written approval of the laboratory. If you have any questions regarding this project in the future, please refer to the Workorder Number above.

Sincerely,

Nancy Stewart
Vice President/LabDirector

1987 AMRO ENVIRONMENTAL LABS 15th ANNIVERSARY MERRIMACK, NH 2002

AMRO Environmental Laboratories Corp.

Date: *25-Nov-02*

CLIENT: Maguire Group, Inc.
Project: 16421 NB Harbor FEIR
Lab Order: 0210141
Date Received: 10/15/02

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Collection Date
0210141-01A	NBH-202-3-SED	10/10/02
0210141-01B	NBH-202-3-SED	10/10/02
0210141-02A	NBH-206-3-SED	10/10/02
0210141-02B	NBH-206-3-SED	10/10/02

AMRO Environmental Laboratories Corp.

25-Nov-02

Lab Order: 0210141
Client: Maguire Group, Inc.
Project: 16421 NB Harbor FEIR

DATES REPORT

Sample ID	Client Sample ID	Collection Date	Matrix	Test Name	TCLP Date	Prep Date	Analysis Date	Batch ID
0210141-01A	NBH-202-3-SED	10/10/02	Sediment	ORGANOCHLORINE PESTICIDES		10/18/02	10/22/02	7932
				PAH BY EPA 8270C		10/21/02	10/22/02	7930
0210141-02A	NBH-206-3-SED			ORGANOCHLORINE PESTICIDES		10/18/02	10/22/02	7932
				PAH BY EPA 8270C		10/21/02	10/22/02	7930

AMRO Environmental Laboratories Corporation
111 Herrick Street
Merrimack, NH 03054

CHAIN-OF-CUSTODY RECORD

43439

Office: (603) 424-2022
Fax: (603) 429-8496

Project No.: 16421 | Project Name: NB Harbor FEIR | Project Manager: TBH | Sampler (Signature): [signature] | AMRO Project No.: 0210114

Project State:

Sample ID	Date/Time Sampled	Matrix (A= Air, S= Soil, GW= Ground W., WW= Waste W., DW= Drinking W., O= Oil, Other= Specify)	Total # of Cont. & Size	Comp	Grab	RCRA(8) Metals	Dioxin/Furan	PCB Congeners	Pesticides	PAH 8270	TOC-9060	Water Content	Grain/Hydro	% Total Solids	Nickel	Zinc	Copper	Remarks
NBH-201-1-SED	10/10/02	Sed	3x8oz	SD	✓	X									X	X	X	
NBH-201-2-SED	10/10/02	Sed	3x8oz		✓										X			
NBH-201-3-SED	10/10/02	Sed	3x8oz		✓													FAST TURN
NBH-202-1-SED	10/10/02	Sed	3x8oz		✓													FOR
NBH-202-2-SED	10/10/02	Sed	3x8oz		✓													Metals,
NBH-202-3-SED	10/10/02	Sed	3x8oz		✓		X	X	X	X	X	X	X	X				Results will
NBH-203-1-SED	10/10/02	Sed	3x8oz		✓													dictate of
NBH-203-2-SED	10/10/02	Sed	3x8oz		✓													analysis.
NBH-203-3-SED	10/10/02	Sed	3x8oz		✓													
NBH-204-1-SED	10/10/02	Sed	3x8oz		✓													

Preservative: Cl-HCl, MeOH, N-HNO3, S-H2SO4, Na-NaOH, O- Other

Container Type: P- Plastic, G-Glass, V-Vial, T- Teflon, O-Other

Send Results To: Tom Hevner, Maguire Group, Inc.

FAX No.: 508-543-5157

Seal Intact? Yes No N/A

P.O. No:

GW-1* GW-2 GW-3 [illegible]

MCP Level Needed:

Results Needed By:

*= May require additional cost

Relinquished By	Date/Time	Received By
[signature]	13:30 10-11-02	[signature]

PRIORITY TURNAROUND TIME AUTHORIZATION

Before submitting samples for expedited TAT, you must have requested in advance and received a coded **AUTHORIZATION NUMBER.**

Samples arriving after 12:00 noon will be tracked and billed as received **on the following day.**

AUTHORIZATION No. _____ BY: _____

Please print clearly, legibly and completely. Samples can not be logged in and the turnaround time clock will not start until any ambiguities are resolved.

NOTES: Preservatives, Special reporting limits, Known Contamination, etc;

AMRO policy requires notification in writing to the laboratory in cases where the samples were collected from highly contaminated sites.

White: Lab Copy | Yellow: Accompanies Report | Pink: Client Copy | SHEET 1 OF 3

AMRO Environmental Laboratories Corporation
111 Herrick Street
Merrimack, NH 03054

CHAIN-OF-CUSTODY RECORD

43450

Office: (603) 424-2022
Fax: (603) 429-8496

Project No.: 16421	Project Name: NB Harbor FEIR	Project Manager: TBH	Samplers (Signature): [signature]	AMRO Project No.: 0210114
	Project State:			

Sample ID	Date/Time Sampled	Matrix A= Air S= Soil GW= Ground W. WW= Waste W. DW= Drinking W. O= Oil Other= Specify	Total # of Cont. & Size	Comp	Grab	PCBA (8) Metals	Dioxin/Furan	PCB Congeners	Pest	PAH	TOC-9060	Water Content	Grain/Hydro	% Fitted Solids	Nickel	Zinc	Copper	Remarks
NBH-204-2-SED	10/10/02	Sed	3 x 8oz	X		X									X	X	X	
NBH-204-3-SED	10/10/02	Sed	3 x 8oz	↓		X									X	X	↓	
NBH-205-1-SED	10/10/02	Sed	3 x 8oz	↓		X									X	X	↓	
NBH-205-2-SED	10/10/02	Sed	3 x 8oz	↓		X									X	X	↓	
NBH-205-3-SED	10/10/02	Sed	3 x 8oz	↓		X									X	X	↓	
NBH-205-4-SED	10/10/02	Sed	3 x 8oz	↓		X									X	X	↓	
~~NBH-206-1-SED~~	~~10/10/02~~	~~S~~	~~3 x 8oz~~															
~~NBH-206-2-SED~~	~~10/10/02~~	~~S~~	~~3 x 8oz~~															
~~NBH-206-3-SED~~	~~10/10/02~~	~~S~~	~~3 x 8oz~~															

Preservative: Cl-HCl, MeOH, N-HN03, S-H2SO4, Na-NaOH, O- Other

Container Type: P- Plastic, G-Glass, V-Vial, T- Teflon, O-Other

Send Results To:	FAX No.:	Seal Intact?	P.O. No:	GW-1* GW-2 GW-3
Tom Heuner Maguire Group, Inc.	508.543-5157	Yes No N/A		MCP Level Needed:
		Results Needed By:		*= May require additional cost

Relinquished By	Date/Time	Received By
[signature]	13:30 10-11-02	[signature]

PRIORITY TURNAROUND TIME AUTHORIZATION

Before submitting samples for expedited TAT, you must have requested in advance and received a coded **AUTHORIZATION NUMBER.** *Samples arriving after 12:00 noon will be tracked and billed as received* **on the following day.**

AUTHORIZATION No. _____ BY: _____

Please print clearly, legibly and completely. Samples can not be logged in and the turnaround time clock will not start until any ambiguities are resolved.

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White: Lab Copy Yellow: Accompanies Report Pink: Client Copy SHEET 2 OF 3

AMRO Environmental Laboratories Corporation
111 Herrick Street
Merrimack, NH 03054

CHAIN-OF-CUSTODY RECORD

43451

Office: (603) 424-2022
Fax: (603) 429-8496

Project No.: 16421	Project Name: NB Harbor FEIR	Project Manager: TBH	Samplers (Signature): TB-Jth	AMRO Project No.: 0210114
	Project State:			

Sample ID	Date/Time Sampled	Matrix (A= Air, S= Soil, GW= Ground W., WW= Waste W., DW= Drinking W., O= Oil, Other= Specify)	Total # of Cont. & Size	Comp	Grab	ICAP(8) Metals	Dioxin/Furan	PCB Congeners	Pest.	PAH	TOC 9060	Water Content	Grain Analysis	% Total Solids	Nickel	Zinc	Copper	Remarks
NBH-206-1-SED	10/10/02	S	3x8oz	X		X									X	X	X	
NBH-206-2-SED	10/10/02	S	3x8oz	X		X									X	X	X	
NBH-206-3-SED	10/10/02	S	3x8oz	X		X	X	X	X	X	X	X	X	X	X	X	X	
NBH-206-4-SED	10/10/02	S	3x8oz	X		X									X	X	X	

Preservative: Cl-HCl, MeOH, N-HN03, S-H2SO4, Na-NaOH, O- Other

Container Type: P- Plastic, G-Glass, V-Vial, T- Teflon, O-Other

Send Results To:	FAX No.:	Seal Intact?	P.O. No:	GW-1*	GW-2	GW-3
Tom Hevner, Maguire Group, Inc.	508.543-5157	Yes No N/A		MCP Level Needed:		
		Results Needed By:		*= May require additional cost		

Relinquished By	Date/Time	Received By
TB-Jth	13:30 10-11-02	[illegible]

PRIORITY TURNAROUND TIME AUTHORIZATION

Before submitting samples for expedited TAT, you must have requested in advance and received a coded AUTHORIZATION NUMBER. *Samples arriving after 12:00 noon will be tracked and billed as received on the following day.*

AUTHORIZATION No. _____ BY: _____

Please print clearly, legibly and completely. Samples can not be logged in and the turnaround time clock will not start until any ambiguities are resolved.

NOTES: Preservatives, Special reporting limits, Known Contamination, etc;

AMRO policy requires notification in writing to the laboratory in cases where the samples were collected from highly contaminated sites.

White: Lab Copy Yellow: Accompanies Report Pink: Client Copy

SHEET 3 OF 3

The Commonwealth of Massachusetts

Department of Environmental Protection

Division of Environmental Analysis
Senator William X. Wall Experiment Station

certifies

M- NH012

AMRO ENVIRONMENTAL LAB
111 HERRICK ST
MERRIMACK, NH 03054-0000

Laboratory Director: **Nancy Stewart**

for the analysis of **NON POTABLE WATER (CHEMISTRY)**
POTABLE WATER (CHEMISTRY)

pursuant to 310 CMR 42.00

This certificate supersedes all previous Massachusetts certificates issued to this laboratory. The laboratory is regulated by and shall be responsible for being in compliance with Massachusetts regulations at 310 CMR 42.00.

This certificate is valid only when accompanied by the latest dated Certified Parameter List as issued by the Massachusetts D.E.P. Contact the Division of Environmental Analysis to verify the current certification status of the laboratory.

Certification is no guarantee of the validity of the data. This certification is subject to unannounced laboratory inspections.

Issued: **01 JUL 2002**
Expires: **30 JUN 2003**

Director, Division of Environmental Analysis

COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Certified Parameter List as of: 15 OCT 2002

M- NH012 AMRO ENVIRONMENTAL LAB
MERRIMACK NH

NON POTABLE WATER (CHEMISTRY) Effective Date 15 OCT 2002 Expiration Date 30 JUN 2003

Analytes and Methods

ALUMINUM	EPA 200.7	ORTHOPHOSPHATE	EPA 300.0
ANTIMONY	EPA 200.7	TOTAL PHOSPHORUS	EPA 365.2
ANTIMONY	EPA 204.2	CHEMICAL OXYGEN DEMAND	EPA 410.4
ARSENIC	EPA 200.7	BIOCHEMICAL OXYGEN DEMAND	EPA 405.1
ARSENIC	EPA 206.2	TOTAL CYANIDE	EPA 335.2
ARSENIC	ASTM D2972-93(C)	NON-FILTERABLE RESIDUE	EPA 160.2
BERYLLIUM	EPA 200.7	OIL AND GREASE	EPA 413.1
CADMIUM	EPA 200.7	TOTAL PHENOLICS	EPA 420.1
CHROMIUM	EPA 200.7	VOLATILE HALOCARBONS	EPA 624
COBALT	EPA 200.7	VOLATILE AROMATICS	EPA 624
COPPER	EPA 200.7	CHLORDANE	EPA 608
IRON	EPA 200.7	ALDRIN	EPA 608
LEAD	EPA 200.7	DIELDRIN	EPA 608
LEAD	EPA 239.2	DDD	EPA 608
MANGANESE	EPA 200.7	DDT	EPA 608
MERCURY	EPA 245.1	HEPTACHLOR	EPA 608
MOLYBDENUM	EPA 200.7	HEPTACHLOR EPOXIDE	EPA 608
NICKEL	EPA 200.7	POLYCHLORINATED BIPHENYLS (WATER)	EPA 608
SELENIUM	EPA 200.7		
SELENIUM	EPA 270.2		
SILVER	EPA 200.7		
THALLIUM	EPA 279.2		
ZINC	EPA 200.7		
PH	EPA 150.1		
SPECIFIC CONDUCTIVITY	EPA 120.1		
TOTAL DISSOLVED SOLIDS	EPA 160.1		
TOTAL HARDNESS (CACO3)	EPA 200.7		
CALCIUM	EPA 200.7		
MAGNESIUM	EPA 200.7		
SODIUM	EPA 200.7		
POTASSIUM	EPA 200.7		
TOTAL ALKALINITY	EPA 310.1		
TOTAL ALKALINITY	EPA 310.2		
CHLORIDE	EPA 325.3		
CHLORIDE	EPA 300.0		
FLUORIDE	EPA 300.0		
SULFATE	EPA 300.0		
AMMONIA-N	EPA 350.2		
NITRATE-N	EPA 300.0		
NITRATE-N	EPA 353.2		
KJELDAHL-N	EPA 351.1		
ORTHOPHOSPHATE	EPA 365.2		

COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Certified Parameter List as of: 15 OCT 2002

M- NH012 AMRO ENVIRONMENTAL LAB
MERRIMACK NH

POTABLE WATER (CHEMISTRY) Effective Date 09 SEP 2002 Expiration Date 30 JUN 2003

Analytes and Methods	
ANTIMONY	EPA 200.9
ARSENIC	EPA 200.7
ARSENIC	EPA 200.9
BARIUM	EPA 200.7
BERYLLIUM	EPA 200.7
CADMIUM	EPA 200.7
CHROMIUM	EPA 200.7
COPPER	EPA 200.7
LEAD	EPA 200.9
MERCURY	EPA 245.1
NICKEL	EPA 200.7
SELENIUM	EPA 200.9
THALLIUM	EPA 200.9
NITRATE-N	EPA 353.2
NITRITE-N	EPA 353.2
FLUORIDE	EPA 300.0
SODIUM	EPA 200.7
SULFATE	EPA 300.0
CYANIDE	SM 4500-CN-C,E
TURBIDITY	EPA 180.1
CALCIUM	EPA 200.7
TOTAL ALKALINITY	SM 2320B
TOTAL DISSOLVED SOLIDS	SM 2540C
PH	EPA 150.1
1,2-DIBROMOETHANE	EPA 504.1
1,2-DIBROMO-3-CHLOROPROPANE	EPA 504.1

CASE NARRATIVE
0210141

GENERAL

1. No QC deviations were observed.

GC/MS-SEMIVOLATILES-PAH SEDIMENT

1. No QC deviations were observed.

GC/ECD-PESTICIDES SEDIMENT

1. The %difference (%D) for some compounds in the opening and closing Continuing Calibration Verification (CCV) standards analyzed on 10/22/02 (T15 + T16) on instrument Trent exceeded the ±15% limit. All samples were re-analyzed on 10/23/02 with the same result. The laboratory used the average percent difference for all analytes as per SW-846 Method 8081A Section 7.5. All results were reported from the rear column (CLP Pesticide 2, 0.32mm). Please refer to the Continuing Calibration Summary Forms in the Pesticide Section.

2. The batch Matrix Spike (MS) and Matrix Spike Duplicate (MSD) were performed on sample 0210156-02A (Batch ID: 7932). All %REC's and %RPD's were within laboratory control limits with the following exception:

   2.1 4'4'-DDT recovered outside the laboratory control limits (33-159%) in both the MS and MSD due to high native concentration relative to the spike concentration.

3. A full list Laboratory Control Sample (LCS) was performed (Batch ID: 7932) per client request. All %REC's were within laboratory control limits with the following exceptions:

   3.1 alpha-BHC, Endrin ketone, Endosulfan sulfate, and Methoxychlor recovered above the laboratory control limits. These analytes were not detected in any associated samples.

4. No other QC deviations were observed.

AMRO Environmental Laboratories Corp.

Date: *25-Nov-02*

CLIENT:	Maguire Group, Inc.	**Client Sample ID:**	NBH-202-3-SED
Lab Order:	0210141		
Project:	16421 NB Harbor FEIR	**Collection Date:**	10/10/02
Lab ID:	0210141-01A	**Matrix:**	SEDIMENT

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
PAH BY EPA 8270C		**SW8270C**				Analyst: **KD**
Naphthalene	79	390	J	µg/Kg-dry	1	10/22/02 12:11:00 PM
2-Methylnaphthalene	ND	390		µg/Kg-dry	1	10/22/02 12:11:00 PM
Acenaphthylene	100	390	J	µg/Kg-dry	1	10/22/02 12:11:00 PM
Acenaphthene	83	390	J	µg/Kg-dry	1	10/22/02 12:11:00 PM
Fluorene	80	390	J	µg/Kg-dry	1	10/22/02 12:11:00 PM
Phenanthrene	460	390		µg/Kg-dry	1	10/22/02 12:11:00 PM
Anthracene	180	390	J	µg/Kg-dry	1	10/22/02 12:11:00 PM
Fluoranthene	620	390		µg/Kg-dry	1	10/22/02 12:11:00 PM
Pyrene	940	390		µg/Kg-dry	1	10/22/02 12:11:00 PM
Benz(a)anthracene	440	390		µg/Kg-dry	1	10/22/02 12:11:00 PM
Chrysene	430	390		µg/Kg-dry	1	10/22/02 12:11:00 PM
Benzo(b)fluoranthene	420	390		µg/Kg-dry	1	10/22/02 12:11:00 PM
Benzo(k)fluoranthene	160	390	J	µg/Kg-dry	1	10/22/02 12:11:00 PM
Benzo(a)pyrene	400	390		µg/Kg-dry	1	10/22/02 12:11:00 PM
Dibenz(a,h)anthracene	ND	390		µg/Kg-dry	1	10/22/02 12:11:00 PM
Indeno(1,2,3-cd)pyrene	240	390	J	µg/Kg-dry	1	10/22/02 12:11:00 PM
Benzo(g,h,i)perylene	270	390	J	µg/Kg-dry	1	10/22/02 12:11:00 PM
Surr: Nitrobenzene-d5	69.2	23-101		%REC	1	10/22/02 12:11:00 PM
Surr: 2-Fluorobiphenyl	79.1	26-105		%REC	1	10/22/02 12:11:00 PM
Surr: 4-Terphenyl-d14	82.3	31-113		%REC	1	10/22/02 12:11:00 PM

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
H - Method prescribed holding time exceeded
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range
- See Case Narrative
RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.

AMRO Environmental Laboratories Corp.

Date: *25-Nov-02*

CLIENT:	Maguire Group, Inc.	**Client Sample ID:**	NBH-206-3-SED
Lab Order:	0210141		
Project:	16421 NB Harbor FEIR	**Collection Date:**	10/10/02
Lab ID:	0210141-02A	**Matrix:**	SEDIMENT

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
PAH BY EPA 8270C		**SW8270C**				Analyst: **KD**
Naphthalene	ND	440		µg/Kg-dry	1	10/22/02 12:37:00 PM
2-Methylnaphthalene	ND	440		µg/Kg-dry	1	10/22/02 12:37:00 PM
Acenaphthylene	ND	440		µg/Kg-dry	1	10/22/02 12:37:00 PM
Acenaphthene	ND	440		µg/Kg-dry	1	10/22/02 12:37:00 PM
Fluorene	ND	440		µg/Kg-dry	1	10/22/02 12:37:00 PM
Phenanthrene	ND	440		µg/Kg-dry	1	10/22/02 12:37:00 PM
Anthracene	ND	440		µg/Kg-dry	1	10/22/02 12:37:00 PM
Fluoranthene	ND	440		µg/Kg-dry	1	10/22/02 12:37:00 PM
Pyrene	ND	440		µg/Kg-dry	1	10/22/02 12:37:00 PM
Benz(a)anthracene	ND	440		µg/Kg-dry	1	10/22/02 12:37:00 PM
Chrysene	ND	440		µg/Kg-dry	1	10/22/02 12:37:00 PM
Benzo(b)fluoranthene	ND	440		µg/Kg-dry	1	10/22/02 12:37:00 PM
Benzo(k)fluoranthene	ND	440		µg/Kg-dry	1	10/22/02 12:37:00 PM
Benzo(a)pyrene	ND	440		µg/Kg-dry	1	10/22/02 12:37:00 PM
Dibenz(a,h)anthracene	ND	440		µg/Kg-dry	1	10/22/02 12:37:00 PM
Indeno(1,2,3-cd)pyrene	ND	440		µg/Kg-dry	1	10/22/02 12:37:00 PM
Benzo(g,h,i)perylene	ND	440		µg/Kg-dry	1	10/22/02 12:37:00 PM
Surr: Nitrobenzene-d5	70.7	23-101		%REC	1	10/22/02 12:37:00 PM
Surr: 2-Fluorobiphenyl	76.6	26-105		%REC	1	10/22/02 12:37:00 PM
Surr: 4-Terphenyl-d14	80.8	31-113		%REC	1	10/22/02 12:37:00 PM

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
H - Method prescribed holding time exceeded
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range
- See Case Narrative
RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.

AMRO Environmental Laboratories Corp.

Date: *02-Dec-02*

CLIENT: Maguire Group, Inc.
Work Order: 0210141
Project: 16421 NB Harbor FEIR

QC SUMMARY REPORT

Method Blank

Sample ID **MB-7930** Batch ID: **7930** Test Code: **SW8270C** Units: **µg/Kg** Analysis Date **10/22/02 9:30:00 AM** Prep Date **10/21/02**

Client ID: Run ID: **SV-4_021022A** SeqNo: **251786**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Naphthalene	ND	250	µg/Kg									
2-Methylnaphthalene	ND	250	µg/Kg									
Acenaphthylene	ND	250	µg/Kg									
Acenaphthene	ND	250	µg/Kg									
Fluorene	ND	250	µg/Kg									
Phenanthrene	ND	250	µg/Kg									
Anthracene	ND	250	µg/Kg									
Fluoranthene	ND	250	µg/Kg									
Pyrene	ND	250	µg/Kg									
Benz(a)anthracene	ND	250	µg/Kg									
Chrysene	ND	250	µg/Kg									
Benzo(b)fluoranthene	ND	250	µg/Kg									
Benzo(k)fluoranthene	ND	250	µg/Kg									
Benzo(a)pyrene	ND	250	µg/Kg									
Dibenz(a,h)anthracene	ND	250	µg/Kg									
Indeno(1,2,3-cd)pyrene	ND	250	µg/Kg									
Benzo(g,h,i)perylene	ND	250	µg/Kg									
Surr: Nitrobenzene-d5	1478	50	µg/Kg	2500	0	59.1	23	101	0			
Surr: 2-Fluorobiphenyl	1552	50	µg/Kg	2500	0	62.1	26	105	0			
Surr: 4-Terphenyl-d14	1482	50	µg/Kg	2500	0	59.3	31	113	0			

Qualifiers: ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank
NA - Not applicable where J values or ND results occur

AMRO Environmental Laboratories Corp.

Date: *02-Dec-02*

CLIENT: Maguire Group, Inc.
Work Order: 0210141
Project: 16421 NB Harbor FEIR

QC SUMMARY REPORT

Sample Matrix Spike

Sample ID **0210161-01AMS** Batch ID: **7930** Test Code: **SW8270C** Units: **µg/Kg-dry** Analysis Date **10/22/02 10:48:00 AM** Prep Date **10/21/02**

Client ID: Run ID: **SV-4_021022A** SeqNo: **251790**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Acenaphthene	1763	280	µg/Kg-dry	2790	0	63.2	26	102	0			
Pyrene	2078	280	µg/Kg-dry	2790	0	74.5	22	114	0			
Surr: Nitrobenzene-d5	1899	56	µg/Kg-dry	2790	0	68.1	23	101	0			
Surr: 2-Fluorobiphenyl	1895	56	µg/Kg-dry	2790	0	67.9	26	105	0			
Surr: 4-Terphenyl-d14	1898	56	µg/Kg-dry	2790	0	68	31	113	0			

Sample ID **0210161-01AMSD** Batch ID: **7930** Test Code: **SW8270C** Units: **µg/Kg-dry** Analysis Date **10/22/02 11:14:00 AM** Prep Date **10/21/02**

Client ID: Run ID: **SV-4_021022A** SeqNo: **251791**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Acenaphthene	1951	280	µg/Kg-dry	2820	0	69.2	26	102	1763	10.1	19	
Pyrene	2451	280	µg/Kg-dry	2820	0	86.9	22	114	2078	16.5	36	
Surr: Nitrobenzene-d5	2256	56	µg/Kg-dry	2820	0	80	23	101	0	0	0	
Surr: 2-Fluorobiphenyl	2316	56	µg/Kg-dry	2820	0	82.1	26	105	0	0	0	
Surr: 4-Terphenyl-d14	2175	56	µg/Kg-dry	2820	0	77.1	31	113	0	0	0	

Qualifiers: ND - Not Detected at the Reporting Limit; S - Spike Recovery outside accepted recovery limits; B - Analyte detected in the associated Method Blank; J - Analyte detected below quantitation limits; R - RPD outside accepted recovery limits; NA - Not applicable where J values or ND results occur; RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.

AMRO Environmental Laboratories Corp.

Date: *02-Dec-02*

CLIENT: Maguire Group, Inc.
Work Order: 0210141
Project: 16421 NB Harbor FEIR

QC SUMMARY REPORT

Laboratory Control Spike - Full List

Sample ID **LCSF-7930** Batch ID: **7930** Test Code: **SW8270C** Units: **µg/Kg** Analysis Date **10/22/02 9:56:00 AM** Prep Date **10/21/02**

Client ID: Run ID: **SV-4_021022A** SeqNo: **251788**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
Naphthalene	1365	250	µg/Kg	2500	0	54.6	35	97	0			
2-Methylnaphthalene	1360	250	µg/Kg	2500	0	54.4	34	99	0			
Acenaphthylene	1442	250	µg/Kg	2500	0	57.7	43	95	0			
Acenaphthene	1480	250	µg/Kg	2500	0	59.2	36	93	0			
Fluorene	1482	250	µg/Kg	2500	0	59.3	44	98	0			
Phenanthrene	1543	250	µg/Kg	2500	0	61.7	37	105	0			
Anthracene	1534	250	µg/Kg	2500	0	61.4	46	101	0			
Fluoranthene	1512	250	µg/Kg	2500	0	60.5	47	99	0			
Pyrene	1570	250	µg/Kg	2500	0	62.8	39	99	0			
Benz(a)anthracene	1582	250	µg/Kg	2500	0	63.3	45	100	0			
Chrysene	1573	250	µg/Kg	2500	0	62.9	44	102	0			
Benzo(b)fluoranthene	1554	250	µg/Kg	2500	0	62.2	44	99	0			
Benzo(k)fluoranthene	1527	250	µg/Kg	2500	0	61.1	39	111	0			
Benzo(a)pyrene	1507	250	µg/Kg	2500	0	60.3	46	101	0			
Dibenz(a,h)anthracene	1530	250	µg/Kg	2500	0	61.2	45	103	0			
Indeno(1,2,3-cd)pyrene	1502	250	µg/Kg	2500	0	60.1	42	101	0			
Benzo(g,h,i)perylene	1521	250	µg/Kg	2500	0	60.8	44	102	0			
Surr: Nitrobenzene-d5	1502	50	µg/Kg	2500	0	60.1	23	101	0			
Surr: 2-Fluorobiphenyl	1570	50	µg/Kg	2500	0	62.8	26	105	0			
Surr: 4-Terphenyl-d14	1558	50	µg/Kg	2500	0	62.3	31	113	0			

Qualifiers: ND - Not Detected at the Reporting Limit; S - Spike Recovery outside accepted recovery limits; B - Analyte detected in the associated Method Blank; J - Analyte detected below quantitation limits; R - RPD outside accepted recovery limits; NA - Not applicable where J values or ND results occur; RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.

AMRO Environmental Laboratories Corp.

Date: *25-Nov-02*

CLIENT:	Maguire Group, Inc.	**Client Sample ID:**	NBH-202-3-SED
Lab Order:	0210141		
Project:	16421 NB Harbor FEIR	**Collection Date:**	10/10/02
Lab ID:	0210141-01A	**Matrix:**	SEDIMENT

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
ORGANOCHLORINE PESTICIDES		**SW8081A**				Analyst: **RAP**
alpha-BHC	ND	1.2		µg/Kg-dry	1	10/22/02 2:38:00 PM
beta-BHC	ND	1.2		µg/Kg-dry	1	10/22/02 2:38:00 PM
delta-BHC	ND	1.2		µg/Kg-dry	1	10/22/02 2:38:00 PM
gamma-BHC	ND	1.2		µg/Kg-dry	1	10/22/02 2:38:00 PM
Heptachlor	ND	1.2		µg/Kg-dry	1	10/22/02 2:38:00 PM
Aldrin	ND	1.2		µg/Kg-dry	1	10/22/02 2:38:00 PM
Heptachlor epoxide	ND	1.2		µg/Kg-dry	1	10/22/02 2:38:00 PM
Endosulfan I	ND	1.2		µg/Kg-dry	1	10/22/02 2:38:00 PM
alpha-Chlordane	ND	1.2		µg/Kg-dry	1	10/22/02 2:38:00 PM
gamma-Chlordane	ND	1.2		µg/Kg-dry	1	10/22/02 2:38:00 PM
Dieldrin	ND	2.5		µg/Kg-dry	1	10/22/02 2:38:00 PM
4,4´-DDE	ND	2.5		µg/Kg-dry	1	10/22/02 2:38:00 PM
Endrin	22	2.5		µg/Kg-dry	1	10/22/02 2:38:00 PM
Endosulfan II	27	2.5		µg/Kg-dry	1	10/22/02 2:38:00 PM
4,4´-DDD	ND	2.5		µg/Kg-dry	1	10/22/02 2:38:00 PM
Endrin aldehyde	ND	2.5		µg/Kg-dry	1	10/22/02 2:38:00 PM
Endrin ketone	ND	2.5		µg/Kg-dry	1	10/22/02 2:38:00 PM
Endosulfan sulfate	ND	2.5		µg/Kg-dry	1	10/22/02 2:38:00 PM
4,4´-DDT	ND	2.5		µg/Kg-dry	1	10/22/02 2:38:00 PM
Methoxychlor	ND	12		µg/Kg-dry	1	10/22/02 2:38:00 PM
Toxaphene	ND	38		µg/Kg-dry	1	10/22/02 2:38:00 PM
Technical Chlordane	ND	38		µg/Kg-dry	1	10/22/02 2:38:00 PM
Surr: Tetrachloro-m-xylene	99.8	26-131		%REC	1	10/22/02 2:38:00 PM
Surr: Decachlorobiphenyl	120	19-163		%REC	1	10/22/02 2:38:00 PM

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
H - Method prescribed holding time exceeded
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range
- See Case Narrative
RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.

AMRO Environmental Laboratories Corp.

Date: *25-Nov-02*

CLIENT:	Maguire Group, Inc.	**Client Sample ID:**	NBH-206-3-SED
Lab Order:	0210141		
Project:	16421 NB Harbor FEIR	**Collection Date:**	10/10/02
Lab ID:	0210141-02A	**Matrix:**	SEDIMENT

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
ORGANOCHLORINE PESTICIDES		**SW8081A**				Analyst: **RAP**
alpha-BHC	ND	1.5		µg/Kg-dry	1	10/22/02 3:06:00 PM
beta-BHC	ND	1.5		µg/Kg-dry	1	10/22/02 3:06:00 PM
delta-BHC	ND	1.5		µg/Kg-dry	1	10/22/02 3:06:00 PM
gamma-BHC	ND	1.5		µg/Kg-dry	1	10/22/02 3:06:00 PM
Heptachlor	ND	1.5		µg/Kg-dry	1	10/22/02 3:06:00 PM
Aldrin	ND	1.5		µg/Kg-dry	1	10/22/02 3:06:00 PM
Heptachlor epoxide	ND	1.5		µg/Kg-dry	1	10/22/02 3:06:00 PM
Endosulfan I	ND	1.5		µg/Kg-dry	1	10/22/02 3:06:00 PM
alpha-Chlordane	ND	1.5		µg/Kg-dry	1	10/22/02 3:06:00 PM
gamma-Chlordane	ND	1.5		µg/Kg-dry	1	10/22/02 3:06:00 PM
Dieldrin	ND	2.9		µg/Kg-dry	1	10/22/02 3:06:00 PM
4,4´-DDE	ND	2.9		µg/Kg-dry	1	10/22/02 3:06:00 PM
Endrin	ND	2.9		µg/Kg-dry	1	10/22/02 3:06:00 PM
Endosulfan II	ND	2.9		µg/Kg-dry	1	10/22/02 3:06:00 PM
4,4´-DDD	ND	2.9		µg/Kg-dry	1	10/22/02 3:06:00 PM
Endrin aldehyde	ND	2.9		µg/Kg-dry	1	10/22/02 3:06:00 PM
Endrin ketone	ND	2.9		µg/Kg-dry	1	10/22/02 3:06:00 PM
Endosulfan sulfate	ND	2.9		µg/Kg-dry	1	10/22/02 3:06:00 PM
4,4´-DDT	ND	2.9		µg/Kg-dry	1	10/22/02 3:06:00 PM
Methoxychlor	ND	15		µg/Kg-dry	1	10/22/02 3:06:00 PM
Toxaphene	ND	46		µg/Kg-dry	1	10/22/02 3:06:00 PM
Technical Chlordane	ND	46		µg/Kg-dry	1	10/22/02 3:06:00 PM
Surr: Tetrachloro-m-xylene	71.4	26-131		%REC	1	10/22/02 3:06:00 PM
Surr: Decachlorobiphenyl	70.4	19-163		%REC	1	10/22/02 3:06:00 PM

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
H - Method prescribed holding time exceeded
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range
- See Case Narrative
RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.

CONTINUING CALIBRATION SUMMARY

Analysis Date: 22 Oct 2002 Analyst: rap

Instrument ID: TRENT

COLUMN ID: **FRONT** CLP Pesticide 1; 0.32mm **BACK** CLP Pesticide 2; 0.32mm

BREAKDOWN (1):

	Front		Back
DDT	1.8	DDT	3.1
ENDRIN	4.0	ENDRIN	3.7

Initial CCV: T15 Term. CCV: T16

INDA

	Front	Back	Front	Back
TCX	-1.7	4.3	-3.6	3.2
ALPHA-BHC	-2.0	3.6	2.4	6.3
GAMMA-BHC	1.0	4.9	-1.4	0.8
HEPTACHLOR	-2.0	-13.1	-26.7 *	* 25.5
ENDOSULFAN I	2.0	-0.7	-11.5	-2.2
DIELDRIN	-2.0	-0.1	-9.5	-4.2
ENDRIN	-1.0	0.5	-6.7	-2.7
DDD	-2.2	2.9	43.5 *	* 38.2
DDT	0.8	5.7	-80.5 *	* -71.3
METHOXYCHLOR	6.1	9.3	-76.6 *	* -56.2
DCB	-0.8	0.4	-9.7	* -22.6

INDB

	Front	Back	Front	Back
TCX	-0.2	0.7	-4.4	1.8
ALDRIN	-4.7	-1.7	-11.3	-3.1
BETA-BHC	1.6	-1.4	2.5	-3.1
DELTA-BHC	25.3 *	10.0	109.6 *	* 42.3
HEPTACHLOR EPOXIDE	-0.3	-4.1	-11.4	-5.6
GAMMA-CHLORDANE	-8.2	0.7	-4.6	-4.1
ALPHA-CHLORDANE	0.2	-1.5	-11.3	-4.9
DDE	-5.4	-3.9	-8.9	-4.6
ENDOSULFAN II	-0.4	2.5	-4.6	8.1
ENDRIN ALDEHYDE	-7.8	2.3	-13.7	5.2
ENDOSULFAN SULFATE	70.3 *	8.7	80.6 *	7.0
ENDRIN KETONE	100.4 *	8.9	22.6 *	* -17.1
DCB	2.9	0.9	-7.3	* -16.6
Ave. %Drift for all analytes (2):	10.4	3.9	23.5	14.9

Data Files		PEM:	C:\HPCHEM\1\DATA\02OCT22\T22OCT03.D
1st INDA:	C:\HPCHEM\1\DATA\02OCT22\T22OCT01.D	2nd INDA:	C:\HPCHEM\1\DATA\02OCT22\T22OCT22.D
1st INDB:	C:\HPCHEM\1\DATA\02OCT22\T22OCT02.D	2nd INDB:	C:\HPCHEM\1\DATA\02OCT22\T22OCT23.D

Notes:
1. 4,4' DDT and Endrin maximum degradation = 15%
2. Ave %Drift maximum = 15%

AMRO Environmental Laboratories Corp.

Date: *02-Dec-02*

CLIENT: Maguire Group, Inc.
Work Order: 0210141
Project: 16421 NB Harbor FEIR

QC SUMMARY REPORT

Method Blank

Sample ID **MB-7932** Batch ID: **7932** Test Code: **SW8081A** Units: **µg/Kg** Analysis Date **10/22/02 1:43:00 PM** Prep Date **10/18/02**

Client ID: Run ID: **GC-TRENT_021022A** SeqNo: **252445**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
alpha-BHC	ND	0.80	µg/Kg									
beta-BHC	ND	0.80	µg/Kg									
delta-BHC	ND	0.80	µg/Kg									
gamma-BHC	ND	0.80	µg/Kg									
Heptachlor	ND	0.80	µg/Kg									
Aldrin	ND	0.80	µg/Kg									
Heptachlor epoxide	ND	0.80	µg/Kg									
Endosulfan I	ND	0.80	µg/Kg									
alpha-Chlordane	ND	0.80	µg/Kg									
gamma-Chlordane	ND	0.80	µg/Kg									
Dieldrin	ND	1.6	µg/Kg									
4,4´-DDE	ND	1.6	µg/Kg									
Endrin	ND	1.6	µg/Kg									
Endosulfan II	ND	1.6	µg/Kg									
4,4´-DDD	ND	1.6	µg/Kg									
Endrin aldehyde	ND	1.6	µg/Kg									
Endrin ketone	ND	1.6	µg/Kg									
Endosulfan sulfate	ND	1.6	µg/Kg									
4,4´-DDT	ND	1.6	µg/Kg									
Methoxychlor	ND	8.0	µg/Kg									
Toxaphene	ND	25	µg/Kg									
Technical Chlordane	ND	25	µg/Kg									
Surr: Tetrachloro-m-xylene	6.65	0	µg/Kg	8	0	83.1	26	131	0			
Surr: Decachlorobiphenyl	6.974	0	µg/Kg	8	0	87.2	19	163	0			

Qualifiers: ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank
NA - Not applicable where J values or ND results occur

AMRO Environmental Laboratories Corp.

Date: *02-Dec-02*

CLIENT: Maguire Group, Inc.
Work Order: 0210141
Project: 16421 NB Harbor FEIR

QC SUMMARY REPORT

Sample Matrix Spike

Sample ID **0210156-02AMS** Batch ID: **7932** Test Code: **SW8081A** Units: **µg/Kg-dry** Analysis Date **10/22/02 4:29:00 PM** Prep Date **10/18/02**
Client ID: Run ID: **GC-TRENT_021022A** SeqNo: **252458**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
gamma-BHC	9.298	0.84	µg/Kg-dry	10.46	0	88.9	22	154	0			
Heptachlor	12.3	0.84	µg/Kg-dry	10.46	0	118	29	122	0			
Aldrin	8.392	0.84	µg/Kg-dry	10.46	0	80.2	22	143	0			
Dieldrin	22.56	1.7	µg/Kg-dry	26.16	0	86.2	22	141	0			
Endrin	20.99	1.7	µg/Kg-dry	26.16	0	80.3	40	162	0			
Surr: Tetrachloro-m-xylene	6.938	0	µg/Kg-dry	8.37	0	82.9	26	131	0			
Surr: Decachlorobiphenyl	9.933	0	µg/Kg-dry	8.37	0	119	19	163	0			

Sample ID **0210156-02AMS** Batch ID: **7932** Test Code: **SW8081A** Units: **µg/Kg-dry** Analysis Date **10/22/02 7:41:00 PM** Prep Date **10/18/02**
Client ID: Run ID: **GC-TRENT_021022A** SeqNo: **252459**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
4,4´-DDT	324.4	17	µg/Kg-dry	26.16	584	-992	33	159	0			S

Qualifiers: ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank
NA - Not applicable where J values or ND results occur

AMRO Environmental Laboratories Corp.

Date: *02-Dec-02*

CLIENT: Maguire Group, Inc.
Work Order: 0210141
Project: 16421 NB Harbor FEIR

QC SUMMARY REPORT

Sample Matrix Spike Duplicate

Sample ID **0210156-02AMSD** Batch ID: **7932** Test Code: **SW8081A** Units: **µg/Kg-dry** Analysis Date **10/22/02 4:56:00 PM** Prep Date **10/18/02**
Client ID: Run ID: **GC-TRENT_021022A** SeqNo: **252460**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
gamma-BHC	8.997	0.83	µg/Kg-dry	10.35	0	86.9	22	154	8.14	10	50	
Heptachlor	10.79	0.83	µg/Kg-dry	10.35	0	104	29	122	12.06	11.2	50	
Aldrin	7.718	0.83	µg/Kg-dry	10.35	0	74.6	22	143	9.034	15.7	50	
Dieldrin	20.32	1.7	µg/Kg-dry	25.87	0	78.6	22	141	20.79	2.28	50	
Endrin	18.04	1.7	µg/Kg-dry	25.87	0	69.7	40	162	20.17	11.2	50	
Surr: Tetrachloro-m-xylene	6.494	0	µg/Kg-dry	8.279	0	78.4	26	131	0	0	0	
Surr: Decachlorobiphenyl	6.367	0	µg/Kg-dry	8.279	0	76.9	19	163	0	0	0	

Sample ID **0210156-02AMSD** Batch ID: **7932** Test Code: **SW8081A** Units: **µg/Kg-dry** Analysis Date **10/22/02 8:09:00 PM** Prep Date **10/18/02**
Client ID: Run ID: **GC-TRENT_021022A** SeqNo: **252461**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
4,4'-DDT	276.5	17	µg/Kg-dry	25.87	584	-1190	33	159	324.4	16	50	S

Qualifiers: ND - Not Detected at the Reporting Limit; S - Spike Recovery outside accepted recovery limits; B - Analyte detected in the associated Method Blank; J - Analyte detected below quantitation limits; R - RPD outside accepted recovery limits; NA - Not applicable where J values or ND results occur; RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.

AMRO Environmental Laboratories Corp.

Date: *02-Dec-02*

CLIENT: Maguire Group, Inc.
Work Order: 0210141
Project: 16421 NB Harbor FEIR

QC SUMMARY REPORT

Laboratory Control Spike - Full List

Sample ID **LCSF-7932** Batch ID: **7932** Test Code: **SW8081A** Units: **µg/Kg** Analysis Date **10/22/02 2:11:00 PM** Prep Date **10/18/02**

Client ID: Run ID: **GC-TRENT_021022A** SeqNo: **252447**

Analyte	QC Sample Result	RL	Units	QC Spike Amount	Original Sample Result	%REC	LowLimit	HighLimit	Original Sample or MS Result	%RPD	RPDLimit	Qua
alpha-BHC	13.09	0.80	µg/Kg	10	0	131	50	130	0			S
beta-BHC	10.99	0.80	µg/Kg	10	0	110	50	130	0			
delta-BHC	10.21	0.80	µg/Kg	10	0	102	50	130	0			
gamma-BHC	12.49	0.80	µg/Kg	10	0	125	27	162	0			
Heptachlor	8.39	0.80	µg/Kg	10	0	83.9	33	132	0			
Aldrin	11.74	0.80	µg/Kg	10	0	117	40	147	0			
Heptachlor epoxide	11.27	0.80	µg/Kg	10	0	113	50	130	0			
Endosulfan I	10.7	0.80	µg/Kg	10	0	107	50	130	0			
alpha-Chlordane	10.03	0.80	µg/Kg	10	0	100	50	130	0			
gamma-Chlordane	10.74	0.80	µg/Kg	10	0	107	50	130	0			
Dieldrin	11.04	1.6	µg/Kg	10	0	110	41	139	0			
4,4´-DDE	11.37	1.6	µg/Kg	10	0	114	50	130	0			
Endrin	12.97	1.6	µg/Kg	10	0	130	43	184	0			
Endosulfan II	11.81	1.6	µg/Kg	10	0	118	50	130	0			
4,4´-DDD	12.22	1.6	µg/Kg	10	0	122	50	130	0			
Endrin aldehyde	10.82	1.6	µg/Kg	10	0	108	50	130	0			
Endrin ketone	14.5	1.6	µg/Kg	10	0	145	50	130	0			S
Endosulfan sulfate	13.09	1.6	µg/Kg	10	0	131	50	130	0			S
4,4´-DDT	13.37	1.6	µg/Kg	10	0	134	38	153	0			
Methoxychlor	13.25	8.0	µg/Kg	10	0	132	50	130	0			S
Surr: Tetrachloro-m-xylene	7.278	0	µg/Kg	8	0	91	26	131	0			
Surr: Decachlorobiphenyl	7.655	0	µg/Kg	8	0	95.7	19	163	0			

Qualifiers: ND - Not Detected at the Reporting Limit; S - Spike Recovery outside accepted recovery limits; B - Analyte detected in the associated Method Blank; J - Analyte detected below quantitation limits; R - RPD outside accepted recovery limits; NA - Not applicable where J values or ND results occur; RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.

SEVERN TRENT SERVICES

STL Burlington
208 South Park Drive
Suite 1
Colchester, VT 05446

Tel: 802 655 1203
Fax: 802 655 1248
www.stl-inc.com

November 19, 2002

Ms. Mary Ann Steen
AMRO Environmental
111 Herrick Street
Merrimack, NH 03054

Re: Laboratory Project No.: 22000
ETR: 90425

Dear Ms. Steen:

Enclosed are the analytical results of samples received intact by Severn Trent Laboratories on October 18, 2002. Laboratory numbers have been assigned and designated as follows:

Lab ID	Client Sample ID	Sample Date	Sample Matrix
	Received: 10/18/02 ETR No: 90425		
506124	01B NBH-202-3-SED	10/10/02	Sediment
506125	02B NBH-206-3-SED	10/10/02	Sediment

In order to accommodate field length limitations in processing the data summary forms, the laboratory did, in certain instances, abbreviate the sample identifiers

PCB Congeners by Method 8082:
Please note that the original extraction of the two field samples in this delivery group were inadvertently accomplished using a total PCB Method 8082 extraction procedure rather than that for Method 8082 PCB Congeners. As a result, only the surrogate monitoring compound Tetrachloro-meta-xylene was spiked into field samples and quality control samples of this delivery group. Since BZ#198 was not spiked into the samples, no percent recoveries are available. Additionally, the original blank spike and duplicate sample analysis is not presented in this case submittal since the Aroclor 1260 spike was used rather than the appropriate fortified congeners.

These samples were subsequently re-extracted outside the method specified holding time, yielding the appropriate surrogate percent recoveries and blank spike and duplicate percent recoveries that were within the control limits. The PCB Congener analysis of the blank spike and blank spike duplicate sample identified as A1LCS/LCSD exhibited percent recoveries of the target congener BZ#87 that exceeded the control criteria due to coelution with BZ#81. This exceedence can be found on the associated form IIIs. Both sets of data have been presented in this case submittal. The re-extracted and re-analyzed samples have been assigned a suffix RE to discern them from the original set.

SEVERN TRENT SERVICES

STL Burlington

PCB Congeners by Method 8082 (cont.):
The analyses of the samples 01BNBH2023 and 01BNBH2023RE were performed at dilutions in order to provide quantification of all target analytes within the calibrated range of instrument response.

Select target congeners coeluted with non-target congeners on both the RTX-5 and RTX-CLP II and analytical columns. Please refer to the following table for a detailed listing:

RTX-5 analytical column		*RTX-CLP II analytical column*	
Target congener	Coelutes with congener	Target congener	Coelutes with congener(s)
BZ#87	BZ#81	BZ#87	BZ#81
BZ#153	BZ#184	BZ#126	BZ#187

Select continuing calibration standards exhibited percent difference relative to the nominal concentrations that exceeded the established 15 percent difference criteria for the target congeners BZ#77, BZ#126, BZ#153, BZ#105, BZ#118, BZ#206 and BZ#209. These congeners were not detected in the field samples of this case submittal.

The PCB congener BZ#209 reported in the preparatory blank PBLKU1 and the field sample 02B NHB-206-3-SED was actually the PCB surrogate monitoring compound Decachlorobiphenyl which was inadvertently spiked into that extraction batch. Consequently, a "B" flag was applied to the field sample for this compound.

Please note that due to a low response and chromatographic tailing, the retention time windows for congeners BZ#77 and BZ 126 were extended to 0.06 rather than the normal 0.05 minutes.

The sample extracts 01BNBH2023RE and 02BNBH2063RE received additional supfur clean-up. The associated clean-up blank is identified as PIBLK_SCU.

Total Organic Carbon by the Lloyd Kahn Method:
No exceptions to the method prescribed quality control criteria were observed during the analyses of the samples in this delivery group.

Particle Size by ASTM Method D422:
No exceptions to the method prescribed quality control criteria were observed during the analyses of the samples in this delivery group.

Moisture Content by ASTM Method D2216:
No exceptions to the method prescribed quality control criteria were observed during the analyses of the samples in this delivery group.

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Client specified matrix spike/matrix spike duplicate samples were not analyzed or requested with the above samples. However, routine method quality control analyses were performed.

If there are any questions regarding this submittal, please contact Ron Pentkowski on at (802) 655-1203.

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I certify that this package is in compliance with the NELAC requirements, both technically and for completeness, for other than the conditions detailed above. The release of the data contained in this hardcopy data package and the computer readable data submitted on diskette has been authorized by the Laboratory Director or his designee, as verified by the following signature.

Sincerely,

Michael F. Wheeler, Ph.D.
Laboratory Director

Enclosure

STL Burlington is a part of Severn Trent Laboratories, Inc.

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Wet Chemistry

Data Qualifiers

N- Matrix spiked sample recovery not within control limits.

*- Duplicate analysis not within control limits.

Concentration Qualifiers

U- Result less than reporting limit.

Result Qualifiers

RL- Reporting Limit, includes dilution and preparation information.

DF- Dilution factor performed on sample.

WET CHEMISTRY

Sample Report Summary

Client Sample No.

01B NBH-202-3-SED

Lab Name: STL BURLINGTON

Lab Code: STLVT

Matrix: SEDIMENT

% Solids: 63.3

Contract:

Case No.:

Client: AMRO

SDG No.: 90425

Lab Sample ID: 506124

Date Received: 10/18/02

Method	Parameter	Analytical Run Date	Analytical Run Time	Analytical Batch	Units	DF	RL	Conc.	Qual.
IN623	Solids, Percent	10/21/02	16:45	N/A	%	1.0		63.3	
IN847	TOC by Lloyd Kahn	10/22/02	16:30	BLKLK1022A	mg/Kg	1	158	34000	

WET CHEMISTRY

Sample Report Summary

Client Sample No.

02B NBH-206-3-SED

Lab Name: STL BURLINGTON

Lab Code: STLVT

Matrix: SEDIMENT

% Solids: 52.6

Contract:

Case No.:

Client: AMRO

SDG No.: 90425

Lab Sample ID: 506125

Date Received: 10/18/02

Method	Parameter	Analytical Run Date	Analytical Run Time	Analytical Batch	Units	DF	RL	Conc.	Qual.
IN623	Solids, Percent	10/21/02	16:45	N/A	%	1.0		52.6	
IN847	TOC by Lloyd Kahn	10/22/02	16:30	BLKLK1022A	mg/Kg	1	191	20300	

2

WET CHEMISTRY

Method Blank Report Summary

Lab Name: STL BURLINGTON

Contract:

SDG No.: 90425

Lab Code: STLVT

Case No.:

Matrix: SOIL

Client: AMRO

% Solids:

Lab Sample ID	Method	Parameter	Conc.	Units	Qual.	DF	RL	Analytical Run Date	Analytical Run Time	Analytical Batch
BLKLK1022A	IN847	TOC by Lloyd Kahn	100	mg/Kg	U	1	100	10/22/02	16:30	BLKLK1022A

WET CHEMISTRY

Laboratory Control Sample Report Summary

Lab Name: STL BURLINGTON

Contract:

SDG No.: 90425

Lab Code: STLVT

Case No.:

Matrix: SOIL

Client: AMRO

% Solids:

Lab Sample ID	Method	Parameter	Analytical Run Date	Analytical Run Time	Analytical Batch	Units	LCS Conc.	True Value	% Recovery*
LCSLK1022A	IN847	TOC by Lloyd Kahn	10/22/02	16:30	BLKLK1022A	mg/Kg	8030	8800.0000	91.3

** Control Limit for Percent Recovery is 80-120%, unless otherwise specified.*

GEOTECHNICAL

Sample Report Summary

Client Sample No.

01B NBH-202-3-SED

Lab Name: STL BURLINGTON

Lab Code: STLVT

Matrix: SEDIMENT

% Solids: 63.3

Contract:

Case No.:

Client: AMRO

SDG No.: 90425

Lab Sample ID: 506124

Date Received: 10/18/02

Method	Parameter	Analytical Run Date	Analytical Run Time	Analytical Batch	Units	DF	RL	Conc.	Qual.
D2216	Moisture Content	11/01/02	1000	N/A	%	1.0	.1	52.14	

GEOTECHNICAL

Sample Report Summary

Client Sample No.

02B NBH-206-3-SED

Lab Name: STL BURLINGTON

Lab Code: STLVT

Matrix: SEDIMENT

% Solids: 52.6

Contract:

Case No.:

Client: AMRO

SDG No.: 90425

Lab Sample ID: 506125

Date Received: 10/18/02

Method	Parameter	Analytical Run Date	Analytical Run Time	Analytical Batch	Units	DF	RL	Conc.	Qual.
D2216	Moisture Content	11/01/02	1000	N/A	%	1.0	.1	87.22	

Moisture Content by ASTM Method 2216

Client:	AMRO	**ETR(s):**	90425
Client Code:	AMRO	**SDG(s):**	N/A
Project:	22000	**Analyst(s):**	MRD
Case:	N/A	**Start Date:**	01-Nov-02
Date Received:	18-Oct-02	**End Date:**	01-Nov-02

Sample No.	**506124**	**506125**				
Sample Id.	01B NBH-202-3-SED	02B NBH-206-3-SED				
Pan, g	1.27	1.27				
Pan/wet Sample, g	37.6	36.73				
Pan/Dry Sample, g	25.15	20.21				
% Moisture	**52.14%**	**87.22%**				

Submitted By: _____ Date: 11/04/02

STL Burlington 90425MC.xls

Particle Size of Soils by ASTM D422

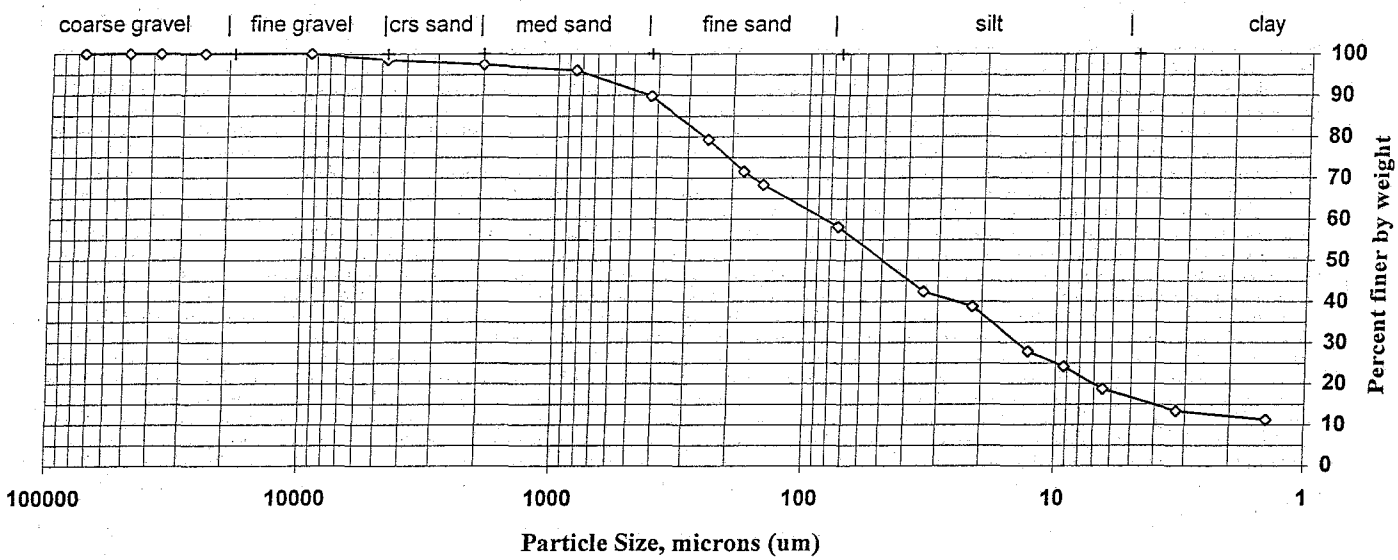
Sample preparation method: D2217

Client:	AMRO	**Project No.:**	22000	**ETR(s) #:**	90425
Client Code:	AMRO	**Job No.:**	N/A	**SDG(s):**	N/A
Date Received:	18-Oct-02	**Start Date:**	21-Oct-02	**End Date:**	01-Nov-02

Lab ID: 506124 **Sample ID:** 01B NBH-202-3-SED

Percent Solids: 65.7%
Specific Gravity: 2.65 (assumed)
Non-soil mass: NA

Maximum Particle Size: 9.5 mm
Shape (> #10): rounded
Hardness (> #10): hard



Sieve size	Particle size, um	Percent finer	Incremental percent
3 inch	75000	100.0	0.0
2 inch	50000	100.0	0.0
1.5 inch	37500	100.0	0.0
1 inch	25000	100.0	0.0
3/4 inch	19000	100.0	0.0
3/8 inch	9500	100.0	0.0
#4	4750	98.6	1.4
#10	2000	97.5	1.1
#20	850	96.0	1.4
#40	425	89.8	6.2
#60	250	79.3	10.5
#80	180	71.6	7.7
#100	150	68.3	3.3
#200	75	58.2	10.1
Hydrometer	34.1	42.4	15.8
|	21.8	38.7	3.6
|	13.0	27.8	10.9
|	9.3	24.2	3.6
|	6.5	18.7	5.5
|	3.3	13.4	5.3
V	1.4	11.2	2.1

Soil Classification	Percent of Total Sample
Gravel	1.4
Sand	40.4
Coarse Sand	1.1
Medium Sand	7.7
Fine Sand	31.6
Silt	39.5
Clay	18.7

Dispersion Device: Mechanical mixer with a metal paddle.
Dispersion Period: 1 minute

0012

Particle Size of Soils by ASTM D422

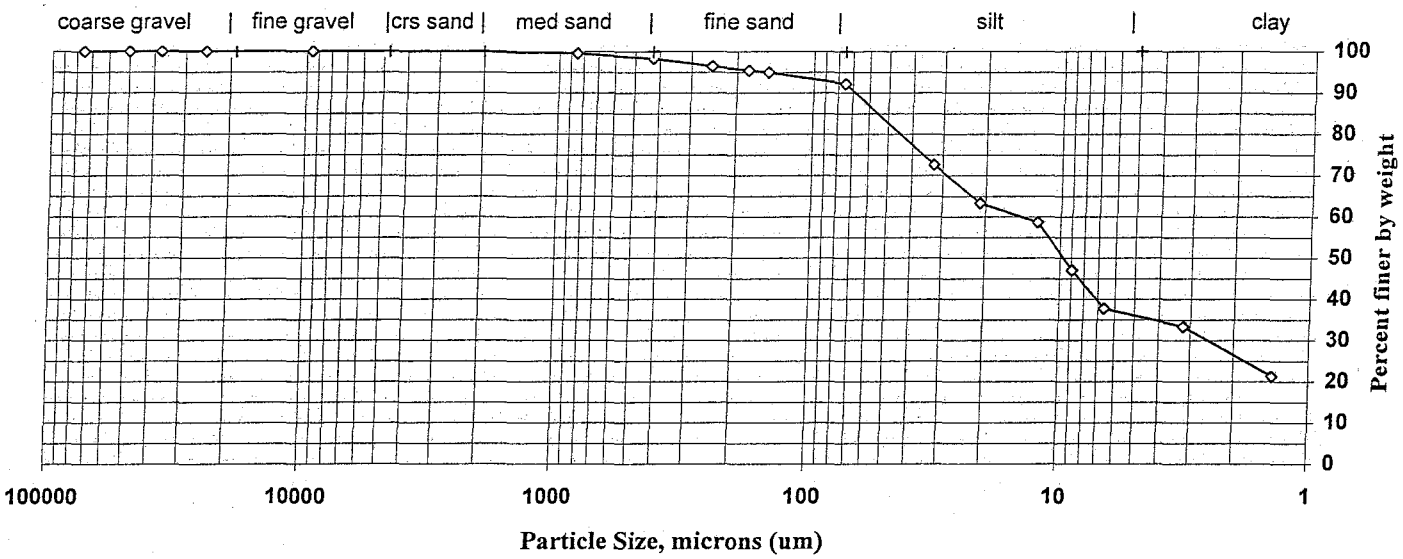
Sample preparation method: D2217

Client:	AMRO	**Project No.:**	22000	**ETR(s) #:**	90425
Client Code:	AMRO	**Job No.:**	N/A	**SDG(s):**	N/A
Date Received:	18-Oct-02	**Start Date:**	21-Oct-02	**End Date:**	01-Nov-02

Lab ID: 506125 **Sample ID:** 02B NBH-206-3-SED

Percent Solids: 53.4%
Specific Gravity: 2.65 (assumed)
Non-soil mass: NA

Maximum Particle Size: Med sand
Shape (> #10): N/A
Hardness (> #10): N/A



Sieve size	Particle size, um	Percent finer	Incremental percent
3 inch	75000	100.0	0.0
2 inch	50000	100.0	0.0
1.5 inch	37500	100.0	0.0
1 inch	25000	100.0	0.0
3/4 inch	19000	100.0	0.0
3/8 inch	9500	100.0	0.0
#4	4750	100.0	0.0
#10	2000	100.0	0.0
#20	850	99.6	0.4
#40	425	98.3	1.2
#60	250	96.5	1.9
#80	180	95.4	1.0
#100	150	94.9	0.5
#200	75	92.2	2.7
Hydrometer	32.6	72.6	19.6
|	21.1	63.3	9.3
|	12.3	58.7	4.6
|	9.0	47.1	11.6
|	6.6	37.8	9.3
|	3.2	33.3	4.5
V	1.4	21.3	12.0

Soil Classification	Percent of Total Sample
Gravel	0.0
Sand	7.8
Coarse Sand	0.0
Medium Sand	1.7
Fine Sand	6.1
Silt	54.4
Clay	37.8

Dispersion Device: Mechanical mixer with a metal paddle.
Dispersion Period: 1 minute

SEVERN TRENT SERVICES

STL Burlington

PCB CONGENER ANALYSIS

Qualifier Definitions:

U= Compound not detected above reporting limit.

J= Compound reported at an estimated concentration below the reporting limit.

E= Compound reported at an estimated concentration which exceeds the calibration range.

S= Specific column result used for quantitation due to confirmation column coelution.

T= Tentative identification, specific column result used with no confirmation information.

X= Estimated concentration due to coelution on both columns.

P= Confirmation column result exceeds reported result by more than 25%.

H= Specific column or estimated result exceeds confirmation result by more than 25% despite expected confirmation coelution.

B= Compound detected above reporting limit in method blank.

N= Compound does not comply with initial and/or ongoing calibration criteria.

FORM 1
OTHER ORGANICS ANALYSIS DATA SHEET

AMRO SAMPLE NO.

01BNBH2023

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90425

Matrix: (soil/water) SOIL Lab Sample ID: 506124

Sample wt/vol: 30.0 (g/mL) G Lab File ID: 07NOV021728-R181

% Moisture: 37 decanted: (Y/N) N Date Received: 10/18/02

Extraction: (SepF/Cont/Sonc) SONC Date Extracted: 10/22/02

Concentrated Extract Volume: 10(mL) Date Analyzed: 11/08/02

Injection Volume: 1.0(uL) Dilution Factor: 10.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) N

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
34883-43-7	BZ#8	26	U
37680-65-2	BZ#18	26	U
7012-37-5	BZ#28	33	
41464-39-5	BZ#44	230	P
41464-40-8	BZ#49	350	
35693-99-3	BZ#52	610	
32598-10-0	BZ#66	330	
32598-13-3	BZ#77	26	U
70362-50-4	BZ#81	260	
38380-02-8	BZ#87	260	
37680-73-2	BZ#101	210	
32598-14-4	BZ#105	110	P
74472-37-0	BZ#114	26	U
31508-00-6	BZ#118	200	
65510-44-3	BZ#123	220	
57465-28-8	BZ#126	46	
38380-07-3	BZ#128	79	
35065-28-2	BZ#138	270	
35065-27-1	BZ#153	190	P
38380-08-4	BZ#156	39	
69782-90-7	BZ#157	26	U
52663-72-6	BZ#167	26	U
32774-16-6	BZ#169	26	U
35065-30-6	BZ#170	30	
35065-29-3	BZ#180	36	
52663-69-1	BZ#183	26	U
74472-48-3	BZ#184	26	U
52663-68-0	BZ#187	26	U

FORM I OTHER

FORM 1
OTHER ORGANICS ANALYSIS DATA SHEET

AMRO SAMPLE NO.

01BNBH2023

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90425

Matrix: (soil/water) SOIL Lab Sample ID: 506124

Sample wt/vol: 30.0 (g/mL) G Lab File ID: 07NOV021728-R181

% Moisture: 37 decanted: (Y/N) N Date Received: 10/18/02

Extraction: (SepF/Cont/Sonc) SONC Date Extracted: 10/22/02

Concentrated Extract Volume: 10(mL) Date Analyzed: 11/08/02

Injection Volume: 1.0(uL) Dilution Factor: 10.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) N

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
39635-31-9------	BZ#189	26	U
52663-78-2------	BZ#195	26	U
40186-72-9------	BZ#206	26	U
2051-24-3-------	BZ#209	26	U

FORM I OTHER

FORM 1
OTHER ORGANICS ANALYSIS DATA SHEET

AMRO SAMPLE NO.

01BNBH2023RE

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90425

Matrix: (soil/water) SOIL Lab Sample ID: 506124R1

Sample wt/vol: 30.0 (g/mL) G Lab File ID: 07NOV021728-R211

% Moisture: 37 decanted: (Y/N) N Date Received: 10/18/02

Extraction: (SepF/Cont/Sonc) SOXH Date Extracted: 11/06/02

Concentrated Extract Volume: 10(mL) Date Analyzed: 11/08/02

Injection Volume: 1.0(uL) Dilution Factor: 10.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) Y

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
34883-43-7	BZ#8	26	U
37680-65-2	BZ#18	26	U
7012-37-5	BZ#28	39	
41464-39-5	BZ#44	270	P
41464-40-8	BZ#49	400	
35693-99-3	BZ#52	710	
32598-10-0	BZ#66	400	
32598-13-3	BZ#77	26	U
70362-50-4	BZ#81	310	
38380-02-8	BZ#87	310	
37680-73-2	BZ#101	270	
32598-14-4	BZ#105	130	P
74472-37-0	BZ#114	26	U
31508-00-6	BZ#118	250	
65510-44-3	BZ#123	250	
57465-28-8	BZ#126	26	U
38380-07-3	BZ#128	94	
35065-28-2	BZ#138	320	
35065-27-1	BZ#153	210	P
38380-08-4	BZ#156	42	
69782-90-7	BZ#157	26	U
52663-72-6	BZ#167	26	U
32774-16-6	BZ#169	26	U
35065-30-6	BZ#170	34	
35065-29-3	BZ#180	37	
52663-69-1	BZ#183	26	U
74472-48-3	BZ#184	26	U
52663-68-0	BZ#187	26	U

FORM I OTHER

FORM 1
OTHER ORGANICS ANALYSIS DATA SHEET

AMRO SAMPLE NO.

01BNBH2023RE

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90425

Matrix: (soil/water) SOIL Lab Sample ID: 506124R1

Sample wt/vol: 30.0 (g/mL) G Lab File ID: 07NOV021728-R211

% Moisture: 37 decanted: (Y/N) N Date Received: 10/18/02

Extraction: (SepF/Cont/Sonc) SOXH Date Extracted: 11/06/02

Concentrated Extract Volume: 10(mL) Date Analyzed: 11/08/02

Injection Volume: 1.0(uL) Dilution Factor: 10.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) Y

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
39635-31-9------	BZ#189	26	U
52663-78-2------	BZ#195	26	U
40186-72-9------	BZ#206	26	U
2051-24-3-------	BZ#209	26	U

FORM I OTHER

FORM 1
OTHER ORGANICS ANALYSIS DATA SHEET

AMRO SAMPLE NO.

02BNBH2063

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90425

Matrix: (soil/water) SOIL Lab Sample ID: 506125

Sample wt/vol: 30.0 (g/mL) G Lab File ID: 07NOV021728-R191

% Moisture: 47 decanted: (Y/N) N Date Received: 10/18/02

Extraction: (SepF/Cont/Sonc) SONC Date Extracted: 10/22/02

Concentrated Extract Volume: 10(mL) Date Analyzed: 11/08/02

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) N

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
34883-43-7	BZ#8	3.1	U
37680-65-2	BZ#18	3.1	U
7012-37-5	BZ#28	3.1	U
41464-39-5	BZ#44	3.1	U
41464-40-8	BZ#49	3.1	U
35693-99-3	BZ#52	3.1	U
32598-10-0	BZ#66	3.1	U
32598-13-3	BZ#77	3.1	U
70362-50-4	BZ#81	3.1	U
38380-02-8	BZ#87	3.1	U
37680-73-2	BZ#101	3.1	U
32598-14-4	BZ#105	3.1	U
74472-37-0	BZ#114	3.1	U
31508-00-6	BZ#118	3.1	U
65510-44-3	BZ#123	3.1	U
57465-28-8	BZ#126	3.1	U
38380-07-3	BZ#128	3.1	U
35065-28-2	BZ#138	3.1	U
35065-27-1	BZ#153	3.1	U
38380-08-4	BZ#156	3.1	U
69782-90-7	BZ#157	3.1	U
52663-72-6	BZ#167	3.1	U
32774-16-6	BZ#169	3.1	U
35065-30-6	BZ#170	3.1	U
35065-29-3	BZ#180	3.1	U
52663-69-1	BZ#183	3.1	U
74472-48-3	BZ#184	3.1	U
52663-68-0	BZ#187	3.1	U

FORM 1
OTHER ORGANICS ANALYSIS DATA SHEET

AMRO SAMPLE NO.

02BNBH2063

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90425

Matrix: (soil/water) SOIL Lab Sample ID: 506125

Sample wt/vol: 30.0 (g/mL) G Lab File ID: 07NOV021728-R191

% Moisture: 47 decanted: (Y/N) N Date Received: 10/18/02

Extraction: (SepF/Cont/Sonc) SONC Date Extracted: 10/22/02

Concentrated Extract Volume: 10(mL) Date Analyzed: 11/08/02

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) N

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
39635-31-9------	BZ#189	3.1	U
52663-78-2------	BZ#195	3.1	U
40186-72-9------	BZ#206	3.1	U
2051-24-3-------	BZ#209	22	B

FORM I OTHER

FORM 1
OTHER ORGANICS ANALYSIS DATA SHEET

AMRO SAMPLE NO.

02BNBH2063RE

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90425

Matrix: (soil/water) SOIL Lab Sample ID: 506125R1

Sample wt/vol: 30.0 (g/mL) G Lab File ID: 07NOV021728-R221

% Moisture: 47 decanted: (Y/N) N Date Received: 10/18/02

Extraction: (SepF/Cont/Sonc) SOXH Date Extracted: 11/06/02

Concentrated Extract Volume: 10(mL) Date Analyzed: 11/08/02

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) Y

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
34883-43-7	BZ#8	3.1	U
37680-65-2	BZ#18	3.1	U
7012-37-5	BZ#28	3.1	U
41464-39-5	BZ#44	3.1	U
41464-40-8	BZ#49	3.1	U
35693-99-3	BZ#52	3.1	U
32598-10-0	BZ#66	4.2	
32598-13-3	BZ#77	3.1	U
70362-50-4	BZ#81	3.1	U
38380-02-8	BZ#87	3.1	U
37680-73-2	BZ#101	3.1	U
32598-14-4	BZ#105	3.1	U
74472-37-0	BZ#114	3.1	U
31508-00-6	BZ#118	3.1	U
65510-44-3	BZ#123	3.1	U
57465-28-8	BZ#126	3.1	U
38380-07-3	BZ#128	3.1	U
35065-28-2	BZ#138	3.1	U
35065-27-1	BZ#153	3.1	U
38380-08-4	BZ#156	3.1	U
69782-90-7	BZ#157	3.1	U
52663-72-6	BZ#167	3.1	U
32774-16-6	BZ#169	3.1	U
35065-30-6	BZ#170	3.1	U
35065-29-3	BZ#180	3.1	U
52663-69-1	BZ#183	3.1	U
74472-48-3	BZ#184	3.1	U
52663-68-0	BZ#187	3.1	U

FORM 1
OTHER ORGANICS ANALYSIS DATA SHEET

AMRO SAMPLE NO.

02BNBH2063RE

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90425

Matrix: (soil/water) SOIL Lab Sample ID: 506125R1

Sample wt/vol: 30.0 (g/mL) G Lab File ID: 07NOV021728-R221

% Moisture: 47 decanted: (Y/N) N Date Received: 10/18/02

Extraction: (SepF/Cont/Sonc) SOXH Date Extracted: 11/06/02

Concentrated Extract Volume: 10(mL) Date Analyzed: 11/08/02

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) Y

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
39635-31-9------	BZ#189	3.1	U
52663-78-2------	BZ#195	3.1	U
40186-72-9------	BZ#206	3.1	U
2051-24-3-------	BZ#209	3.1	U

FORM I OTHER

FORM 1
OTHER ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

PBLKA1

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90425

Matrix: (soil/water) SOIL Lab Sample ID: PBLKA1

Sample wt/vol: 30.0 (g/mL) G Lab File ID: 07NOV021728-R051

% Moisture: 0 decanted: (Y/N) N Date Received: _____

Extraction: (SepF/Cont/Sonc) SOXH Date Extracted: 11/06/02

Concentrated Extract Volume: 10(mL) Date Analyzed: 11/07/02

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) Y

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
34883-43-7	BZ#8	1.7	U
37680-65-2	BZ#18	1.7	U
7012-37-5	BZ#28	1.7	U
41464-39-5	BZ#44	1.7	U
41464-40-8	BZ#49	1.7	U
35693-99-3	BZ#52	1.7	U
32598-10-0	BZ#66	1.7	U
32598-13-3	BZ#77	1.7	U
70362-50-4	BZ#81	1.7	U
38380-02-8	BZ#87	1.7	U
37680-73-2	BZ#101	1.7	U
32598-14-4	BZ#105	1.7	U
74472-37-0	BZ#114	1.7	U
31508-00-6	BZ#118	1.7	U
65510-44-3	BZ#123	1.7	U
57465-28-8	BZ#126	1.7	U
38380-07-3	BZ#128	1.7	U
35065-28-2	BZ#138	1.7	U
35065-27-1	BZ#153	1.7	U
38380-08-4	BZ#156	1.7	U
69782-90-7	BZ#157	1.7	U
52663-72-6	BZ#167	1.7	U
32774-16-6	BZ#169	1.7	U
35065-30-6	BZ#170	1.7	U
35065-29-3	BZ#180	1.7	U
52663-69-1	BZ#183	1.7	U
74472-48-3	BZ#184	1.7	U
52663-68-0	BZ#187	1.7	U

FORM 1
OTHER ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

PBLKA1

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90425

Matrix: (soil/water) SOIL Lab Sample ID: PBLKA1

Sample wt/vol: 30.0 (g/mL) G Lab File ID: 07NOV021728-R051

% Moisture: 0 decanted: (Y/N) N Date Received: _____

Extraction: (SepF/Cont/Sonc) SOXH Date Extracted: 11/06/02

Concentrated Extract Volume: 10(mL) Date Analyzed: 11/07/02

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) Y

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
39635-31-9------	BZ#189	1.7	U
52663-78-2------	BZ#195	1.7	U
40186-72-9------	BZ#206	1.7	U
2051-24-3-------	BZ#209	1.7	U

FORM I OTHER

FORM 1
OTHER ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

PBLKU1

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90425

Matrix: (soil/water) SOIL Lab Sample ID: PBLKU1

Sample wt/vol: 30.0 (g/mL) G Lab File ID: 07NOV021728-R091

% Moisture: 0 decanted: (Y/N) N Date Received: _____

Extraction: (SepF/Cont/Sonc) SONC Date Extracted: 10/22/02

Concentrated Extract Volume: 10(mL) Date Analyzed: 11/07/02

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) N

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
34883-43-7	BZ#8	1.7	U
37680-65-2	BZ#18	1.7	U
7012-37-5	BZ#28	1.7	U
41464-39-5	BZ#44	1.7	U
41464-40-8	BZ#49	1.7	U
35693-99-3	BZ#52	1.7	U
32598-10-0	BZ#66	1.7	U
32598-13-3	BZ#77	1.7	U
70362-50-4	BZ#81	1.7	U
38380-02-8	BZ#87	1.7	U
37680-73-2	BZ#101	1.7	U
32598-14-4	BZ#105	1.7	U
74472-37-0	BZ#114	1.7	U
31508-00-6	BZ#118	1.7	U
65510-44-3	BZ#123	1.7	U
57465-28-8	BZ#126	1.7	U
38380-07-3	BZ#128	1.7	U
35065-28-2	BZ#138	1.7	U
35065-27-1	BZ#153	1.7	U
38380-08-4	BZ#156	1.7	U
69782-90-7	BZ#157	1.7	U
52663-72-6	BZ#167	1.7	U
32774-16-6	BZ#169	1.7	U
35065-30-6	BZ#170	1.7	U
35065-29-3	BZ#180	1.7	U
52663-69-1	BZ#183	1.7	U
74472-48-3	BZ#184	1.7	U
52663-68-0	BZ#187	1.7	U

FORM I OTHER

FORM 1
OTHER ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

PBLKU1

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90425

Matrix: (soil/water) SOIL Lab Sample ID: PBLKU1

Sample wt/vol: 30.0 (g/mL) G Lab File ID: 07NOV021728-R091

% Moisture: 0 decanted: (Y/N) N Date Received: _____

Extraction: (SepF/Cont/Sonc) SONC Date Extracted: 10/22/02

Concentrated Extract Volume: 10(mL) Date Analyzed: 11/07/02

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) N

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
39635-31-9------	BZ#189	1.7	U
52663-78-2------	BZ#195	1.7	U
40186-72-9------	BZ#206	1.7	U
2051-24-3-------	BZ#209	13	

FORM I OTHER

FORM 1
OTHER ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

PIBLK_SCU

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90425

Matrix: (soil/water) SOIL Lab Sample ID: PIBLK_SCU

Sample wt/vol: 30.0 (g/mL) G Lab File ID: 07NOV021728-R041

% Moisture: 0 decanted: (Y/N) N Date Received: _____

Extraction: (SepF/Cont/Sonc) OTHER Date Extracted:

Concentrated Extract Volume: 10(mL) Date Analyzed: 11/07/02

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) Y

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
34883-43-7	BZ#8	1.7	U
37680-65-2	BZ#18	1.7	U
7012-37-5	BZ#28	1.7	U
41464-39-5	BZ#44	1.7	U
41464-40-8	BZ#49	1.7	U
35693-99-3	BZ#52	1.7	U
32598-10-0	BZ#66	1.7	U
32598-13-3	BZ#77	1.7	U
70362-50-4	BZ#81	1.7	U
38380-02-8	BZ#87	1.7	U
37680-73-2	BZ#101	1.7	U
32598-14-4	BZ#105	1.7	U
74472-37-0	BZ#114	1.7	U
31508-00-6	BZ#118	1.7	U
65510-44-3	BZ#123	1.7	U
57465-28-8	BZ#126	1.7	U
38380-07-3	BZ#128	1.7	U
35065-28-2	BZ#138	1.7	U
35065-27-1	BZ#153	1.7	U
38380-08-4	BZ#156	1.7	U
69782-90-7	BZ#157	1.7	U
52663-72-6	BZ#167	1.7	U
32774-16-6	BZ#169	1.7	U
35065-30-6	BZ#170	1.7	U
35065-29-3	BZ#180	1.7	U
52663-69-1	BZ#183	1.7	U
74472-48-3	BZ#184	1.7	U
52663-68-0	BZ#187	1.7	U

FORM 1
OTHER ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

PIBLK_SCU

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90425

Matrix: (soil/water) SOIL Lab Sample ID: PIBLK_SCU

Sample wt/vol: 30.0 (g/mL) G Lab File ID: 07NOV021728-R041

% Moisture: 0 decanted: (Y/N) N Date Received: _____

Extraction: (SepF/Cont/Sonc) SONC Date Extracted:

Concentrated Extract Volume: 10(mL) Date Analyzed: 11/07/02

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) Y

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
39635-31-9------	BZ#189	1.7	U
52663-78-2------	BZ#195	1.7	U
40186-72-9------	BZ#206	1.7	U
2051-24-3-------	BZ#209	1.7	U

FORM I OTHER

FORM 1
OTHER ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

A1LCS

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90425

Matrix: (soil/water) SOIL Lab Sample ID: A1LCS

Sample wt/vol: 30.0 (g/mL) G Lab File ID: 07NOV021728-R061

% Moisture: 0 decanted: (Y/N) N Date Received: _____

Extraction: (SepF/Cont/Sonc) SOXH Date Extracted: 11/06/02

Concentrated Extract Volume: 10(mL) Date Analyzed: 11/07/02

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) Y

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
34883-43-7	BZ#8	32	
37680-65-2	BZ#18	33	
7012-37-5	BZ#28	31	
41464-39-5	BZ#44	32	
41464-40-8	BZ#49	32	
35693-99-3	BZ#52	32	
32598-10-0	BZ#66	31	
32598-13-3	BZ#77	30	
70362-50-4	BZ#81	64	
38380-02-8	BZ#87	64	
37680-73-2	BZ#101	33	
32598-14-4	BZ#105	30	
74472-37-0	BZ#114	31	
31508-00-6	BZ#118	31	
65510-44-3	BZ#123	31	
57465-28-8	BZ#126	30	P
38380-07-3	BZ#128	32	
35065-28-2	BZ#138	32	
35065-27-1	BZ#153	33	P
38380-08-4	BZ#156	30	
69782-90-7	BZ#157	30	
52663-72-6	BZ#167	31	
32774-16-6	BZ#169	30	
35065-30-6	BZ#170	32	
35065-29-3	BZ#180	32	
52663-69-1	BZ#183	32	
74472-48-3	BZ#184	33	P
52663-68-0	BZ#187	32	P

FORM I OTHER

FORM 1
OTHER ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

A1LCS

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90425

Matrix: (soil/water) SOIL Lab Sample ID: A1LCS

Sample wt/vol: 30.0 (g/mL) G Lab File ID: 07NOV021728-R061

% Moisture: 0 decanted: (Y/N) N Date Received: _____

Extraction: (SepF/Cont/Sonc) SOXH Date Extracted: 11/06/02

Concentrated Extract Volume: 10(mL) Date Analyzed: 11/07/02

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) Y

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
39635-31-9------	BZ#189	31	
52663-78-2------	BZ#195	32	
40186-72-9------	BZ#206	33	
2051-24-3-------	BZ#209	33	

FORM I OTHER

FORM 1
OTHER ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

A1LCSD

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90425

Matrix: (soil/water) SOIL Lab Sample ID: A1LCSD

Sample wt/vol: 30.0 (g/mL) G Lab File ID: 07NOV021728-R071

% Moisture: 0 decanted: (Y/N) N Date Received: _____

Extraction: (SepF/Cont/Sonc) SOXH Date Extracted: 11/06/02

Concentrated Extract Volume: 10(mL) Date Analyzed: 11/07/02

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) Y

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
34883-43-7	BZ#8	33	
37680-65-2	BZ#18	34	
7012-37-5	BZ#28	32	
41464-39-5	BZ#44	34	
41464-40-8	BZ#49	34	
35693-99-3	BZ#52	34	
32598-10-0	BZ#66	32	
32598-13-3	BZ#77	31	
70362-50-4	BZ#81	66	
38380-02-8	BZ#87	66	
37680-73-2	BZ#101	33	
32598-14-4	BZ#105	32	
74472-37-0	BZ#114	32	
31508-00-6	BZ#118	32	
65510-44-3	BZ#123	33	
57465-28-8	BZ#126	31	P
38380-07-3	BZ#128	33	
35065-28-2	BZ#138	32	
35065-27-1	BZ#153	34	P
38380-08-4	BZ#156	32	
69782-90-7	BZ#157	32	
52663-72-6	BZ#167	32	
32774-16-6	BZ#169	31	
35065-30-6	BZ#170	33	
35065-29-3	BZ#180	32	
52663-69-1	BZ#183	33	
74472-48-3	BZ#184	34	P
52663-68-0	BZ#187	33	P

FORM I OTHER

FORM 1
OTHER ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

A1LCSD

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90425

Matrix: (soil/water) SOIL Lab Sample ID: A1LCSD

Sample wt/vol: 30.0 (g/mL) G Lab File ID: 07NOV021728-R071

% Moisture: 0 decanted: (Y/N) N Date Received: _____

Extraction: (SepF/Cont/Sonc) SOXH Date Extracted: 11/06/02

Concentrated Extract Volume: 10(mL) Date Analyzed: 11/07/02

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) Y

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
39635-31-9------	BZ#189	32	
52663-78-2------	BZ#195	33	
40186-72-9------	BZ#206	33	
2051-24-3-------	BZ#209	33	

FORM I OTHER

FORM 2
SOIL OTHER SURROGATE RECOVERY

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90425

GC Column(1): RTX-5 ID: 0.25 (mm) GC Column(2): RTX-CLPII ID: 0.25 (mm)

	CLIENT SAMPLE NO.	S1 1 %REC #	S1 2 %REC #	S2 1 %REC #	S2 2 %REC #	OTHER (1)	OTHER (2)	TOT OUT
01	PIBLK_SCU	99	98	94	94			0
02	PBLKA1	100	100	93	93			0
03	A1LCS	100	93	100	100			0
04	A1LCSD	107	107	107	107			0
05	PBLKU1	60	60					0
06	01BNBH2023	56	59					0
07	02BNBH2063	53	53					0
08	01BNBH2023RE	72	75	66	69			0
09	02BNBH2063RE	79	76	79	76			0
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								

ADVISORY
QC LIMITS

S1 = Tetrachloro-meta-xylen (30-150)
S2 = BZ#198 (30-150)

Column to be used to flag recovery values
* Values outside of QC limits
D Surrogate diluted out

FORM 3
SOIL OTHER LAB CONTROL SAMPLE

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90425

Matrix Spike - Sample No.: A1LCS

COMPOUND	SPIKE ADDED (ug/Kg)	SAMPLE CONCENTRATION (ug/Kg)	LCS CONCENTRATION (ug/Kg)	LCS % REC #	QC. LIMITS REC.
BZ#8	33		32	97	40-150
BZ#18	33		33	100	40-150
BZ#28	33		31	94	40-150
BZ#44	33		32	97	40-150
BZ#49	33		32	97	40-150
BZ#52	33		32	97	40-150
BZ#66	33		31	94	40-150
BZ#77	33		30	91	40-150
BZ#81	33		64	194*	40-150
BZ#87	33		64	194*	40-150
BZ#101	33		33	100	40-150
BZ#105	33		30	91	40-150
BZ#114	33		31	94	40-150
BZ#118	33		31	94	40-150
BZ#123	33		31	94	40-150
BZ#126	33		30	91	40-150
BZ#128	33		32	97	40-150
BZ#138	33		32	97	40-150
BZ#153	33		33	100	40-150
BZ#156	33		30	91	40-150
BZ#157	33		30	91	40-150
BZ#167	33		31	94	40-150
BZ#169	33		30	91	40-150
BZ#170	33		32	97	40-150
BZ#180	33		32	97	40-150
BZ#183	33		32	97	40-150
BZ#184	33		33	100	40-150
BZ#187	33		32	97	40-150

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

COMMENTS: _____

FORM 3
SOIL OTHER LAB CONTROL SAMPLE

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90425

Matrix Spike - Sample No.: A1LCS

COMPOUND	SPIKE ADDED (ug/Kg)	SAMPLE CONCENTRATION (ug/Kg)	LCS CONCENTRATION (ug/Kg)	LCS % REC #	QC. LIMITS REC.
BZ#189	33		31	94	40-150
BZ#195	33		32	97	40-150
BZ#206	33		33	100	40-150
BZ#209	33		33	100	40-150

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

COMMENTS: _____

FORM 3
SOIL OTHER LAB CONTROL SAMPLE

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90425

Matrix Spike - Sample No.: A1LCS

COMPOUND	SPIKE ADDED (ug/Kg)	LCSD CONCENTRATION (ug/Kg)	LCSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
BZ#8	33	33	100	3	40	40-150
BZ#18	33	34	103	3	40	40-150
BZ#28	33	32	97	3	40	40-150
BZ#44	33	34	103	6	40	40-150
BZ#49	33	34	103	6	40	40-150
BZ#52	33	34	103	6	40	40-150
BZ#66	33	32	97	3	40	40-150
BZ#77	33	31	94	3	40	40-150
BZ#81	33	66	200*	3	40	40-150
BZ#87	33	66	200*	3	40	40-150
BZ#101	33	33	100	0	40	40-150
BZ#105	33	32	97	6	40	40-150
BZ#114	33	32	97	3	40	40-150
BZ#118	33	32	97	3	40	40-150
BZ#123	33	33	100	6	40	40-150
BZ#126	33	31	94	3	40	40-150
BZ#128	33	33	100	3	40	40-150
BZ#138	33	32	97	0	40	40-150
BZ#153	33	34	103	3	40	40-150
BZ#156	33	32	97	6	40	40-150
BZ#157	33	32	97	6	40	40-150
BZ#167	33	32	97	3	40	40-150
BZ#169	33	31	94	3	40	40-150
BZ#170	33	33	100	3	40	40-150
BZ#180	33	32	97	0	40	40-150
BZ#183	33	33	100	3	40	40-150
BZ#184	33	34	103	3	40	40-150
BZ#187	33	33	100	3	40	40-150

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

COMMENTS: _____

FORM 3
SOIL OTHER LAB CONTROL SAMPLE

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90425

Matrix Spike - Sample No.: A1LCS

COMPOUND	SPIKE ADDED (ug/Kg)	LCSD CONCENTRATION (ug/Kg)	LCSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
BZ#189	33	32	97	3	40	40-150
BZ#195	33	33	100	3	40	40-150
BZ#206	33	33	100	0	40	40-150
BZ#209	33	33	100	0	40	40-150

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

RPD: 0 out of 32 outside limits
Spike Recovery: 4 out of 64 outside limits

COMMENTS: _____

FORM 4
OTHER METHOD BLANK SUMMARY

CLIENT SAMPLE NO.

PBLKA1

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90425

Lab Sample ID: PBLKA1 Lab File ID: 07NOV021728-R051

Matrix (soil/water) SOIL Extraction:(SepF/Cont/Sonc) SOXH

Sulfur Cleanup (Y/N) Y Date Extracted: 11/06/02

Date Analyzed (1): 11/07/02 Date Analyzed (2): 11/07/02

Time Analyzed (1): 2053 Time Analyzed (2): 2053

Instrument ID (1): 3327_1 Instrument ID (2): 3327_2

GC Column (1): RTX-5 ID: 0.25(mm) GC Column (2): RTX-CLPII ID: 0.25(mm)

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS and MSD:

	SAMPLE NO.	LAB SAMPLE ID	DATE ANALYZED 1	DATE ANALYZED 2
01	A1LCS	A1LCS	11/07/02	11/07/02
02	A1LCSD	A1LCSD	11/07/02	11/07/02
03	01BNBH2023RE	506124R1 *	11/08/02	11/08/02
04	02BNBH2063RE	506125R1 *	11/08/02	11/08/02
05				
06				
07				
08				
09				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
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24				

COMMENTS: *-Sample extracts received additional sulfur clean-up. The associated clean-up blank is PIBLK_SCU.

FORM IV OTHER

FORM 4
OTHER METHOD BLANK SUMMARY

CLIENT SAMPLE NO.

PBLKU1

Lab Name: STL BURLINGTON Contract: 22000

Lab Code: STLVT Case No.: 22000 SAS No.: SDG No.: 90425

Lab Sample ID: PBLKU1 Lab File ID: 07NOV021728-R091

Matrix (soil/water) SOIL Extraction:(SepF/Cont/Sonc) SONC

Sulfur Cleanup (Y/N) N Date Extracted: 10/22/02

Date Analyzed (1): 11/07/02 Date Analyzed (2): 11/07/02

Time Analyzed (1): 2353 Time Analyzed (2): 2353

Instrument ID (1): 3327_1 Instrument ID (2): 3327_2

GC Column (1): RTX-5 ID: 0.25(mm) GC Column (2): RTX-CLPII ID: 0.25(mm)

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS and MSD:

	SAMPLE NO.	LAB SAMPLE ID	DATE ANALYZED 1	DATE ANALYZED 2
01	01BNBH2023	506124 *	11/08/02	11/08/02
02	02BNBH2063	506125 *	11/08/02	11/08/02
03				
04				
05				
06				
07				
08				
09				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				

COMMENTS: * - Sample extracts received sulfur clean-up. The associated clean-up blank is PIBLK_SCU.

AMRO Environmental Laboratories Corporation
111 Herrick Street
Merrimack, NH 03054

CHAIN-OF-CUSTODY RECORD

Office: (603) 4[illegible]22
Fax: (603) 429-8496

Project No.:	Project Name:	Project Manager:	Samplers (Signature):	AMRO Project No.:
16421	NB HARBOR FEIR		CC	0210141
	Project State: MA			

Sample ID	Date/Time Sampled	Matrix (A= Air, S= Soil, GW= Ground W., WW= Waste W., DW= Drinking W., O= Oil, Other= Specify)	Total # of Cont. & Size	Comp	Grab	DIOXINS 8280 FURANS	PCB 8082 NO AA CONGENERS	TOC 9060	WATER CONTENT ASTM D 2216	GRAIN SIZE W/ HYDRO ASTM D422	Remarks
01B NBH-202-3-SED	10-10-02	SED	2-8 oz		✓	✓	✓	✓	✓	✓	
02B NBH-206-3-SED	10-10-02	SED	2-8 oz		✓	✓	✓	✓	✓	✓	

Preservative: Cl-HCl, MeOH, N-HN03, S-H2SO4, Na-NaOH, O- Other

Container Type: P- Plastic, G-Glass, V-Vial, T- Teflon, O-Other

Send Results To:	FAX No.:	Seal Intact?	P.O. No:	GW-1*	GW-2	GW-3
AMRO ENVIRONMENTAL 111 HERRICK ST MERRIMACK NH 03054	603 429 8496	Yes No N/A		MCP Level Needed:		
		Results Needed By: STD		*= May require additional cost		

Relinquished By	Date/ Time	Received By
C Cearley	10/17/02 9:30	Bob Hamlin
Bob Hamlin	10/17/02 15	[illegible]

PRIORITY TURNAROUND TIME AUTHORIZATION

Before submitting samples for expedited TAT, you must have requested in advance and received a coded **AUTHORIZATION NUMBER.**

***Samples arriving after 12:00 noon will be tracked and billed as received* on the following day.**

AUTHORIZATION No. _____ BY: _____

Please print clearly, legibly and completely. Samples can not be logged in and the turnaround time clock will not start until any ambiguities are resolved.

NOTES: Preservatives, Special reporting limits, Known Contamination, etc;

AMRO policy requires notification in writing to the laboratory in cases where the samples were collected from highly contaminated sites.

White: Lab Copy Yellow: Accompanies Report Pink: Client Copy SHEET 1 OF 1

RELINQUISH BY D Hamlin 10/17/02

received: R Bo[illegible] 10/18/02 0930

CC

qc/qcmemos/forms/amrococ/Rev.2 04/01/02

SEVERN TRENT SERVICES

STL Sacramento
880 Riverside Parkway
West Sacramento, CA 95605-1500

Tel: 916 373 5600
Fax: 916 371 8420
www.stl-inc.com

November 25, 2002

STL SACRAMENTO PROJECT NUMBER: G2J180250
PO/CONTRACT:

Nancy Stewart
Amro Environmental Laboratories
111 Herrick Street
Merrimack, NH 03054

Dear Mr. Stewart,

This report contains the analytical results for the samples received under chain of custody by STL Sacramento on October 18, 2002. These samples are associated with your 16421/0210141 project.

The test results in this report meet all NELAC requirements for parameters that accreditation is required or available. Any exceptions to NELAC requirements are noted in the case narrative. The case narrative is an integral part of this report.

If you have any questions, please feel free to call me at (916) 374-4402.

Sincerely,

Jill Kellmann
Project Manager

STL Sacramento is a part of Severn Trent Laboratories, Inc.

TABLE OF CONTENTS

STL SACRAMENTO PROJECT NUMBER G2J180250

Case Narrative

STL Sacramento Quality Assurance Program

Sample Description Information

Chain of Custody Documentation

SOLID, 8280A, Dioxins/Furans
Samples: 1 and 2
- Sample Data Sheets
- Method Blank Report
- Laboratory QC Reports

CASE NARRATIVE

STL SACRAMENTO PROJECT NUMBER G2J180250

There were no anomalies associated with this project.

STL Sacramento

Quality Control Definitions

QC Parameter	Definition
QC Batch	A set of up to 20 field samples plus associated laboratory QC samples that are similar in composition (matrix) and that are processed within the same time period with the same reagent and standard lots.
Duplicate Control Sample (DCS)	Consist of a pair of LCSs analyzed within the same QC batch to monitor precision and accuracy independent of sample matrix effects. This QC is performed only if required by client or when insufficient sample is available to perform MS/MSD.
Duplicate Sample (DU)	A second aliquot of an environmental sample, taken from the same sample container when possible, that is processed independently with the first sample aliquot. The results are used to assess the effect of the sample matrix on the precision of the analytical process. The precision estimated using this sample is not necessarily representative of the precision for other samples in the batch.
Laboratory Control Sample (LCS)	A volume of reagent water for aqueous samples or a contaminant-free solid matrix (Ottawa sand) for soil and sediment samples which is spiked with known amounts of representative target analytes and required surrogates. An LCS is carried through the entire analytical process and is used to monitor the accuracy of the analytical process independent of potential matrix effects.
Matrix Spike and Matrix Spike Duplicate (MS/MSD)	A field sample fortified with known quantities of target analytes that are also added to the LCS. Matrix spike duplicate is a second matrix spike sample. MSs/MSDs are carried through the entire analytical process and are used to determine sample matrix effect on accuracy of the measurement system. The accuracy and precision estimated using MS/MSD is only representative of the precision of the sample that was spiked.
Method Blank (MB)	A sample composed of all the reagents (in the same quantities) in reagent water carried through the entire analytical process. The method blank is used to monitor the level of contamination introduced during sample preparation steps.
Surrogate Spike	Organic constituents not expected to be detected in environmental media and are added to every sample and QC at a known concentration. Surrogates are used to determine the efficiency of the sample preparation and the analytical process.

Source: STL Sacramento Laboratory Quality Manual

STL Sacramento Certifications:
Alaska (UST-055), Arizona (#AZ00616), Arkansas, California (NELAP # 01119CA) (ELAP #I-2439), Connecticut (#PH-0691), Florida (E87570), Hawaii, Louisiana (AI # 30612), New Jersey (Lab ID 44005), Nevada (#CA 044), New York (LAB ID 11666 serial # 107407), Oregon (LAB ID CA 044), South Carolina (LAB ID 87014, Cert. # 870140), Utah (E-168), Virginia (#00178), Washington (# C087), West Virginia (# 9930C), Wisconsin (Lab 998204680), USNAVY, USACE, USDA Foreign Plant (Permit # 37-82605), USDA Foreign Soil (Permit # S-46613)..

Sample Summary
G2J180250

WO#	Sample #	Client Sample ID	Sampling Date	Received Date
FACET	1	01B NBH-202-3-SED	10/10/02	10/18/02 09:05 AM
FACFG	2	02B NBH-206-3-SED	10/10/02	10/18/02 09:05 AM

Notes(s):

- The analytical results of the samples listed above are presented on the following pages.
- All calculations are performed before rounding to avoid round-off errors in calculated results.
- Results noted as "ND" were not detected at or above the stated limit.
- This report must not be reproduced, except in full, without the written approval of the laboratory.
- Results for the following parameters are never reported on a dry weight basis: color, corrosivity, density, flashpoint, ignitability, layers, odor, paint filter test, pH, porosity, pressure, reactivity, redox potential, specific gravity, spot tests, solids, solubility, temperature, viscosity, and weight

AMRO Environmental Laboratories Corporation
111 Herrick Street
Merrimack, NH 03054

CHAIN-OF-CUSTODY RECORD

Office: (603) 424-2022
Fax: (603) 429-8496

Project No.:	Project Name:	Project Manager:	Samplers (Signature):	AMRO Project No.:
16421	NB HARBOR FEIR		CC	0210141
	Project State: MA			

Sample ID	Date/Time Sampled	Matrix (A= Air, S= Soil, GW= Ground W., WW= Waste W., DW= Drinking W., O= Oil, Other= Specify)	Total # of Cont. & Size	Comp	Grab	DIOXINS 8280 FURANS	PCB 8082 NOAA CONGENERS	TOC 9060	WATER CONTENT ASTM D2216	GRAIN SIZE W/ HYDRO ASTM D422	Remarks
01B NBH-202-3-SED	10-10-02	SED	2-8 oz		✓	✓	✓	✓	✓	✓	
02B NBH-206-3-SED	10-10-02	SED	2-8 oz		✓	✓	✓	✓	✓	✓	

RECEIVED IN GOOD CONDITION UNDER COC
OCT 18 2002
INI CC

Preservative: Cl-HCl, MeOH, N-HN03, S-H2SO4, Na-NaOH, O- Other
Container Type: P- Plastic, G-Glass, V-Vial, T- Teflon, O-Other

Send Results To:	FAX No.:	Seal Intact?	P.O. No:	GW-1* GW-2 GW-3
AMRO ENVIRONMENTAL 111 HERRICK ST MERRIMACK NH 03054	603 429 8496	Yes No N/A		MCP Level Needed:
		Results Needed By: STD		*= May require additional cost

Relinquished By	Date/ Time	Received By
C Cearley	10/17/02 9:30	Bob Hawkins
Bob Hawkins	10/17/02 15:00	[signature]

PRIORITY TURNAROUND TIME AUTHORIZATION
Before submitting samples for expedited TAT, you must have requested in advance and received a coded **AUTHORIZATION NUMBER.**
Samples arriving after 12:00 noon will be tracked and billed as received on the following day.
AUTHORIZATION No. _____ BY: _____

Please print clearly, legibly and completely. Samples can not be logged in and the turnaround time clock will not start until any ambiguities are resolved.

NOTES: Preservatives, Special reporting limits, Known Contamination, etc;

AMRO policy requires notification in writing to the laboratory in cases where the samples were collected from highly contaminated sites.

White: Lab Copy Yellow: Accompanies Report Pink: Client Copy SHEET 1 OF 1

~~Received~~ RELINQUISHED D. [signature] 10/17/02 16:50 rec'd By: [signature] 10-18-02 1115

ICee

qc/qcmemos/forms/amroco... 2 04/0

SOLID, 8280A, Dioxins/Furans

AMRO ENVIRONMENTAL LABORATORIES

Client Sample ID: 01B NBH-202-3-SED

Trace Level Organic Compounds

Lot-Sample #...: G2J180250-001 Work Order #...: FACET1AC Matrix.....: SOLID
Date Sampled...: 10/10/02 Date Received..: 10/18/02
Prep Date.....: 10/25/02 Analysis Date..: 11/05/02
Prep Batch #...: 2298333
Dilution Factor: 1
% Moisture.....: 34

PARAMETER	RESULT	DETECTION LIMIT	UNITS	METHOD
2,3,7,8-TCDD	ND	0.028	ng/g	SW846 8280A
Total TCDD	ND	0.028	ng/g	SW846 8280A
1,2,3,7,8-PeCDD	ND	0.15	ng/g	SW846 8280A
Total PeCDD	ND	0.59	ng/g	SW846 8280A
1,2,3,4,7,8-HxCDD	ND	0.058	ng/g	SW846 8280A
1,2,3,6,7,8-HxCDD	ND	0.056	ng/g	SW846 8280A
1,2,3,7,8,9-HxCDD	ND	0.051	ng/g	SW846 8280A
Total HxCDD	ND	0.058	ng/g	SW846 8280A
1,2,3,4,6,7,8-HpCDD	ND	0.063	ng/g	SW846 8280A
Total HpCDD	ND	0.12	ng/g	SW846 8280A
OCDD	ND	0.55	ng/g	SW846 8280A
2,3,7,8-TCDF	ND	0.13	ng/g	SW846 8280A
Total TCDF	ND	0.17	ng/g	SW846 8280A
1,2,3,7,8-PeCDF	ND	0.050	ng/g	SW846 8280A
2,3,4,7,8-PeCDF	ND	0.11	ng/g	SW846 8280A
Total PeCDF	ND	0.15	ng/g	SW846 8280A
1,2,3,4,7,8-HxCDF	ND	0.056	ng/g	SW846 8280A
1,2,3,6,7,8-HxCDF	ND	0.047	ng/g	SW846 8280A
2,3,4,6,7,8-HxCDF	ND	0.068	ng/g	SW846 8280A
1,2,3,7,8,9-HxCDF	ND	0.064	ng/g	SW846 8280A
Total HxCDF	ND	0.085	ng/g	SW846 8280A
1,2,3,4,6,7,8-HpCDF	ND	0.097	ng/g	SW846 8280A
1,2,3,4,7,8,9-HpCDF	ND	0.12	ng/g	SW846 8280A
Total HpCDF	ND	0.20	ng/g	SW846 8280A
OCDF	ND	0.21	ng/g	SW846 8280A

INTERNAL STANDARDS	PERCENT RECOVERY	RECOVERY LIMITS
13C-2,3,7,8-TCDD	72	(25 - 150)
13C-2,3,7,8-TCDF	68	(25 - 150)
13C-1,2,3,6,7,8-HxCDD	77	(25 - 150)
13C-1,2,3,4,6,7,8-HpCDF	69	(25 - 150)
13C-OCDD	64	(25 - 150)

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
37Cl4-2,3,7,8-TCDD	57	(25 - 150)

NOTE(S):

Results and reporting limits have been adjusted for dry weight.

AMRO ENVIRONMENTAL LABORATORIES

Client Sample ID: 02B NBH-206-3-SED

Trace Level Organic Compounds

Lot-Sample #...: G2J180250-002 Work Order #...: FACFG1AC Matrix.....: SOLID
Date Sampled...: 10/10/02 Date Received..: 10/18/02
Prep Date.....: 10/25/02 Analysis Date..: 11/05/02
Prep Batch #...: 2298333
Dilution Factor: 1
% Moisture.....: 47

PARAMETER	RESULT	DETECTION LIMIT	UNITS	METHOD
2,3,7,8-TCDD	ND	0.058	ng/g	SW846 8280A
Total TCDD	ND	0.058	ng/g	SW846 8280A
1,2,3,7,8-PeCDD	ND	0.17	ng/g	SW846 8280A
Total PeCDD	ND	0.49	ng/g	SW846 8280A
1,2,3,4,7,8-HxCDD	ND	0.071	ng/g	SW846 8280A
1,2,3,6,7,8-HxCDD	ND	0.12	ng/g	SW846 8280A
1,2,3,7,8,9-HxCDD	ND	0.18	ng/g	SW846 8280A
Total HxCDD	ND	0.18	ng/g	SW846 8280A
1,2,3,4,6,7,8-HpCDD	ND	0.088	ng/g	SW846 8280A
Total HpCDD	ND	0.24	ng/g	SW846 8280A
OCDD	ND	0.81	ng/g	SW846 8280A
2,3,7,8-TCDF	ND	0.031	ng/g	SW846 8280A
Total TCDF	ND	0.11	ng/g	SW846 8280A
1,2,3,7,8-PeCDF	ND	0.075	ng/g	SW846 8280A
2,3,4,7,8-PeCDF	ND	0.11	ng/g	SW846 8280A
Total PeCDF	ND	0.17	ng/g	SW846 8280A
1,2,3,4,7,8-HxCDF	ND	0.091	ng/g	SW846 8280A
1,2,3,6,7,8-HxCDF	ND	0.083	ng/g	SW846 8280A
2,3,4,6,7,8-HxCDF	ND	0.088	ng/g	SW846 8280A
1,2,3,7,8,9-HxCDF	ND	0.11	ng/g	SW846 8280A
Total HxCDF	ND	0.15	ng/g	SW846 8280A
1,2,3,4,6,7,8-HpCDF	ND	0.28	ng/g	SW846 8280A
1,2,3,4,7,8,9-HpCDF	ND	0.34	ng/g	SW846 8280A
Total HpCDF	ND	0.38	ng/g	SW846 8280A
OCDF	ND	0.29	ng/g	SW846 8280A

INTERNAL STANDARDS	PERCENT RECOVERY	RECOVERY LIMITS
13C-2,3,7,8-TCDD	68	(25 - 150)
13C-2,3,7,8-TCDF	67	(25 - 150)
13C-1,2,3,6,7,8-HxCDD	78	(25 - 150)
13C-1,2,3,4,6,7,8-HpCDF	70	(25 - 150)
13C-OCDD	65	(25 - 150)

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
37Cl4-2,3,7,8-TCDD	56	(25 - 150)

NOTE(S):

Results and reporting limits have been adjusted for dry weight.

QC DATA ASSOCIATION SUMMARY

G2J180250

Sample Preparation and Analysis Control Numbers

SAMPLE#	MATRIX	ANALYTICAL METHOD	LEACH BATCH #	PREP BATCH #	MS RUN#
001	SOLID	ASTM D 2216-90		2302600	2302330
	SOLID	SW846 8280A		2298333	2302316
002	SOLID	ASTM D 2216-90		2302600	2302330
	SOLID	SW846 8280A		2298333	2302316

METHOD BLANK REPORT

Trace Level Organic Compounds

Client Lot #...: G2J180250 Work Order #...: FARPW1AA Matrix.....: SOLID
MB Lot-Sample #: G2J250000-333

Prep Date.....: 10/25/02
Analysis Date..: 11/01/02 Prep Batch #...: 2298333
Dilution Factor: 1

PARAMETER	RESULT	DETECTION LIMIT	UNITS	METHOD
2,3,7,8-TCDD	ND	0.021	ng/g	SW846 8280A
Total TCDD	ND	0.021	ng/g	SW846 8280A
1,2,3,7,8-PeCDD	ND	0.27	ng/g	SW846 8280A
Total PeCDD	ND	0.27	ng/g	SW846 8280A
1,2,3,4,7,8-HxCDD	ND	0.020	ng/g	SW846 8280A
1,2,3,6,7,8-HxCDD	ND	0.042	ng/g	SW846 8280A
1,2,3,7,8,9-HxCDD	ND	0.073	ng/g	SW846 8280A
Total HxCDD	ND	0.073	ng/g	SW846 8280A
1,2,3,4,6,7,8-HpCDD	ND	0.019	ng/g	SW846 8280A
Total HpCDD	ND	0.019	ng/g	SW846 8280A
OCDD	ND	0.13	ng/g	SW846 8280A
2,3,7,8-TCDF	ND	0.014	ng/g	SW846 8280A
Total TCDF	ND	0.042	ng/g	SW846 8280A
1,2,3,7,8-PeCDF	ND	0.032	ng/g	SW846 8280A
2,3,4,7,8-PeCDF	ND	0.040	ng/g	SW846 8280A
Total PeCDF	ND	0.058	ng/g	SW846 8280A
1,2,3,4,7,8-HxCDF	ND	0.026	ng/g	SW846 8280A
1,2,3,6,7,8-HxCDF	ND	0.025	ng/g	SW846 8280A
2,3,4,6,7,8-HxCDF	ND	0.046	ng/g	SW846 8280A
1,2,3,7,8,9-HxCDF	ND	0.043	ng/g	SW846 8280A
Total HxCDF	ND	0.060	ng/g	SW846 8280A
1,2,3,4,6,7,8-HpCDF	ND	0.18	ng/g	SW846 8280A
1,2,3,4,7,8,9-HpCDF	ND	0.14	ng/g	SW846 8280A
Total HpCDF	ND	0.18	ng/g	SW846 8280A
OCDF	ND	0.17	ng/g	SW846 8280A

INTERNAL STANDARDS	PERCENT RECOVERY	RECOVERY LIMITS
13C-2,3,7,8-TCDD	71	(25 - 150)
13C-2,3,7,8-TCDF	67	(25 - 150)
13C-1,2,3,6,7,8-HxCDD	74	(25 - 150)
13C-1,2,3,4,6,7,8-HpCDF	69	(25 - 150)
13C-OCDD	50	(25 - 150)

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
37Cl4-2,3,7,8-TCDD	57	(25 - 150)

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

LABORATORY CONTROL SAMPLE EVALUATION REPORT

Trace Level Organic Compounds

Client Lot #...: G2J180250 Work Order #...: FARPW1AC Matrix.....: SOLID
LCS Lot-Sample#: G2J250000-333
Prep Date.....: 10/25/02 Analysis Date..: 11/01/02
Prep Batch #...: 2298333
Dilution Factor: 1

PARAMETER	PERCENT RECOVERY	RECOVERY LIMITS	METHOD
2,3,7,8-TCDD	95	(66 - 139)	SW846 8280A
1,2,3,7,8-PeCDD	101	(55 - 145)	SW846 8280A
1,2,3,6,7,8-HxCDD	94	(63 - 135)	SW846 8280A
1,2,3,4,6,7,8-HpCDD	79	(55 - 138)	SW846 8280A
OCDD	97	(52 - 139)	SW846 8280A
2,3,7,8-TCDF	98	(70 - 128)	SW846 8280A
1,2,3,7,8-PeCDF	101	(59 - 137)	SW846 8280A
1,2,3,6,7,8-HxCDF	113	(64 - 136)	SW846 8280A
1,2,3,4,6,7,8-HpCDF	98	(73 - 130)	SW846 8280A
OCDF	66	(60 - 136)	SW846 8280A

INTERNAL STANDARD	PERCENT RECOVERY	RECOVERY LIMITS
13C-2,3,7,8-TCDD	69	(25 - 150)
13C-2,3,7,8-TCDF	68	(25 - 150)
13C-1,2,3,6,7,8-HxCDD	76	(25 - 150)
13C-1,2,3,4,6,7,8-HpCDF	61	(25 - 150)
13C-OCDD	38	(25 - 150)

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
37Cl4-2,3,7,8-TCDD	60	(25 - 150)

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

Bold print denotes control parameters

LABORATORY CONTROL SAMPLE DATA REPORT

Trace Level Organic Compounds

Client Lot #...: G2J180250 Work Order #...: FARPW1AC Matrix.....: SOLID
LCS Lot-Sample#: G2J250000-333
Prep Date.....: 10/25/02 Analysis Date..: 11/01/02
Prep Batch #...: 2298333
Dilution Factor: 1

PARAMETER	SPIKE AMOUNT	MEASURED AMOUNT	UNITS	PERCENT RECOVERY	METHOD
2,3,7,8-TCDD	2.50	2.36	ng/g	95	SW846 8280A
1,2,3,7,8-PeCDD	6.25	6.33	ng/g	101	SW846 8280A
1,2,3,6,7,8-HxCDD	6.25	5.90	ng/g	94	SW846 8280A
1,2,3,4,6,7,8-HpCDD	6.25	4.97	ng/g	79	SW846 8280A
OCDD	12.5	12.1	ng/g	97	SW846 8280A
2,3,7,8-TCDF	2.50	2.44	ng/g	98	SW846 8280A
1,2,3,7,8-PeCDF	6.25	6.34	ng/g	101	SW846 8280A
1,2,3,6,7,8-HxCDF	6.25	7.08	ng/g	113	SW846 8280A
1,2,3,4,6,7,8-HpCDF	6.25	6.13	ng/g	98	SW846 8280A
OCDF	12.5	8.22	ng/g	66	SW846 8280A

INTERNAL STANDARD	PERCENT RECOVERY	RECOVERY LIMITS
13C-2,3,7,8-TCDD	69	(25 - 150)
13C-2,3,7,8-TCDF	68	(25 - 150)
13C-1,2,3,6,7,8-HxCDD	76	(25 - 150)
13C-1,2,3,4,6,7,8-HpCDF	61	(25 - 150)
13C-OCDD	38	(25 - 150)

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
37Cl4-2,3,7,8-TCDD	60	(25 - 150)

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

Bold print denotes control parameters

MATRIX SPIKE SAMPLE EVALUATION REPORT

Trace Level Organic Compounds

Client Lot #...: G2J180250 Work Order #...: E98VC1AC-MS Matrix.....: SOLID
MS Lot-Sample #: C2J170335-007 E98VC1AD-MSD
Date Sampled...: 10/15/02 Date Received..: 10/17/02
Prep Date.....: 10/25/02 Analysis Date..: 11/02/02
Prep Batch #...: 2298333
Dilution Factor: 1 % Moisture.....: 0.0

PARAMETER	PERCENT RECOVERY	RECOVERY LIMITS	RPD	RPD LIMITS	METHOD
2,3,7,8-TCDD	104	(66 - 139)			SW846 8280A
	94	(66 - 139)	9.9	(0-50)	SW846 8280A
1,2,3,7,8-PeCDD	107	(55 - 145)			SW846 8280A
	99	(55 - 145)	8.8	(0-50)	SW846 8280A
1,2,3,6,7,8-HxCDD	110	(63 - 135)			SW846 8280A
	97	(63 - 135)	12	(0-50)	SW846 8280A
1,2,3,4,6,7,8-HpCDD	102	(55 - 138)			SW846 8280A
	89	(55 - 138)	11	(0-50)	SW846 8280A
OCDD	105	(52 - 139)			SW846 8280A
	103	(52 - 139)	2.2	(0-50)	SW846 8280A
2,3,7,8-TCDF	106	(28 - 146)			SW846 8280A
	105	(28 - 146)	0.97	(0-50)	SW846 8280A
1,2,3,7,8-PeCDF	110	(59 - 137)			SW846 8280A
	103	(59 - 137)	6.0	(0-50)	SW846 8280A
1,2,3,6,7,8-HxCDF	110	(64 - 136)			SW846 8280A
	118	(64 - 136)	6.2	(0-50)	SW846 8280A
1,2,3,4,6,7,8-HpCDF	99	(73 - 130)			SW846 8280A
	108	(73 - 130)	6.1	(0-50)	SW846 8280A
OCDF	101	(60 - 136)			SW846 8280A
	98	(60 - 136)	3.0	(0-50)	SW846 8280A

INTERNAL STANDARDS	PERCENT RECOVERY	RECOVERY LIMITS
13C-2,3,7,8-TCDD	75	(25 - 150)
	84	(25 - 150)
13C-2,3,7,8-TCDF	73	(25 - 150)
	79	(25 - 150)
13C-1,2,3,6,7,8-HxCDD	63	(25 - 150)
	64	(25 - 150)
13C-1,2,3,4,6,7,8-HpCDF	62	(25 - 150)
	54	(25 - 150)
13C-OCDD	60	(25 - 150)
	52	(25 - 150)

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
37Cl4-2,3,7,8-TCDD	62	(25 - 150)
	67	(25 - 150)

(Continued on next page)

MATRIX SPIKE SAMPLE EVALUATION REPORT

Trace Level Organic Compounds

Client Lot #...: G2J180250 Work Order #...: E98VC1AC-MS Matrix.....: SOLID
MS Lot-Sample #: C2J170335-007 E98VC1AD-MSD

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

Bold print denotes control parameters

Results and reporting limits have been adjusted for dry weight.

MATRIX SPIKE SAMPLE DATA REPORT

Trace Level Organic Compounds

Client Lot #...: G2J180250 Work Order #...: E98VC1AC-MS Matrix.....: SOLID
MS Lot-Sample #: C2J170335-007 E98VC1AD-MSD
Date Sampled...: 10/15/02 Date Received..: 10/17/02
Prep Date.....: 10/25/02 Analysis Date..: 11/02/02
Prep Batch #...: 2298333
Dilution Factor: 1 % Moisture.....: 0.0

PARAMETER	SAMPLE AMOUNT	SPIKE AMT	MEASRD AMOUNT	UNITS	PERCNT RECVRY	RPD	METHOD
2,3,7,8-TCDD	ND	2.45	2.54	ng/g	104		SW846 8280A
	ND	2.45	2.30	ng/g	94	9.9	SW846 8280A
1,2,3,7,8-PeCDD	ND	6.13	6.58	ng/g	107		SW846 8280A
	ND	6.12	6.03	ng/g	99	8.8	SW846 8280A
1,2,3,6,7,8-HxCDD	ND	6.13	6.74	ng/g	110		SW846 8280A
	ND	6.12	5.96	ng/g	97	12	SW846 8280A
1,2,3,4,6,7,8-HpCDD	1.4	6.13	7.61	ng/g	102		SW846 8280A
	1.4	6.12	6.84	ng/g	89	11	SW846 8280A
OCDD	2.2	12.3	15.1	ng/g	105		SW846 8280A
	2.2	12.2	14.8	ng/g	103	2.2	SW846 8280A
2,3,7,8-TCDF	1.8	2.45	4.40	ng/g	106		SW846 8280A
	1.8	2.45	4.35	ng/g	105	0.97	SW846 8280A
1,2,3,7,8-PeCDF	0.83	6.13	7.56	ng/g	110		SW846 8280A
	0.83	6.12	7.12	ng/g	103	6.0	SW846 8280A
1,2,3,6,7,8-HxCDF	1.0	6.13	7.71	ng/g	110		SW846 8280A
	1.0	6.12	8.21	ng/g	118	6.2	SW846 8280A
1,2,3,4,6,7,8-HpCDF	2.4	6.13	8.51	ng/g	99		SW846 8280A
	2.4	6.12	9.05	ng/g	108	6.1	SW846 8280A
OCDF	ND	12.3	12.4	ng/g	101		SW846 8280A
	ND	12.2	12.0	ng/g	98	3.0	SW846 8280A

INTERNAL STANDARDS	PERCENT RECOVERY	RECOVERY LIMITS
13C-2,3,7,8-TCDD	75	(25 - 150)
	84	(25 - 150)
13C-2,3,7,8-TCDF	73	(25 - 150)
	79	(25 - 150)
13C-1,2,3,6,7,8-HxCDD	63	(25 - 150)
	64	(25 - 150)
13C-1,2,3,4,6,7,8-HpCDF	62	(25 - 150)
	54	(25 - 150)
13C-OCDD	60	(25 - 150)
	52	(25 - 150)

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
37Cl4-2,3,7,8-TCDD	62	(25 - 150)
	67	(25 - 150)

(Continued on next page)

MATRIX SPIKE SAMPLE DATA REPORT

Trace Level Organic Compounds

Client Lot #...: G2J180250 Work Order #...: E98VC1AC-MS Matrix.....: SOLID
MS Lot-Sample #: C2J170335-007 E98VC1AD-MSD

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

Bold print denotes control parameters

Results and reporting limits have been adjusted for dry weight.

MAGUIRE GROUP INC.	VIBRACORE LOG

PROJECT:	16421 - MACZM - DMMP	BORING NO.	NBH-201-SED
LOCATION:	New Bedford Harbor, MA	PAGE 1 OF	1
DRILLING CO:	CR Environmental	DATE STARTED:	10/10/2002
EQUIPMENT:	Cyprinodon	DATE FINISHED:	10/10/2002
DRILLED BY:	Capt. Eric Steele	SEDIMENT ELEVATIOI	33.5 Feet
INSPECTED BY:	Dorian Bertram		

Location Coordinates
817,019 m E
2,690,933 m N

	CASING	SAMPLER	CORE BAR
TYPE:	VibraCore	PE Liner	
SIZE ID:	4"	4"	
PENETRATION:	12'	12'	

SAMPLE DATA

DEPTH (ft)	SAMPLING DEPTH FROM - TO	STRATA CHANGE (ft)	LITHOLOGY (Description of materials)	SAMPLE ID	PEN/ RECOV (in./in.)	HNU
	0-1.5		**MARINE: SILT;** organic Silt, dark gray, slight sheen, shell fragments, saturated.	S-1	126/126	
	1.5-3.3			S-2		
	3.3-5		**MARINE: SANDY SILT;** organic Silt, 10-15% fine Sand, dark gray, saturated.	S-3		
5.0						
10.0			**GRAVELLY SAND;** 10-15% fine sub-rounded Gravel, coarse to fine Sand, brown, saturated.			
15.0			Bottom of Vibracore - 10.5'			
20.0						

GENERAL REMARKS:

MAGUIRE GROUP INC.	VIBRACORE LOG

PROJECT:	16421 - MACZM - DMMP	BORING NO.	NBH-202-SED
LOCATION:	New Bedford Harbor, MA	PAGE 1 OF	1
DRILLING CO:	CR Environmental	DATE STARTED:	10/10/2002
EQUIPMENT:	Cyprinodon	DATE FINISHED:	10/10/2002
DRILLED BY:	Capt. Eric Steele	SEDIMENT ELEVATIOI	Not Determined
INSPECTED BY:	Dorian Bertram		

Location Coordinates
816,046 m E
2,691,483 m N

	CASING	SAMPLER	CORE BAR
TYPE:	VibraCore	PE Liner	
SIZE ID:	4"	4"	
PENETRATION:	12'	12'	

SAMPLE DATA

DEPTH (ft)	SAMPLING DEPTH FROM - TO	STRATA CHANGE (ft)	LITHOLOGY (Description of materials)	SAMPLE ID	PEN/ RECOV (in./in.)
	0-2		**MARINE: SILT;** organic Silt, <5% fine Sand, sheen, black, saturated.	S-2	64/64
	2-4		**MARINE: SILTY CLAY;** non-plastic Clay, organic Silt, gray, saturated.	S-2	
5.0	4-5.3		**MISCELLANEOUS FILL: SILTY SAND;** medium to fine Sand, 10-15% organic non-plastic fines, shell and metal fragments.	S-3	
			Bottom of Vibracore - 5.3'		
10.0					
15.0					
20.0					

GENERAL REMARKS:

MAGUIRE GROUP INC.	VIBRACORE LOG

PROJECT:	16421 - MACZM - DMMP	BORING NO.	NBH-203-SED
LOCATION:	New Bedford Harbor, MA	PAGE 1 OF	1
DRILLING CO:	CR Environmental	DATE STARTED:	10/10/2002
EQUIPMENT:	Cyprinodon	DATE FINISHED:	10/10/2002
DRILLED BY:	Capt. Eric Steele	SEDIMENT ELEVATION	Not Determined
INSPECTED BY:	Dorian Bertram		

Location Coordinates
816,497 m E
2,691,987 m N

	CASING	SAMPLER	CORE BAR
TYPE:	VibraCore	PE Liner	
SIZE ID:	4"	4"	
PENETRATION:	12'	12'	

SAMPLE DATA

DEPTH (ft)	SAMPLING DEPTH FROM - TO	STRATA CHANGE (ft)	LITHOLOGY (Description of materials)	SAMPLE ID	PEN/ RECOV (in./in.)
	0-2.7		**MARINE: SILTY CLAY;** non-plastic Clay, organic Silt, gray, saturated.	S-1	60/60
	2.7-5		**GRAVELLY SILTY SAND;** 10-15% coarse to fine Gravel, coarse to fine Sand, 10-15% non-plastic organic Fines, gray, saturated.	S-2	
5.0					
			Bottom of Vibracore - 5'		
10.0					
15.0					
20.0					

GENERAL REMARKS:

MAGUIRE GROUP INC.	VIBRACORE LOG

PROJECT:	16421 - MACZM - DMMP	BORING NO.	NBH-204-SED
LOCATION:	New Bedford Harbor, MA	PAGE 1 OF	1
DRILLING CO:	CR Environmental	DATE STARTED:	10/10/2002
EQUIPMENT:	Cyprinodon	DATE FINISHED:	10/10/2002
DRILLED BY:	Capt. Eric Steele	SEDIMENT ELEVATIOI	Not Determined
INSPECTED BY:	Dorian Bertram		

Location Coordinates
817,274 m E
2,695,483 m N

	CASING	SAMPLER	CORE BAR
TYPE:	VibraCore	PE Liner	
SIZE ID:	4"	4"	
PENETRATION:	12'	12'	

SAMPLE DATA

DEPTH (ft)	SAMPLING DEPTH FROM - TO	STRATA CHANGE (ft)	LITHOLOGY (Description of materials)	SAMPLE ID	PEN/ RECOV (in./in.)
	0-1.5		**MARINE: SILTY SAND;** medium to fine Sand, organic non-plastic Fines, shell fragments and quahogs, charcoal gray to olive, saturated.	S-1	56/56
	1.5-2.2		**MARINE: SAND;** medium to fine Sand, olive, saturated.	S-2	
	2.2-4.6		**MARINE: CLAY;** inorganic and organic non-plastic Clay.	S-3	
5.0			Bottom of Vibracore - 4.6'		
10.0					
15.0					
20.0					

GENERAL REMARKS:

MAGUIRE GROUP INC.	VIBRACORE LOG

PROJECT:	16421 - MACZM - DMMP	BORING NO.	NBH-205-SED
LOCATION:	New Bedford Harbor, MA	PAGE 1 OF	1
DRILLING CO:	CR Environmental	DATE STARTED:	10/10/2002
EQUIPMENT:	Cyprinodon	DATE FINISHED:	10/10/2002
DRILLED BY:	Capt. Eric Steele	SEDIMENT ELEVATION	Not Determined
INSPECTED BY:	Dorian Bertram		

Location Coordinates
816,178 m E
2,696,663 m N

	CASING	SAMPLER	CORE BAR
TYPE:	VibraCore	PE Liner	
SIZE ID:	4"	4"	
PENETRATION:	12'	12'	

SAMPLE DATA

DEPTH (ft)	SAMPLING DEPTH FROM - TO	STRATA CHANGE (ft)	LITHOLOGY (Description of materials)	SAMPLE ID	PEN/ RECOV (in./in.)
	0-2		**MARINE: SILT;** inorganic non-plastic Silt, shell hash, wood debris, peat, dark gray to olive gray, saturated.	S-1	150/150
	2-4		**MARINE: SILT;** inorganic non-plastic Silt, gray, saturated.	S-2	
5.0	4-6		**MARINE: SILT;** SAME AS ABOVE.	S-3	
10.0	6-8		**MARINE: SILT;** SAME AS ABOVE.	S-4	
15.0			Bottom of Vibracore - 12.5'		
20.0					

GENERAL REMARKS:

MAGUIRE GROUP INC.	VIBRACORE LOG

PROJECT:	16421 - MACZM - DMMP	BORING NO.	NBH-206-SED
LOCATION:	New Bedford Harbor, MA	PAGE 1 OF	1
DRILLING CO:	CR Environmental	DATE STARTED:	10/10/2002
EQUIPMENT:	Cyprinodon	DATE FINISHED:	10/10/2002
DRILLED BY:	Capt. Eric Steele	SEDIMENT ELEVATIOI	Not Determined
INSPECTED BY:	Dorian Bertram		

Location Coordinates
816,044 m E
2,696,107 m N

	CASING	SAMPLER	CORE BAR
TYPE:	VibraCore	PE Liner	
SIZE ID:	4"	4"	
PENETRATION:	12'	12'	

SAMPLE DATA

DEPTH (ft)	SAMPLING DEPTH FROM - TO	STRATA CHANGE (ft)	LITHOLOGY (Description of materials)	SAMPLE ID	PEN/ RECOV (in./in.)
	0-2		**MARINE: SILT;** organic non-plastic Silt, shell hash, gray, saturated.	S-1	144/144
	2-4		**MARINE: SILT;** SAME AS ABOVE.	S-2	
5.0	4-6		**MARINE: SILT;** SAME AS ABOVE.	S-3	
	6-7		**MARINE: SILT;** SAME AS ABOVE.	S-4	
10.0					
15.0			Bottom of Vibracore - 12'		
20.0					

GENERAL REMARKS:

APPENDIX E

BENTHIC INFAUNAL ANALYSIS

BENTHIC INFAUNAL ANALYSIS FOR THE NEW BEDFORD/FAIRHAVEN HARBOR DREDGED MATERIAL DISPOSAL PLAN #11669 CONFINED AQUATIC DISPOSAL (CAD)

Addendum to the Draft Environmental Impact Report

Prepared for:

Massachusetts Coastal Zone Management Agency
251 Causeway Street, Suite 900
Boston, MA 02202

Submitted by:

Maguire Group Inc.

July 2003

BENTHIC INFAUNAL ANALYSIS FOR THE NEW BEDFORD/FAIRHAVEN HARBOR DREDGED MATERIAL DISPOSAL PLAN #11669 CONFINED AQUATIC DISPOSAL (CAD)

Addendum to the Draft Environmental Impact Report

Prepared for:

Maguire Group Inc.

Prepared by:

ENSR International
89 Water Street
Woods Hole, MA 02543

Under ENSR Contract Number: 04391010

July 2003

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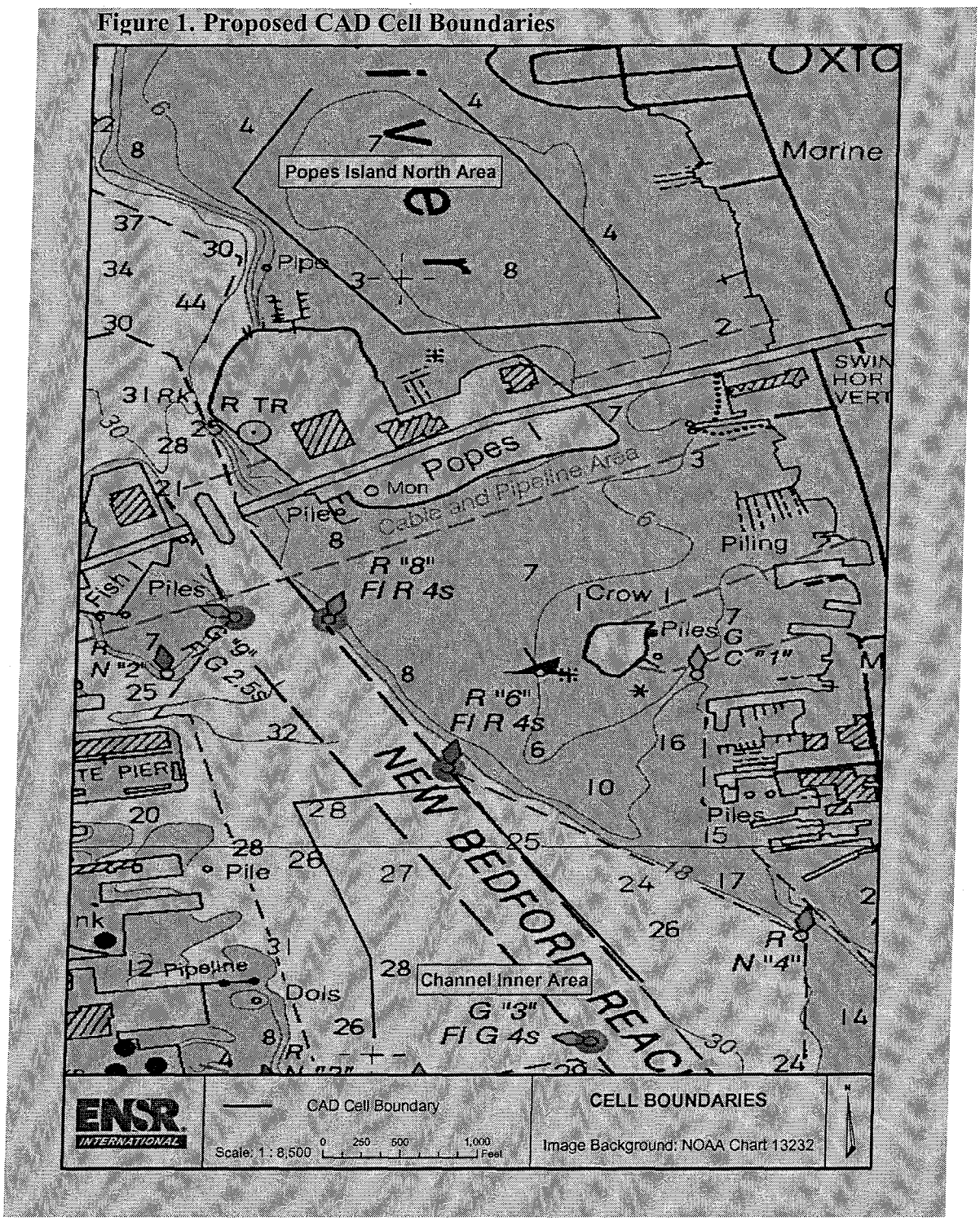
INTRODUCTION

The City of New Bedford and the Town of Fairhaven along with the Massachusetts Coastal Zone Management (MCZM) through the Massachusetts Executive Office of Environmental Affairs (EOEA) have developed a dredged material disposal plan (DMMP) as part of the local New Bedford/Fairhaven Harbor (Harbor) planning process. The DMMP was developed to evaluate and permit, within the Harbor, alternative treatment technology and/or upland or aquatic Zones of Siting Feasibility (ZSFs) for eventual placement of dredged material that is unsuitable for unconfined open water disposal (UDM). The DMMP encompasses a ten year planning horizon for both public and private dredging projects and will guide the development of the Harbor for the five (immediate term) and ten (long term) year planning horizons, providing a framework for future decisions related to port development (Maguire Group, Inc. 2002).

A draft environmental impact report (DEIR) was developed by Maguire Group, Inc. (2002) to provide an analysis of alternative upland and aquatic dredged material disposal sites and alternative technologies to treat sediment that is classified as UDM. The DEIR identified two proposed preferred alternatives for disposal of UDM, consisting of two Confined Aquatic Disposal (CAD) sites. The two proposed preferred CAD sites were named 1) Popes Island North (Fairhaven, MA) because it is located North of Popes Island and 2) Channel Inner because it is located within the navigation channel, south of Popes Island (New Bedford, MA) (Figure 1). Because of the potential danger to human health, disposal of unsuitable dredge material (e.g. contaminated with PCBs) from the Harbor is a concern. The CAD cells constructed north and south of Popes Island should provide a logical, cost-effective place to dispose of this material.

The selection of the preferred sites in the DEIR was supported by previously collected data. However, the MCZM recognized that additional site-specific information was needed to complete the Massachusetts Environmental Protection Act (MEPA) process for subsequent federal and state permitting. MCZM recommended that Maguire Group, Inc. perform a benthic macrofaunal assessment to supplement the existing information in the DEIR to better meet the MEPA requirements. The following report provides the results from a survey conducted on October 30, 2002 by ENSR International and Maguire Group, Inc. This survey was specifically undertaken to collect material for sediment grain-size and total organic carbon (TOC) analyses along with the collection of benthic samples to be used to determine the macrofaunal diversity at both proposed, preferred CAD sites.

Figure 1. Proposed CAD Cell Boundaries



Nearly all of New Bedford/Fairhaven Harbor is classified as the New Bedford Harbor superfund site (NBHSS). The NBHSS designation extends from the northern reaches of the Acushnet River estuary south through the commercial harbor of New Bedford and into 17,000 adjacent acres of Buzzards Bay. Due to urban development, many pollutants including polychlorinated biphenyls (PCBs), heavy metals, and polyaromatic hydrocarbons (PAHs) contaminate the marine sediment although it is the PCB contamination that is the most serious problem for the Harbor. The NBHSS is currently on the National Priorities List (NPL) and the Harbor has been divided by the U.S. Environmental Protection Agency (EPA) into three study areas: the upper, lower, and outer harbors. The upper harbor is the most contaminated segment, with historical PCB concentrations recorded up to 100,000 ppm. This area has been the focus of recent remediation efforts. The upper, lower, and sections of the outer harbor are closed to commercial and recreational fishing.

In an effort to assess the effectiveness of the Superfund remedies, a long-term monitoring (LTM) plan was developed by the Environmental Protection Agency's (EPA) Research Laboratory (Atlantic Ecology Division). The LTM plan focuses on the ecological health of the sediments and includes collection of data on sediment chemistry, grain size, toxicity, and benthic infauna. ENSR was the prime contractor for the LTM project in 1999 and the Coastal and Marine Center, located in Woods Hole, MA, served as the point of contact to the EPA and United States Army Corps of Engineers (USACE). In order to take advantage of existing LTM data collected from the proposed CAD cell areas, the present benthic macrofaunal assessment was designed to sample and analyze the collected material in the same fashion as the LTM plan so that results could be compared.

MATERIALS AND METHODS

Field Design and Sampling Strategy

The sampling strategy for the CAD cell macrofaunal survey (October 30, 2002) was designed so that sample collection and data analysis would be performed using the same methods employed for the NBH LTM effort in 1999. The LTM plan methodology was based on a format originally developed as part of the Environmental Monitoring and Assessment Program (EMAP) as implemented for the baseline sampling conducted in 1993 (Nelson et al. 1996). The LTM plan divided the Harbor into three segments of which Segment 2, the lower Harbor, corresponds to the area where the proposed CAD cells will be placed. In 1999, 28 stations, within a hexagonal grid, were sampled in Segment 2 and nine of these sampling stations are in the vicinity of the proposed CAD cell sites (Figure 2). Figure 3 shows the hexagons sampled during the 1999 NBH Long Term Monitoring Study (in red) that correlate with the two proposed CAD cell sites.

Following suggestions from MCZM, 17 samples were taken from the proposed CAD cell areas. It was decided that eight replicated stations would be sufficient to adequately represent the benthic macrofaunal communities and would keep project costs competitive. ENSR has the 1999 LTM plan report that included data and results from Segment 2 sediment samples. This existing information was used to supplement the data collected from the proposed CAD cell sites to provide further information about this area and reduce the overall sampling costs for this project. Replicates were taken for archival purposes with the intent that if the first samples analyzed showed variation from the LTM stations located near the CAD cell sites then the replicates from each station could be analyzed for verification. To be consistent with the sampling protocol in the LTM plan, a 0.04 m^2 Ted Young Modified Van Veen Grab was used to collect the benthic samples. Navigation was performed using a Hypack Differential Global Positioning System (DGPS). Stations were located using the target coordinates determined by Maguire Group, Inc., previous to the survey. A list of coordinates and depth for each station is provided in Table 1.

Each benthic biology grab sample was checked for depth of penetration (7 cm or greater was considered acceptable), depth of the apparent redox potential discontinuity (RPD), presence of surface biology, odor, sediment color, and texture. A rough description of the appearance of the sediment was included in the field notes. Samples were washed into a bucket, sieved through a 500-micron mesh screen, and fixed in 10% buffered formalin. These samples were later re-sieved, rinsed with freshwater, and preserved in 80% ethanol. The sediment grain-size and TOC samples were taken from a third grab, at each station, in order to preserve the integrity of the benthic biology samples.

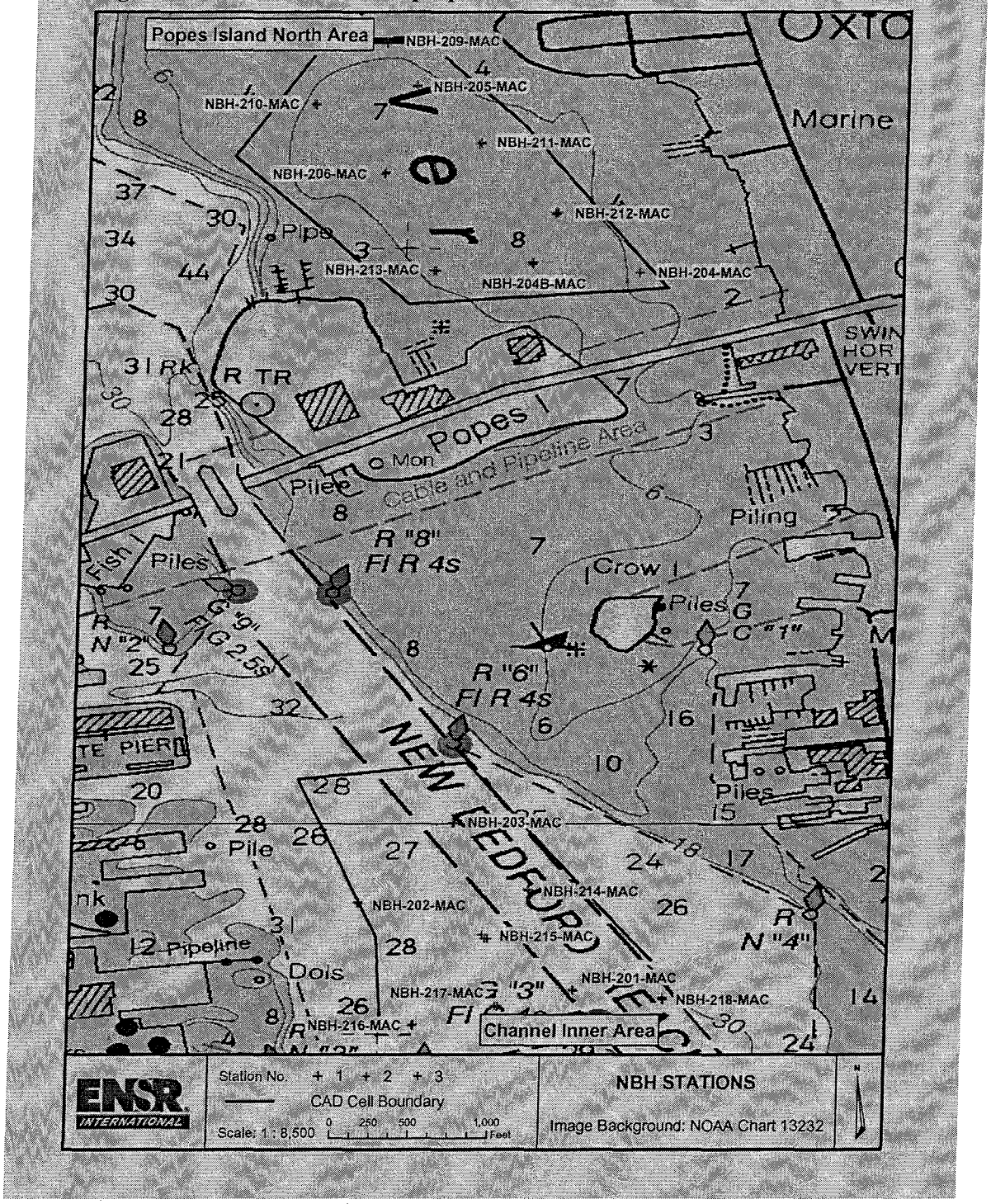
Table 1. Coordinates for stations sampled in the proposed CAD Cell sites. Bold face type=Popes Island North; regular type=Channel Inner.				
Station Name	Easting	Northing	Latitude (°N)	Longitude (°W)
NBH-201-MAC	817092.48	2690922.85	41.63046564	-70.91136496
NBH-202-MAC	816051.96	2691482.56	41.63202124	-70.91515682
NBH-203-MAC	816499.43	2691987.05	41.63339724	-70.91350739
NBH-204-MAC	817277.79	2695486.75	41.64298644	-70.9105718
NBH-204B-MAC	816767.52	2695550.93	41.64317223	-70.91243695
NBH-205-MAC	816186.77	2696665.63	41.64624216	-70.91453359
NBH-206-MAC	816053.68	2696116.8	41.64473856	-70.91503428
NBH-209-MAC	816034.82	2696938.61	41.64699414	-70.91508266
NBH-210-MAC	815710.97	2696538.76	41.64590297	-70.91627753
NBH-211-MAC	816493.34	2696295.99	41.64522201	-70.91342127
NBH-212-MAC	816871.46	2695853.86	41.64400157	-70.91204906
NBH-213-MAC	816310.45	2695494.89	41.64302707	-70.91411051
NBH-214-MAC	816857.48	2691568.92	41.63224304	-70.91220823
NBH-215-MAC	816645.27	2691275.88	41.63144289	-70.91299183
NBH-216-MAC	816335.29	2690704.43	41.62988055	-70.91414001
NBH-217-MAC	816730.58	2690819.21	41.63018807	-70.91269129
NBH-218-MAC	817512.56	2690868.24	41.63030781	-70.90982982

Sediment grain-size samples were removed using a 2.5-cm diameter sub-corer and the sample placed in a WhirlPac®. Sediment for TOC was also removed from this sample with a stainless steel spoon and placed in a 125-ml glass jar. All sediment grain-size and TOC samples were stored on ice through the duration of the survey and for shipping.

Sample Documentation, Custody, and Quality Assurance/Quality Control

Standard ENSR procedures for sample tracking and custody were followed. The sediment grain-size and TOC sample containers were labeled on the outside. The infaunal containers were labeled both on the inside and outside. Information on the labels included the survey name, date and time of sampling, station and replicate, sample type, and the laboratory to which the samples were to be delivered for analysis.

Figure 2 . Station locations in proposed CAD cell sites.



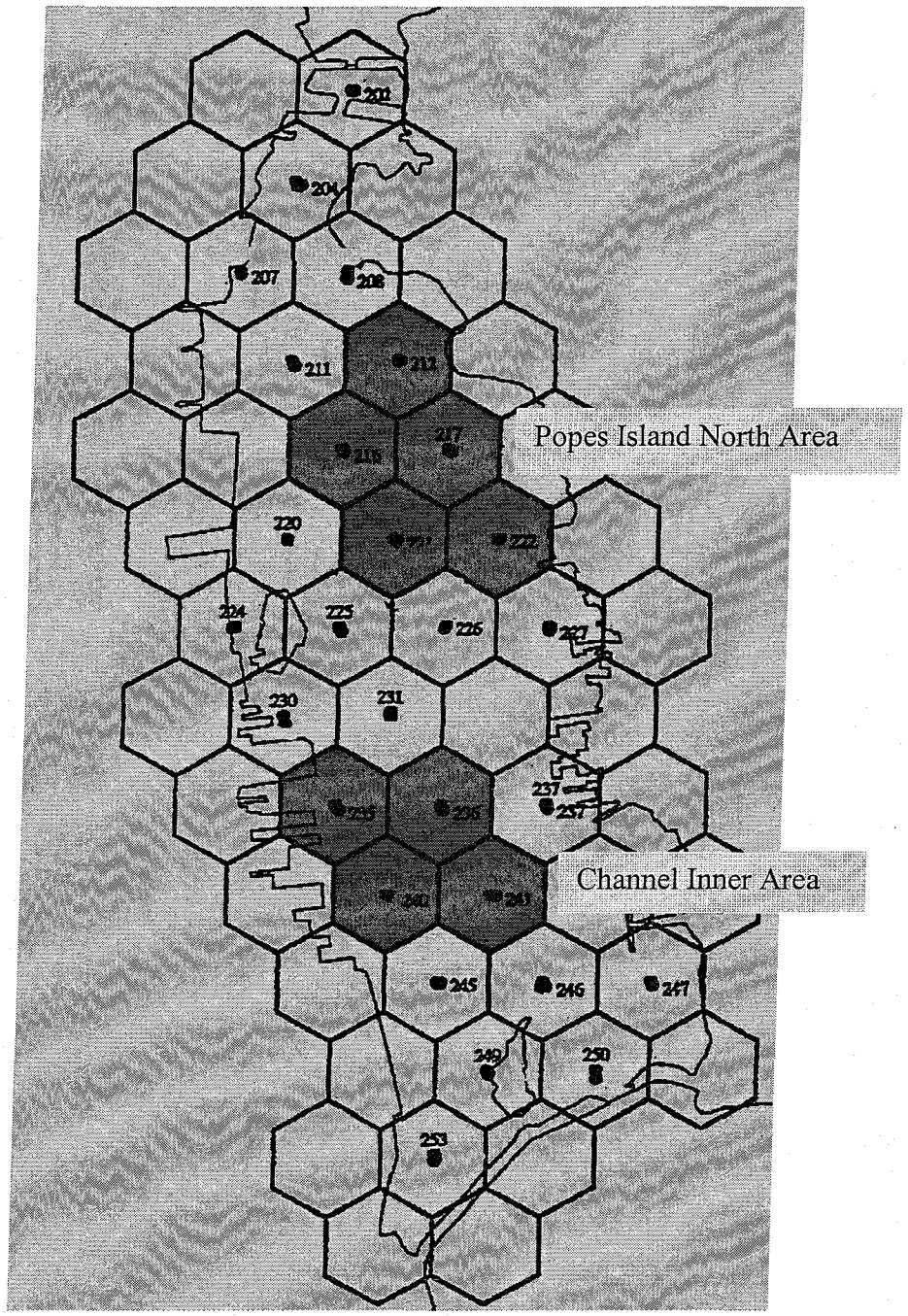


Figure 3. Map showing station numbering system for New Bedford Harbor Long Term Benthic Monitoring (USACE), Section 2. Areas highlighted in red are those previously sampled by the USACE in the vicinity of the proposed CAD cell locations.

All pertinent information on field activities and sampling efforts was recorded into a bound, numbered logbook. Entries were recorded in indelible ink and included, at a minimum:

- date and time of starting work
- names of ship's crew and scientific party
- sampling sites and activities and references to ship's navigation system
- deviations from survey plan, if any
- field observations such as weather and sea state

Chain-of-custody forms were created by hand before the samples left the survey vessel or the custody of the scientist responsible for shipping. All coolers and boxes used for shipping were sealed with numbered chain-of-custody tape; the number on the tape was recorded on the chain-of-custody form.

Quality Control Sample Collection

Quality Control (QC) associated with total organic carbon analyses included one equipment rinsate blank, one field duplicate, and one matrix spike/matrix spike duplicate (MS/MSD). All field and QC samples were collected and prepared on October 30, 2002.

Equipment rinsate blanks were collected by pouring de-ionized water over the decontaminated sampling equipment (stainless-steel utility pan and stainless-steel spoon). This water was collected in the stainless-steel pan, and then poured into appropriate sample bottles. A field duplicate was prepared by taking an aliquot of the homogenized sediment, from one sample chosen randomly, distributing it into an appropriate sample bottle, and submitting it to the analytical laboratory as a separate sample. One MS/MSD sample was collected at the same station as the field duplicate (NBH-204-MAC). Grain-size duplicate analyses were performed on NBH-218-MAC for quality control.

Laboratory Methods

Severn Trent Laboratories, in Burlington, Vermont, performed analyses of TOC. GeoPlan, in Hingham, Massachusetts, performed sediment grain-size analysis. Extraction of TOC followed the Lloyd Kahn method and results were reported as % dry weight. Sediment grain-size was determined for sands using wet sieve analysis and for silt and clay using pipette analysis. Wet sieving yields percentages of the following phi classes: gravel (>2.00 mm), very coarse sand (1.00-2.00 mm), coarse sand (0.50-1.00 mm), medium sand (0.25-0.50 mm), fine sand (0.125-0.25 mm), very fine sand ((0.0625-0.125 mm), and silt-and-clay (<0.0625 mm). Pipette analysis results in percentages of silt (0.0039-0.0625 mm) and clay (<0.0039 mm).

Sorting of the animals contained in the benthic biology samples was performed by Ocean's Taxonomic Services (OTS) in Plymouth, MA. ENSR's Marine & Coastal Center personnel performed species identifications in Woods Hole, MA laboratory. Sample processing generally followed protocols described in EMAP Near-Coastal Laboratory

Procedures Macrobenthic Community Assessment (EPA, 1991) which was the same protocol used to identify the animals collected during the LTM plan. All organisms were removed from the sediment residue and identified to the lowest possible taxon, usually species.

RESULTS

Sediment Grain-Size

Sediment grain-size composition was measured for each station sampled. Details of this analysis are presented in Table 2 and Figures 4 and 5. Mean values of percent gravel, sand, silt and clay for nine stations sampled in the proposed Popes Island North CAD cell site are shown in Figure 4. Sediments were comprised predominantly of silt and clay except station NBH-204-MAC which had more than 70% gravel and sand. Sediment grain-size composition for eight stations sampled in the Channel Inner proposed CAD cell site are found in Figure 5. Similar to the Popes Island North CAD cell sites, the composition of the sediment is predominantly silt and clay except at station NBH-218-MAC that was mostly sand (70%) with nearly 20% gravel. Station NBH-214-MAC had approximately 47% sand, 47% silt and clay, and 6% gravel.

Figure 4. Sediment Composition at Popes Island North proposed CAD cell site.

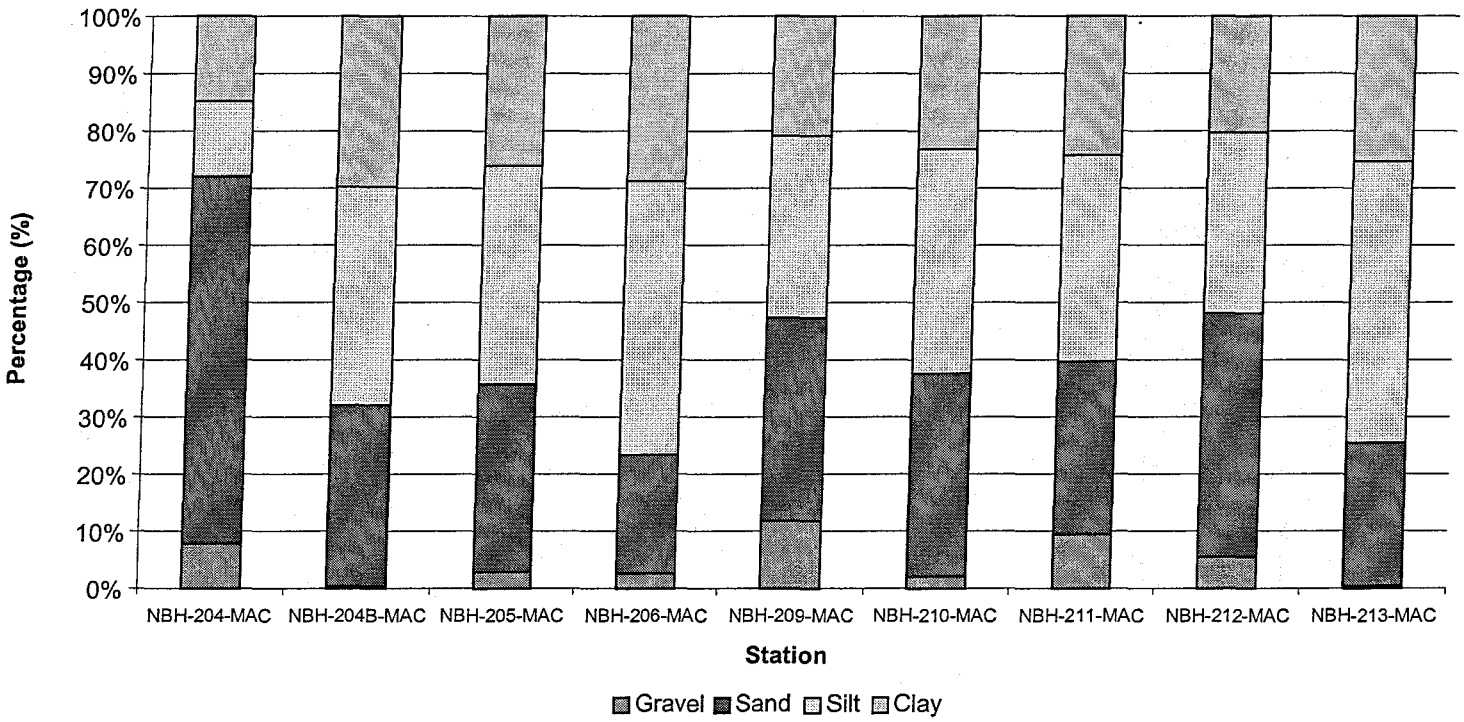


Figure 5. Sediment Composition at proposed Channel Inner CAD site.

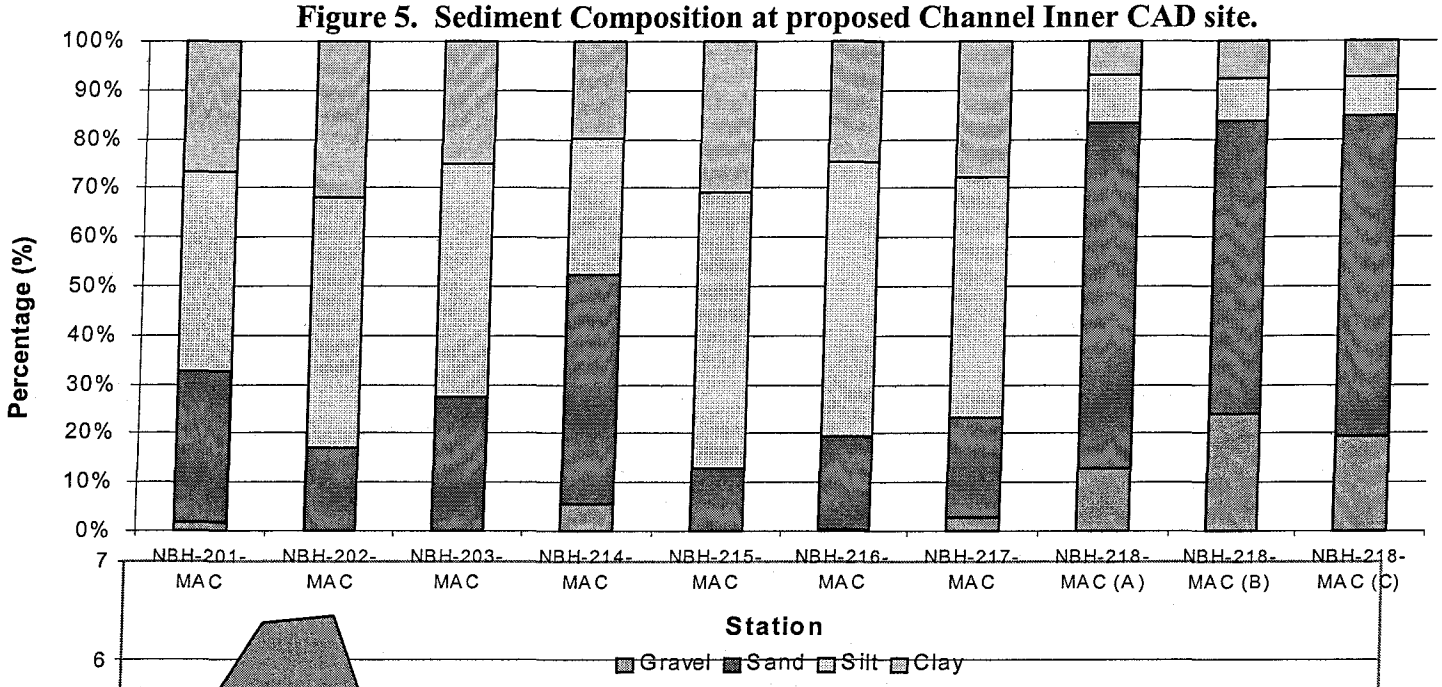


Figure 6. Total organic carbon from Popes Island North and Channel Inner proposed CAD

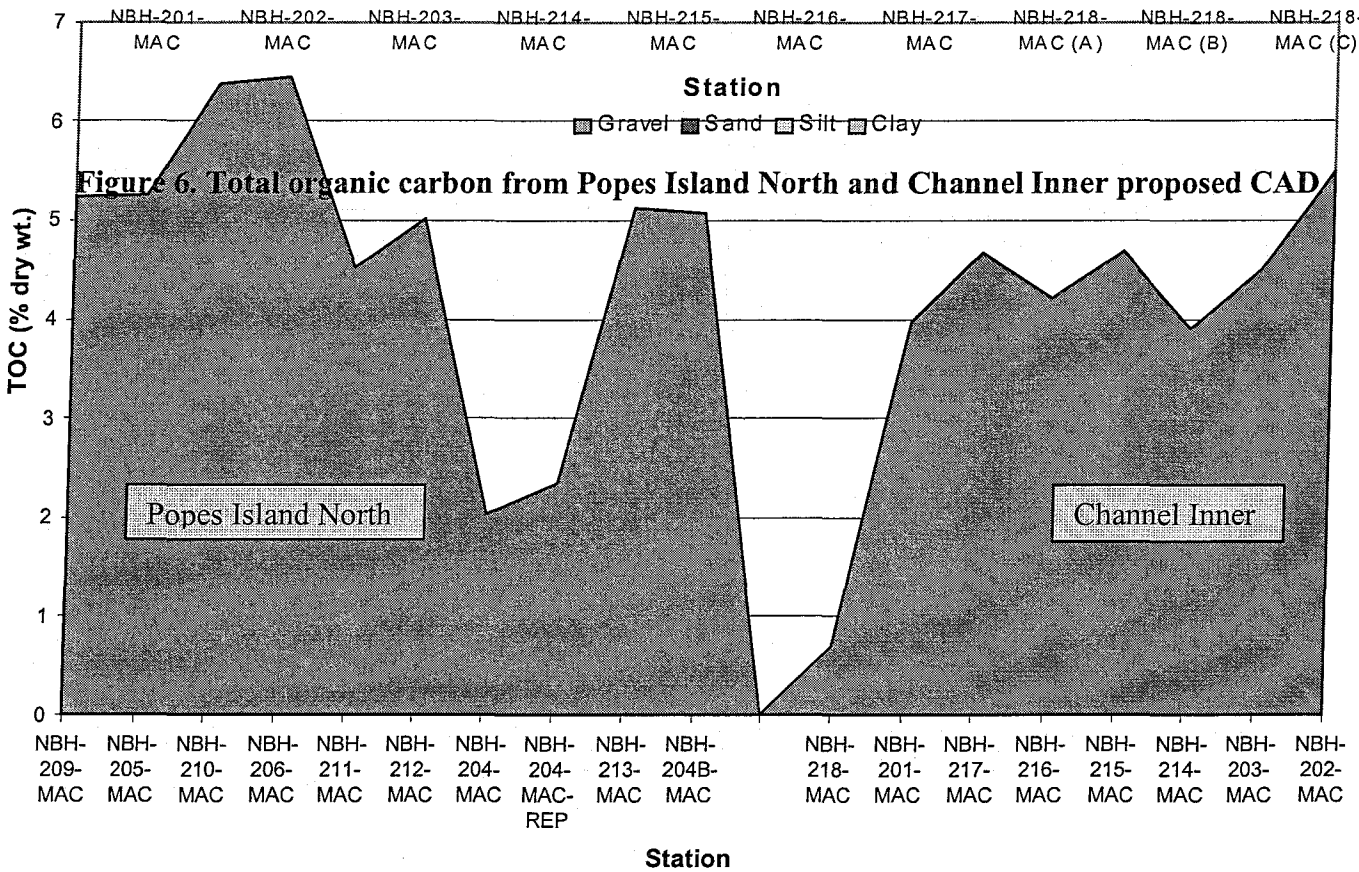


Table 2 . Sediment grain-size data from the two proposed CAD cell site stations.

Station Name	% Gravel	% Sand	% Silt	% Clay	PHI PERCENT >-5	-4	-3	-2	-1	0	1	2	3	4	Total Sample Mean	Total Sample Std Dev.	Coarse Only Mean	Coarse Only Std Dev.
NBH-201-MAC	1.7	31.0	40.4	26.9	0.00	0.00	0.00	0.00	1.68	6.39	4.03	5.46	6.58	8.56	5.35	3.05	1.56	4.13
NBH-202-MAC	0.0	17.1	50.8	32.1	0.00	0.00	0.00	0.00	0.00	1.06	2.78	2.65	3.84	6.76	6.32	2.35	2.23	4.29
NBH-203-MAC	0.1	27.4	47.7	24.9	0.00	0.00	0.00	0.00	0.06	0.97	2.46	5.43	8.68	9.83	5.75	2.48	2.37	3.56
NBH-204-MAC	7.9	64.2	13.1	14.8	0.00	0.00	0.00	0.00	7.87	1.41	3.73	19.33	31.26	8.47	3.38	2.98	1.75	2.15
NBH-204B-MAC	0.4	31.8	38.2	29.7	0.00	0.00	0.00	0.00	0.39	3.39	3.32	7.36	11.79	5.93	5.57	2.91	1.88	3.89
NBH-205-MAC	2.8	33.0	38.2	26.0	0.00	0.00	0.00	0.00	2.84	3.51	4.02	7.01	11.55	6.86	5.23	3.05	1.66	3.87
NBH-206-MAC	2.7	20.8	47.8	28.7	0.00	0.00	0.00	0.00	2.71	2.82	2.71	3.63	6.10	5.58	5.81	2.81	1.53	4.59
NBH-209-MAC	11.9	35.5	31.9	20.7	0.00	0.00	0.00	0.00	11.86	4.85	3.97	9.07	10.93	6.71	4.24	3.51	0.97	3.73
NBH-210-MAC	2.2	35.5	39.1	23.1	0.00	0.00	0.00	0.00	2.24	1.97	4.47	7.13	12.78	9.16	5.15	2.90	1.92	3.53
NBH-211-MAC	9.4	30.3	36.0	24.2	0.00	0.00	0.00	0.00	9.44	4.05	3.44	7.38	10.49	4.94	4.74	3.43	1.01	4.13
NBH-212-MAC	5.6	42.6	31.5	20.3	0.00	0.00	0.00	0.00	5.58	3.60	5.30	10.41	16.27	7.00	4.45	3.20	1.52	3.31
NBH-213-MAC	0.6	25.0	49.1	25.3	0.00	0.00	0.00	0.00	0.63	2.40	3.26	5.26	8.01	6.12	5.71	2.64	1.90	4.04
NBH-214-MAC	5.7	46.8	27.7	19.8	0.00	0.00	0.00	0.00	5.74	6.20	4.52	9.62	12.58	13.91	4.29	3.23	1.62	3.16
NBH-215-MAC	0.1	12.7	56.3	31.0	0.00	0.00	0.00	0.00	0.07	1.46	2.02	1.67	2.44	5.08	6.43	2.20	2.08	4.58
NBH-216-MAC	0.3	19.1	55.9	24.7	0.00	0.00	0.00	0.00	0.30	2.72	2.78	2.96	4.23	6.46	5.95	2.43	1.91	4.30
NBH-217-MAC	2.7	20.4	49.2	27.7	0.00	0.00	0.00	0.00	2.73	4.84	3.07	3.00	3.48	6.00	5.74	2.89	1.26	4.81
NBH-218-MAC (A)	12.9	70.3	9.7	7.1	0.00	0.00	0.00	0.00	12.91	6.56	11.94	23.84	21.38	6.56	2.18	2.74	1.15	1.83
NBH-218-MAC (B)	24.1	59.5	8.7	7.7	0.00	0.00	0.00	0.00	24.06	4.82	8.98	21.63	18.51	5.58	1.86	2.97	0.77	2.02
NBH-218-MAC (C)	19.6	65.0	8.1	7.3	0.00	0.00	0.00	0.00	19.60	5.81	9.89	23.10	19.95	6.21	1.94	2.85	0.93	1.92

Table 3. Total Organic Carbon (TOC) data from each station taken at the two proposed CAD cell sites.

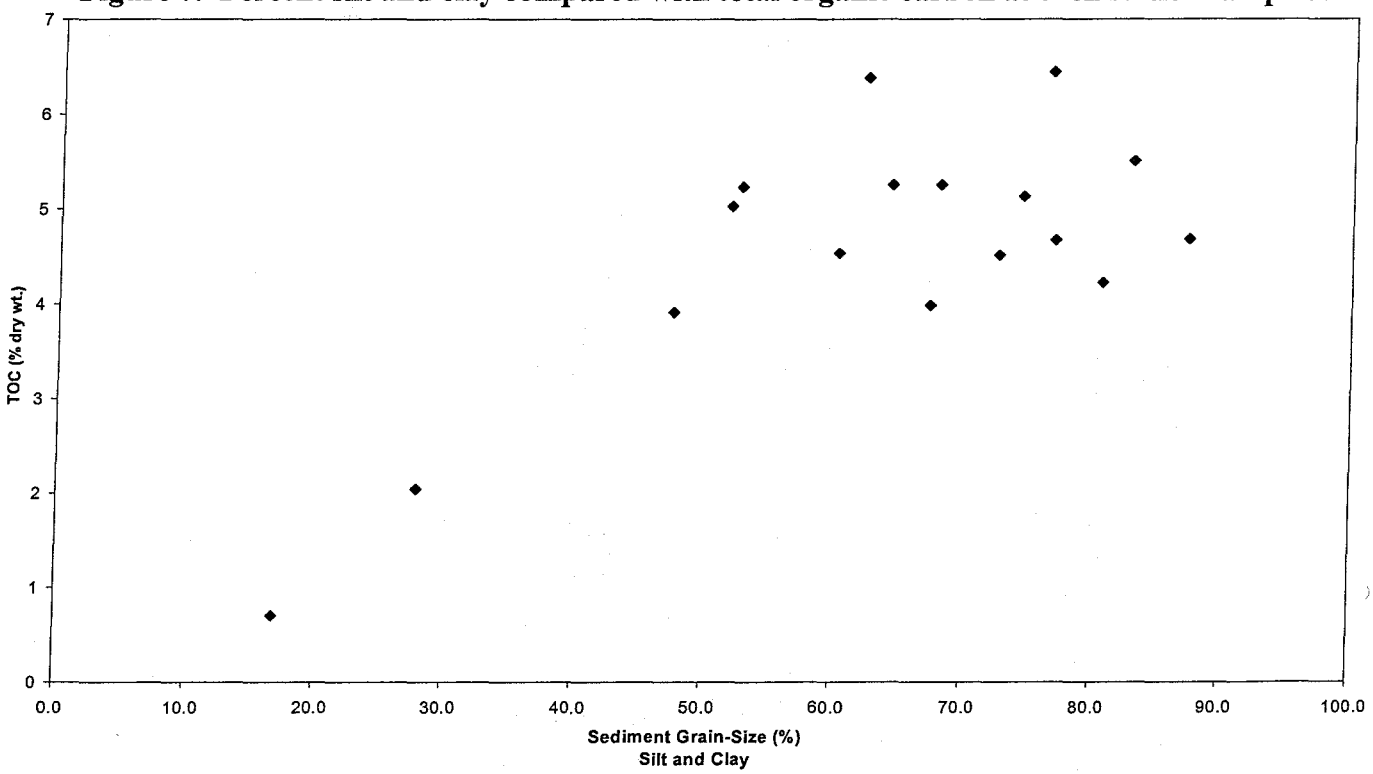
Popes Island North	TOC (% dry weight)	Channel Inner	TOC (% dry weight)
NBH-204-MAC	2.04	NBH-218-MAC	0.70
NBH-204-MAC-REP	2.35	NBH-201-MAC	3.98
NBH-211-MAC	4.53	NBH-214-MAC	3.91
NBH-212-MAC	5.02	NBH-216-MAC	4.22
NBH-204B-MAC	5.08	NBH-203-MAC	4.51
NBH-213-MAC	5.13	NBH-217-MAC	4.67
NBH-209-MAC	5.23	NBH-215-MAC	4.68
NBH-205-MAC	5.25	NBH-202-MAC	5.50
NBH-210-MAC	6.38	-	-
NBH-206-MAC	6.44	-	-
Mean TOC	**4.74**	**Mean TOC**	**4.02**

Total Organic Carbon

The total organic carbon (TOC) found in the sediments collected from the proposed CAD cell sites generally paralleled the trend that sites with greater percentages of silt and clay had higher TOC values (Figure 7). Table 3 presents the TOC results taken from each station with the benthic grab.

For example, stations NBH-206-MAC and NBH-210-MAC, located in Popes Island North, and NBH-202-MAC from Channel Inner proposed CAD cell sites had the highest TOC values. These sites also had sediments containing more than 50% silt and clay. Sediments from NBH-204-MAC had the lowest TOC value (mean 2.2% dry wt.) in the Popes Island North samples and the sediment texture for this station was greater than 50% sand (Figure 4). Values for TOC analyzed from Channel Inner sediment ranged from 0.70 to 5.50% dry weight (wt.). Values for TOC analyzed from Popes Island North sediment ranged from 2.04 to 6.44 % dry wt. Average TOC at Popes Island North (4.74% dry wt.) was greater than at Channel Inner (4.02% dry wt.) but not significantly different (t-test 0.99; df=18; $p<0.05$).

Figure 7. Percent silt and clay compared with total organic carbon at each station sampled.



Benthic Infauna

The Microsoft Excel database generated for this project contained a number of valid species that were included in community analyses. However, a few taxa are not considered in the following discussion because they are considered to be epifaunal,

clinging, or boring organisms such as the slipper limpets in the genus *Crepidula* are not considered true constituents of the infaunal community. Therefore these few taxa were excluded from any characterization of the community and are marked with an asterisk in the species list presented in Table 4. In addition, when juvenile or damaged specimens could not be identified to species, the category "spp." was used. If no species were identified in the genus, then the taxon was considered as contributing to the total density of infaunal organisms, but was neither included in discussions of species richness or diversity nor in the species list (Table 4). Oligochaetes are an important component of the infauna and were identified to the lowest practical taxonomic level for this study; however, they were not identified to species for the LTM 1999 investigation (ENSR, 2001).

In order to be cost-efficient and because existing data could be used, it was determined prior to the fieldwork that half of the collected samples in each proposed CAD cell site would be randomly chosen to be analyzed. Table 5 lists the stations that were analyzed for benthic community parameters and Figure 2 shows the locations of these stations. Appendix 1 contains the results from the benthic infaunal identifications for the four stations located in the proposed Popes Island North (PIN) and the four stations in Channel Inner (CI) CAD cell locations. Each of the stations was analyzed for abundance, density, diversity and evenness. After the samples from the proposed CAD cell sites were completely analyzed the results were compared with the data obtained from Section 2 in the NBH LTM 1999 study (ENSR, 2001).

Table 4. Species identified from the 2002 New Bedford/Fairhaven Harbor samples (superscripts p,c indicate areas of occurrence; p = Popes Island North, C = Channel Inner; asterisk* indicate species excluded from community analyses).

NEMERTEA
- *Amphiporus bioculatus* McIntosh, 1873[c]
- *Amphiporus groenlandica* Oersted, 1844[c]
- Nemertea spp.[c]

ANNELIDA
- Polychaeta
  - Capitellidae
    - *Capitella capitata* complex
    - *Heteromastus filiformis* (Claparède, 1864)[c]
    - *Mediomastus ambiseta* Hartman, 1947[c,p]
  - Cirratulidae
    - *Tharyx acutus* Webster & Benedict, 1887[c,p]
  - Glyceridae
    - *Glycera americana* Leidy, 1855[c,p]
  - Hesionidae
    - *Ophiodromus obscura* (Verrill, 1873)[c]
    - *Gyptis vittata* Webster & Benedict, 1887[c,p]
  - Nephtyidae
    - *Nephtys cornuta* Berkeley & Berkeley, 1945[c]
    - *Nephtys incisa* Malmgren, 1865[c]
  - Nereididae
    - *Nereis virens* Sars, 1835
    - *Neanthes succinea* (Frey & Leuckart, 1847)[c]
  - Onuphidae
    - *Onuphis quadricuspis* (Bosc, 1802)[c]
  - Orbiniidae
    - *Leitoscoloplos acutus* (Verrill, 1873)[c,p]
    - *Leitoscoloplos robustus* (Verrill, 1873)[c,p]
  - Pectinaridae
    - *Pectinaria gouldii* (Verrill, 1873)[c,p]
  - Phyllodocidae
    - *Eumida sanguinea* (Oersted, 1843)[c]
    - *Eteone heteropoda* Hartman, 1951[p]
    - *Phyllodoce arenae* Webster, 1879[c]
    - *Phyllodoce maculata* (Linneaus, 1767)[c]
  - Sabellaria
    - *Sabellaria vulgaris* Verrill, 1873[c*]
  - Spionidae
    - *Prionospio heterobranchia* Moore 1907[c,p]
    - *Polydora cornuta* Bosc, 1802[c]
    - *Scolelepis squamata* (Müller, 1806)[c]
    - *Streblospio benedicti* Webster, 1879[c,p]

Table 4 (continued). Species identified from the 2002 New Bedford/Fairhaven Harbor samples (superscripts p,c indicate areas of occurrence; p = Popes Island North, C = Channel Inner; asterisk* indicate species excluded from community analyses).

Syllidae
Exogone dispar[c] (Webster, 1879)
Oligochaeta
Tubificidae
Tubificidae sp. 1[p,c]
Tubificidae sp. 2[c]
Tubificidae sp. 3[p]
Tubificoides sp. 1[p,c]
Peloscolex gabriella (Marcus, 1950)[c]
CRUSTACEA
Amphipoda
Ampeliscidae
Ampelisca abdita Mills, 1864[c]
Aoridae
Lembos smithi Holmes, 1905[c]
Microdeutopus anomalus (Rathke, 1843)[c]
Corophiidae
Apocorophium acutum (Chevreux, 1908)[c]
Corophium bonelli (Milne-Edwards, 1830)c
Cirripedia
Balanidae
Balanus venustus Darwin, 1854[c*]
Cumacea
Leuconidae
Leucon americanus Zimmer, 1943[c,p]
Decapoda
Xanthidae
Eurypanopeus depressus (Smith, 1869)[c]
Isopoda
Janiridae
Ianiropsis sp. 1[c]
Mysidacea
Mysidae
Heteromysis formosa (Smith, 1873)[c]
MOLLUSCA
Bivalvia
Bivalvia spp.[c]
Anomiidae
Anomia simplex Orbigny, 1842[c*]
Arcidae
Anadara transversa (Say, 1822)[c]
Mactridae
Mulinia lateralis (Say, 1822)[c,p]
Nuculidae
Nucula proxima Say, 1822[c]
Tellinidae
Tellina agilis Stimpson, 1857[c,p]
Veneridae
Gemma gemma (Totten, 1834)[p]
Mercenaria mercenaria (Linnaeus, 1758)[p]
Gastropoda
Gastropoda sp.[p*]
Nudibranchia
Corambidae
Coryphella rufibranchialis (Johnston, 1832)[c]
Opisthobranchia
Acteonidae
Rictaxis punctostriatus (Adams, 1840)[c,p]
Acteocinidae
Acteocina canaliculata (Say, 1822)[c]
Cylichnidae
Cylichna oryza (Totten, 1835)[c]
Haminoeidae
Haminoea solitaria Say, 1822)[p]
Prosobranchia
Calyptraeidae
Crepidula fornicata (Linnaeus, 1758)[c*]
Crepidula plana Say, 1822[c*]
Nassariidae
Ilyanassa obsoleta (Say, 1822)[p]

Table 5. Stations analyzed for benthic infaunal community parameters.

Popes Island North	Segment 2 corresponding PIN stations	Channel Inner	Segment 2 corresponding CI Stations
NBH-204B-MAC	212	NBH-203-MAC	235
NBH-209-MAC	216	NBH-216-MAC	236
NBH-212-MAC	217	NBH-218-MAC	240
NBH-210-MAC	221	NBH-201-MAC	241
-	222	-	-

Species Dominance

Table 6 shows the total number of valid taxa and individuals from Segment 2 of the NBH LTM study along with the results from Popes Island North and Channel Inner CAD cell locations. It is important to note that three replicate grabs were taken at each station and that two of these three grab samples were analyzed for the NBH LTM study. Also, a total of 27 stations were sampled during this program from Segment 2. For the present study 16 stations were sampled and of these 8 were analyzed for benthic infaunal parameters with the thought that the data from the NBH LTM 1999 study could be used to supplement information and make comparisons to determine if anomalies exist.

Table 6. Number of valid infaunal taxa and number of individuals found at the two proposed CAD cell sites and all 27 hexagons sampled in Segment 2 from the NBH LTM study.

Area (year sampled)	Segment 2 18 Samples Analyzed (1999)	Popes Island North (PIN) 4 Samples Analyzed (2002)	Channel Inner (CI) 4 Samples Analyzed (2002)	CI and PIN Combined 8 Samples Analyzed (2002)
Number of species	105	24	49	54
Number of Individuals	53,131	955	655	2,635

Table 7. Number of valid infaunal species and number of individuals found at the two proposed CAD cell sites and 9 stations sampled in Segment 2 from the NBH LTM study.

Area (year sampled)	Segment 2 five stations in the area of PIN (1999)	Popes Island North (PIN) CAD site (2002)	Segment 2 four stations in the area of CI (1999)	Channel Inner (CI) CAD site (2002)
Number of species[1]	29	24	41	49
Number of Individuals*	4,252	955	3,431	655

*Number of individuals for Segment 2 is the sum of the mean of two replicates for each station; number of individuals for CAD sites is based on one replicate, the second replicate remains archived.
[1]Presence of Segment 2 oligochaetes was counted as a single species; oligochaetes were identified to species from the CAD cell samples

If anomalies were identified when the CAD cell data was compared with the NBH LTM 1999 results then the remaining 8 archived samples would be analyzed as part of a separate task order. In order to render the Segment 2 data more comparable with the CAD cell data further comparison was made using data from the nine stations sampled in Segment 2 located in same area as the proposed CAD cell sites (Figure 3). Table 7 compares the total number of valid taxa and individuals from the four CAD stations sampled at the proposed PIN site with the corresponding 5 stations from Segment 2. This table also compares the total number of valid taxa and individuals from the four CAD stations sampled at the proposed CI site with the corresponding 4 stations from Segment 2.

Results from a Student's t-test comparing the mean number of individuals from the PIN stations with the mean number of individuals from the five corresponding Segment 2 stations showed no statistically significant difference ($t=1.60$, $p<0.05$, $df=7$) despite a 4.5 times difference. The results from a Chi-Square test that was performed to compare the number of taxa at the PIN site and corresponding Segment 2 locations also showed no statistically significant difference ($X^2=0.48$. $p<0.05$, $df=1$). The four Segment 2 stations

corresponding to the CI proposed CAD site had a total number of 41 species and 3,431 individuals. The four sites sampled for the CI CAD cell had 49 species and 655 individuals. Despite the 5.3 times difference in number of individuals found at the Segment 2 CI corresponding sites there was no significant difference when the means from the 1999 and 2002 sampling efforts were compared ($t=2.10$, $p<0.05$, $df=6$). A chi-square test comparing the number of species found at the proposed CI CAD cell site with the number of species that were found in corresponding sites at Segment 2 showed no statistically significant difference ($p=0.71$, $p<0.05$, $df=1$).

The results from these statistical comparisons supports the hypothesis that the number of individuals and species identified from the 1999 NBH LTM samples was not significantly different from the 2002 CAD cell results. Therefore, analysis of the eight remaining replicate samples is not warranted. Table 7 lists the values used for the chi-square comparisons and table 8 lists values used for t-tests.

From this point forward all data from the proposed CAD cell sites were compared with the corresponding stations sampled within Segment 2 during the NBH LTM study. Table 9a and 9b and Table 10a and 10b compare the top ten dominant species found in Segment 2 with those found at the two proposed CAD cell sites. Although *Mulinia laterialis* was the most abundant species found at the Segment 2 stations in the 1999 NBH LTM study, it was the only species of mollusk found within the top ten dominant taxa. Within the top ten dominant species found at the CI proposed CAD cell site and the corresponding stations in Segment 2, four out of ten (40%) of these taxa were the same (*Mediomastus ambiseta*, *Pectinaria gouldii*, *Mulinia lateralis*, and *Rictaxis punctostriatus*) (Tables 9a and 9b). Eight out of ten (80%) of the top ten species were the same when the proposed PIN CAD cell site was compared with the corresponding Segment 2 locations (*Streblospio benedicti*, *Mediomastus ambiseta*, *Leitoscoloplos robustus*, Oligochaeta spp./*Tubificoides* sp. 1 and Tubificidae sp. 1, *Mercenaria mercenaria*, *Mulinia lateralis*, and *Tharyx acutus*) (Tables 10a and 10b).

Annelids (polychaetes and oligochaetes) were the most diverse fauna found at the proposed CAD cell sites and from the Segment 2 corresponding stations. The proposed CI CAD cell site had polychaetes representing 4 out of 10 taxa (40%), oligochaetes with 2 out of 10 (20%), gastropods 2 out of 10 (20%) and nemerteans and bivalves each with 1 out of 10 (10%) of the top ten taxa (Table 9a). Bivalves comprised 4 out of 10 (40%) while polychaetes represented 5 out of 10 (50%) of the top ten dominant fauna at the corresponding CI Segment 2 sites. The remaining 1 out of 10 (10%) was represented by the gastropod, *Rictaxis punctostriatus* (Table 9b). The proposed PIN CAD cell site had polychaetes representing 5 out of 10 (50%), bivalves 3 out of 10 (30%), and oligochaetes 2 out of 10 (20%) of the top ten taxa (Table 10a). Polychaetes comprised 8 out of 10 (80%) of the top ten fauna at the Segment 2 PIN (Table 10b) corresponding sites with oligochaetes and a bivalve species each with 1 out of 10 or 10%. Numbers of valid individuals and taxa for the analyzed PIN and CI proposed CAD cell stations is shown in Figure 8.

Table 8. Values used for abundance t-test comparisons	
Station	Value for t-test
NBH-212-MAC PIN	252
NBH-210-MAC PIN	286
NBH-209-MAC PIN	194
NBH-204B-MAC PIN	225
NBH-218-MAC CI	501
NBH-216-MAC CI	29
NBH-203-MAC CI	169
NBH-201-MAC CI	22
Segment 2 212 (PIN)	1976
Segment 2 216 (PIN)	859
Segment 2 217 (PIN)	1356
Segment 2 221 (PIN)	21
Segment 2 222 (PIN)	305
Segment 2 235 (CI)	356
Segment 2 236 (CI)	1019
Segment 2 240 (CI)	1706
Segment 2 241 (CI)	414
( )=corresponding proposed CAD Cell	

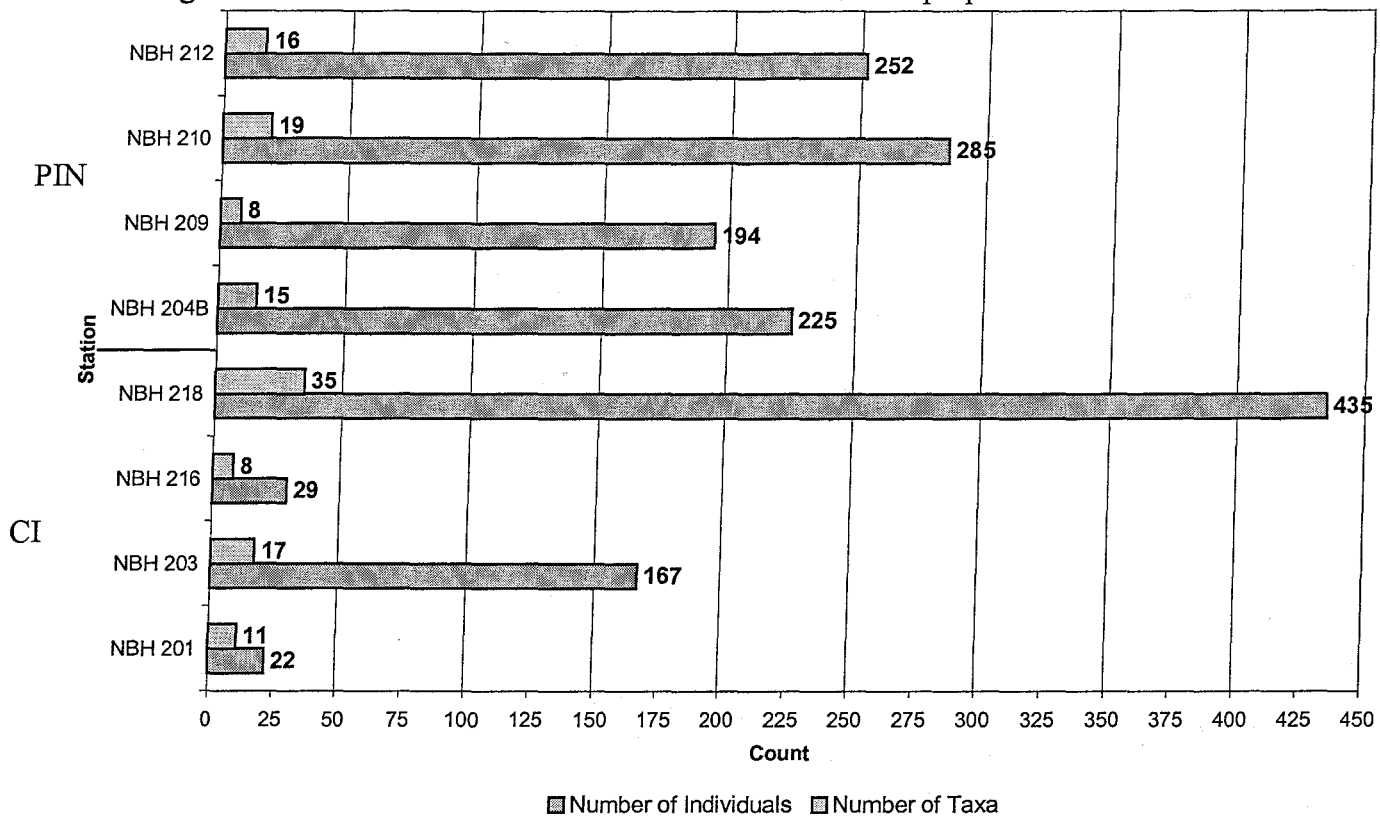
Table 9a. Dominant valid infaunal species found at CI proposed CAD Cell sites. (2002)		
Species	**Total Abundance**	**Cumulative Percent**
Mediomastus ambiseta (P)	251	38.4
Tubificidae sp. 2 (O)	134	58.9
Amphiporus bioculatus (N)	23	62.4
Leitoscoloplos acutus (P)	22	65.7
Pectinaria gouldii (P)	19	68.7
Cylichna oryza (G)	14	70.8
Mulinia lateralis (B)	14	72.9
Ophiodromus obscurus (P)	14	75.1
Rictaxis punctostriatus (G)	14	77.2
Tubificidae sp. 1 (O)	14	79.4
P=polychaete; O=oligochaete; N=nemertean; G=gastropod; B=bivalve		

Table 10b. Dominant valid infaunal species found at PIN corresponding Segment 2 sites. (1999)		
Species	**Total Abundance**	**Cumulative Percent**
Mulinia lateralis (B)	2533	59.6
Streblospio benedicti (P)	640	74.6
Tharyx acutus (P)	519	86.8
Leitoscoloplos robustus (P)	139	90.1
Oligochaeta spp.(O)	121	92.9
Mercenaria mercenaria (P)	77	94.7
Eteone heteropoda (P)	75	96.3
Pectinaria gouldii (P)	33	97.1
Mediomastus ambiseta (P)	30	97.7
Polydora cornuta (P)	26	98.3
P=polychaete; O=oligochaete; N=nemertean; G=gastropod; B=bivalve		

Table 10a. Dominant valid infaunal species found at PIN proposed CAD Cell sites. (2002)		
Species	**Total Abundance**	**Cumulative Percent**
Streblospio benedicti (P)	309	32.4
Mediomastus ambiseta (P)	149	48.0
Tubificoides sp. 1 (O)	105	59.0
Leitoscoloplos robustus (P)	86	68.0
Leitoscoloplos acutus (P)	85	76.9
Gemma gemma (B)	73	84.5
Tubificidae sp. 1 (O)	34	88.1
Mulinia lateralis (B)	26	90.8
Tharyx acutus (P)	20	92.9
Mercenaria mercenaria (B)	19	94.9
P=polychaete; O=oligochaete; N=nemertean; G=gastropod; B=bivalve		

Table 9b. Dominant valid infaunal species found at CI corresponding Segment 2 sites. (1999)		
Species	**Total Abundance**	**Cumulative Percent**
Mulinia lateralis (B)	2212	64.5
Mediomastus ambiseta (P)	362	75.0
Pectinaria gouldii (P)	207	81.0
Macoma tenta (B)	158	85.6
Streblospio benedicti (P)	113	88.10
Prionospio (Minuspio) perkinsi (P)	59	89.8
Tharyx acutus (P)	49	91.1
Rictaxis punctostriatus (G)	45	92.4
Mercenaria mercenaria (B)	45	93.7
Tellina agilis (B)	39	94.8
P=polychaete; O=oligochaete; N=nemertean; G=gastropod; B=bivalve		

Figure 8. Number of valid individuals and taxa found at the proposed PIN and CI CAD cell stations.



Diversity and Evenness

Shannon-Wiener diversity and Pielou's evenness were calculated for the 4 CI and the 4 PIN stations that were analyzed and an average of these parameters was calculated for the corresponding Segment 2 locations. The Shannon-Wiener diversity calculation (Lloyd *et al.*, 1968) characterizes the diversity of a sample or community by a single number (Magurran, 1988). Species diversity involves two components: the number of species, or richness, and the distribution of individuals among species, or evenness. Pielou's calculation for evenness was used for this analysis and evenness can be defined as the distribution of individuals among species or the calculation of the uniformity in species abundance within a certain assemblage (sampling station).

Table 11 presents the results of evenness and diversity calculations for each analyzed station sampled during the October 2002 survey and for corresponding stations sampled in Segment 2 for the NBH LTM study. The evenness and diversity at the proposed CI stations was, on average, slightly higher than diversity at the proposed PIN stations but was not statistically significantly different ($t=0.69$, $p<0.05$, $df=6$; $t=0.82$, $p<0.05$, $df=6$, respectively). Average diversity and evenness found at the PIN proposed CAD cell samples were compared with corresponding stations sampled in Segment 2 during the NBH LTM monitoring effort. The results showed higher average diversity and evenness from the PIN CAD cell samples, however, these differences were not significantly different ($X^2=0.03$, $p<0.05$, $df=1$; $X^2=0.06$, $p<0.05$, $df=1$, respectively). A similar trend was observed when the results from the CI proposed CAD cell samples were compared with corresponding Segment 2 station data. The average evenness and diversity were

slightly higher at the CI CAD cell sites but not significantly different (X^2=0.09, $p<0.05$, df=1; X^2=0.08, $p<0.05$, df=1, respectively).

Table 11. Diversity and evenness calculations for the analyzed proposed CAD Cell sites and their corresponding NBH LTM Segment 2 stations.

Cell/Area	Station	Number of Individuals	Number of Taxa	H' Shannon-Wiener Index	J' Pielou's Evenness	Average H'	Average J'
CI 2002	NBH 201	22	11	2.2635	0.9440	1.9223	0.7407
CI 2002	NBH 203	167	17	1.9690	0.6950		
CI 2002	NBH 216	29	8	1.7617	0.8472		
CI 2002	NBH 218	435	35	1.6951	0.4768		
PIN 2002	NBH 204b	225	15	1.4249	0.5262	1.7425	0.6639
PIN 2002	NBH 209	194	8	1.4426	0.6938		
PIN 2002	NBH 210	285	19	2.0992	0.7129		
PIN 2002	NBH 212	252	16	2.0033	0.7225		
NBH LTM Seg. 2 1999	CI	3431	36	NA	NA	1.5025*	0.4193*
NBH LTM Seg. 2 1999	PIN	4252	30	NA	NA	1.4124^	0.4153^

*average of 4 cells in Segment 2 corresponding to the CI CAD cell locations
^average of 5 cells in Segment 2 corresponding to the PIN CAD cell locations

DISCUSSION AND CONCLUSION

Most of the stations sampled as part of this 2002 survey were comprised of silt and clay with high total organic carbon concentrations. Because contaminants typically bind to finer grain size particles it is likely that these stations have chemical contamination. The marine sediment of New Bedford/Fairhaven Harbor is historically contaminated with PCBs, PAHs, and heavy metals (ENSR 2001). Data for sediment chemistry is presented in the 1999 NBH LTM report (ENSR, 2001). The 1999 monitoring effort showed that PCB concentrations in the proposed CAD cell locations ranged between 1-50 ug/g dry weight. Copper concentrations found in the 1999 study ranged between 100 and >1000 ug/g dry weight. Sediment toxicity from the 1999 study was less than 60% survivability at all Segment 2 sites corresponding to the proposed CAD cell locations. This suggests that the sediment in the vicinity of the proposed CAD cell sites is anthropogenically affected and contaminated possibly exceeding benchmark screening values. Analysis of the sediments for the proposed CAD cell monitoring was not available (to ENSR) to compare with the 1999 data set.

Composition and dominance of the benthic fauna in samples collected as part of the proposed CAD cell monitoring effort (2002) were similar to those reported for the NBH LTM samples taken in 1993 (Nelson *et al.*, 1996), 1995 (EPA unpublished data) and 1999 (ENSR, 2001). *Streblospio benedicti*, *Tharyx acutus*, *Leitoscoloplos* spp., *Mediomastus ambiseta,* Oligochaeta *spp.,* and *Mulinia lateralis* were the dominant species found at the proposed CAD cell stations. These same species were also found to dominate the benthic infauna of Segment 2 in 1995. *Mulinia lateralis* was very abundant in 1993 and 1999 but not in 1995. If *Mulinia lateralis* is removed from the 1993 and 1999 data then the species composition for these two years is even more similar to the 2002 monitoring results.

Differences in species abundance when comparing the 2002 data with the 1999 results could be attributed to differences in temporal sampling events. The NBH LTM samples were taken in the summer of 1999 while the samples for the monitoring of the proposed CAD cell sites were taken in the fall of 2002. As the water temperature and food supply decrease and storms appear more frequently during the fall the benthic population abundance tends to decrease. Comparison of NBH LTM data with the CAD cell results suggests that the benthic fauna populations remain statistically similar and suggest that community structure hasn't changed over the course of 10 years.

The dominant organisms that comprise the benthic community at the proposed CAD cell sites can be classified as pioneering or opportunistic species (Rhoads and Germano, 1982). Similar opportunistic communities were observed at the Boston Harbor Navigational Improvement Project (BHNIP) CAD cell sites in 1999 (ENSR, 2001). This project included analyzing sites that have been dredged, filled and capped as well as ambient localities and unfilled cells using Sediment Profile Image and benthic infaunal analyses. The investigation at the BHNIP CAD cell site showed that within a year of filling and capping the opportunistic benthic infauna had re-colonized the sediment surfaces. It is highly likely that construction, filling, and capping events that would take

place at the proposed New Bedford/Fairhaven Harbor CAD cell sites would temporarily impact the benthic communities. However, as in the BHNIP cells the CAD cell surfaces would re-colonized rapidly by similar opportunistic species. Eventually, the benthic community would return to a pre-dredging composition. Adults and larvae from adjacent areas, which were not dredged, would provide recruits to the disturbed sites.

It would be useful to ground-truth the Sediment Profile Images (SPI) taken at the New Bedford/Fairhaven Harbor proposed CAD cell sites with the results from this benthic infaunal analysis. The SPI analysis should show, for example, presence/absence of methane, depth of redox potential discontinuity, and permits the calculation of organism-sediment indices. These calculated SPI parameters along with the benthic infaunal analyses would provide strong evidence to support the fact that the communities in the Lower New Bedford/Fairhaven Harbor, in the area of the proposed CAD cell sites, are dominated by opportunistic species that can tolerate disturbed conditions.

Appendix 1. Benthic Infaunal Data from Popes Island North and Channel Inner Proposed CAD Cell Sites.

		NBH-201-MAC	NBH-203-MAC	NBH-216-MAC	NBH-218-MAC	NBH-204B-MAC	NBH-209-MAC	NBH-210-MAC	NBH-212-MAC	Grand Total
Taxon	NODC Code	CI	CI	CI	CI	PIN	PIN	PIN	PIN	
Acteocina canaliculata	5110040103	1	3							4
Ampelisca abdita	6169020108	1			2					3
Amphiporus bioculatus	4306050110	2	13	5	3					23
Amphiporus groenlandica	4306050124	1								1
Anadara transversa	5506010201				4					4
Anomia simplex	5509090202				3					3
Apocorophium acutum	6169150213		2							2
Balanus venustus	6134020121				31					31
Bivalvia spp.	55SPP		1							1
Bocardiella hamata	5001432801				4					4
Capitella capitata	5001600101					1			2	3
Corophium bonelli	6169150202				1					1
Coryphella rufibranchialis	514104011001		1	1						2
Crepidula fornicata	5103640204				20					20
Crepidula plana	5103640207				8					8
Cylichna oryza	5110040208		13	1						14
Eteone heteropoda	5001130207					3	3	5	4	15
Eumida sanguinea	5001130302				9					9
Eurypanopeus depressus	6189020501				2					2
Exogone dispar	5001230701				1					1
Gastropoda spp.	5105SPP							1		1
Gemma gemma	5515471301						61	2	10	73
Glycera americana	5001270104				2			1		3
Glycinde solitaria	5001280104		5	4	3			3		15
Gyptis vittata	5001210103	1						3		4
Haminoea solitaria	5110120102							1		1
Heteromastus filiformis	5001600201				3					3
Heteromysis formosa	6153010802				7					7
Ianiropsis sp. 1	61630607SP01				1					1
Ilyanassa obsoleta	5105080201								1	1
Leitoscoloplos acutus	5001400305	3		11	8	8	31	27	19	107
Leitoscoloplos robustus	5001400304	2		1	3	14		61	11	92
Lembos smithi	6169060303				4					4
Leucon americanus	6154040110	1	5			5			1	12
		NBH-201-MAC	NBH-203-MAC	NBH-216-MAC	NBH-218-MAC	NBH-204B-MAC	NBH-209-MAC	NBH-210-MAC	NBH-212-MAC	Grand Total

Appendix 1 (continued). Benthic Infaunal Data from Popes Island North and Channel Inner Proposed CAD Cell Sites.

Taxon	NODC Code	CI	CI	CI	CI	PIN	PIN	PIN	PIN	
Maldanidae sp. juv.	500163SPP				3					3
Mediomastus ambiseta	5001600401	3	80		168	60	8	52	29	400
Mercenaria mercenaria	5515471101					5		4	10	19
Microdeutopus anomalus	6169060402				3					3
Mulinia lateralis	5515250301		10	3	1	2	4	16	4	40
Neanthes succinea	5001240309	4			3					7
Neanthes virens	5001240302				1					1
Nemertea spp.	43SPP		1							1
Nephtys cornuta	5001250104				1					1
Nephtys incisa	5001250115		2							2
Nucula proxima	5502020204				7					7
Onuphis quadricuspis	5001290110				1					1
Ophiodromus obscurus	5001210404				14					14
Pectinaria gouldii	5001660302		10	3	6	1		4	3	27
Peloscolex gabriella	5009020201				1					1
Phyllodoce arenae	5001131410				3					3
Polydora cornuta	5001430448				3					3
Prionospio heterobranchia	5001430503				3	1		1	1	6
Prionospio perkinsi	5001430517		1							1
Rictaxis punctostriatus	5110010403	3	11					2		16
Sabellaria vulgaris	5001650202				1					1
Scolelepis bousfieldi	5001432002		1							1
Spio limicola	5001430707							1		1
Streblospio benedicti	5001431801		1		3	84	80	63	82	313
Tellina agilis	5515310205		3		1			1		5
Tharyx acutus	5001500305				11	6	3	1	10	31
Tubificidae sp. 1	500902SP01				14	32			2	48
Tubificidae sp. 2	500902SP02				134					134
Tubificidae sp. 3	500902SP03					2				2
Tubificoides sp. 1	50090209SP01		6			1	4	37	63	111
Grand Total		22	169	29	501	225	194	286	252	1678

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APPENDIX F

COMPARISON OF SEDIMENT PROFILE IMAGE AND BENTHIC COMMUNITY ANALYSIS

COMPARISON OF SEDIMENT PROFILE IMAGE AND BENTHIC COMMUNITY ANALYSIS FOR THE NEW BEDFORD/FAIRHAVEN DREDGED MATERIAL DISPOSAL PLAN #11669 CONFINED AQUATIC DISPOSAL (CAD)

Addendum to the Draft Environmental Impact Report

Prepared for:

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Submitted by:

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July 2003

COMPARISON OF SEDIMENT PROFILE IMAGE AND BENTHIC COMMUNITY ANALYSIS FOR THE NEW BEDFORD/FAIRHAVEN DREDGED MATERIAL DISPOSAL PLAN #11669 CONFINED AQUATIC DISPOSAL (CAD)

Addendum to the Draft Environmental Impact Report

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Under ENSR Contract Number: 04391010

July 2003

Comparison of Sediment Profile Images (1999) and Benthic Infaunal Analysis (2002)

In 1999, a report on the results from sediment profile image analysis was submitted to Maguire Group Inc. (SAIC 1999). The sediment profile image analysis was conducted within New Bedford/Fairhaven Harbor (the Harbor) to characterize the habitat as part of the Dredge Material Management Plan (DMMP) to determine appropriate sites for the placement of confined aquatic disposal (CAD) cells. In 2002, ENSR International submitted the results of a benthic community analysis (ENSR 2003) from samples taken within two proposed CAD cell sites in the Harbor also to support habitat characterization for the DMMP. This summary compares the results from the SPI and benthic infaunal analysis to reconfirm that the communities remained similar over the three years between surveys.

The results of the 1999 sediment profile survey demonstrates that the stations sampled within the navigational channel near Popes Island (the same sites that were revised for the benthic community survey in 2002), consisted of fine-grained, silt-clay sediments (>4 phi). Of the images that could be analyzed from this area (Popes Island and Channel Inner), Stage I species (opportunistic polychaetes) were the predominant successional stage. Evidence of Stage III organisms was observed in only three images suggesting that the communities largely consisted of pioneering, early successional stage polychaete worms. Planview images taken by SAIC as part of the 1999 survey in the Harbor showed that Stage I worm tubes were present at the sediment surface at several sites (SAIC 1999). The redox potential discontinuity (RPD) depth, a measurement used to determine the apparent dissolved oxygen conditions within sediment pore waters ranged from 1 to 3 cm, which are intermediate values reflecting moderate to high levels of organic loading in the Harbor (SAIC, 1999). The Organism-Sediment Index (OSI) is a metric which defines overall benthic habitat quality by reflecting the depth of the apparent redox layer, successional stage of infauna, the presence/absence of methane gas in the sediment, and the presence/absence of reduced sediment (i.e. anaerobic sediment) at the sediment water interface. OSI values less than 0 indicate degraded habitat quality, values between 0 and +6 reflect intermediate quality and values greater than +6 are considered indicative of good or healthy benthic habitat quality. The sites surveyed in the New Bedford Channel and near Popes Island ranged from +2 to +6 suggesting that the habitat in this area is of intermediate, disturbed quality. The general absence of bioturbating Stage III organisms coupled with high inputs of organic sediment are thought to be factors contributing to the intermediate habitat quality in these proposed CAD cell areas. Images from the SPI survey can be found in the SAIC (1999) report

The results from the sediment grain-size analysis conducted as part of the ENSR (2002) survey showed that fine-grained silt and clay were the predominant sediment type found at the Popes Island and Channel Inner stations and total organic carbon was high (ENSR, 2002). These results agree with those found by the SPI survey conducted in 1999 by SAIC. The overwhelmingly dominant species found at the field sites sampled in 2002

were opportunistic polychaetes (*Mediomastus ambiseta* and *Streblospio benedicti*). These two polychaetes are considered to be successional Stage I species.

The SPI survey (1999) and the benthic infaunal analysis (2002) are remarkably consistent with each. This provides strong evidence to support the fact that the communities in the Lower New Bedford/Fairhaven Harbor, in the area of the two proposed CAD cell sites, are dominated by opportunistic species that can tolerate disturbed conditions.

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APPENDIX G

SUSPENDED PARTICULATE PHASE ACUTE TOXICITY TESTING WITH MYSIDS

Laboratory Testing In Support of *Site Specific Water Quality Criteria Assessment and Hydrographic Data Collection for New Bedford Harbor*

TASK 2A
SUSPENDED PARTICULATE PHASE ACUTE TOXICITY TESTING WITH MYSIDS

Data Report

Prepared for:

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Submitted by:

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July 2003

Laboratory Testing In Support of *Site Specific Water Quality Criteria Assessment and Hydrographic Data Collection for New Bedford Harbor*

TASK 2A
SUSPENDED PARTICULATE PHASE ACUTE TOXICITY TESTING WITH MYSIDS

Data Report

Prepared for:

Maguire Group Inc.

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December 12, 2002

Introduction

Task 2 of SAIC's Site Specific Water Quality Assessment Study involves toxicity testing and chemical analyses to determine risks to aquatic organisms from potential resuspension of sediments during dredging operations in New Bedford Harbor. These data will provide site-specific measures of the allowable chemical concentrations in water associated with the sediment resuspension during dredging. To date these concentrations have been derived through modeling exercises (ASA, 2001; 2002), and thus represents a data gap.

In Task 2A, toxicity testing of Suspended Particulate Phase (SPP) mixtures is performed to document the occurrence and magnitude of toxicity, as well as to select samples for further evaluation of the cause of toxicity using Toxicity Identification Evaluations (TIE, Task 2B). Also, the chemical exposure concentrations corresponding to non-toxic SPP samples are used to as a precursor to the derivation of Water Effect Ratios (Task 2C), which, when applied to the default water quality criteria values, represents an adjusted criteria for site specific conditions.

This document reports on Task 2A, including SPP testing, and data obtained from chemical analyses of SPP and elutriates. Minimal interpretation of the chemistry data is provided here, as this aspect of the Water Quality Criteria Assessment will be further addressed in Task 2B and Task 2C.

Approach

SPP testing is a standard and generally required activity for evaluation of dredged materials to determine the potential impact of dissolved and suspended contaminants on water column organisms (USEPA and USACE, 1991; 1998). For New Bedford Harbor, the SPP testing was conducted with six sediment samples collected from candidate CAD cell areas and navigation dredging areas with the intention of representing the most highly contaminated sediments that would be involved in navigation dredging operations. Background data on these locations were obtained from the draft EIS (Office of Coastal Zone Management, 2002). An SPP consisting of reference sediment was tested for toxicity, resulting in a total of seven toxicity evaluations; the chemical composition of the reference sample was not analyzed.

Methods

Sample Collection and Transport

Samples were collected by Maguire Group as part of an ongoing 'Nature and Extent' study. Three sediments from the Pope's Island CAD cell (PI-CAD; NBH-204, NBH-205 and NBH-206) and two from the more southerly CAD cell area (LH--CAD; NBH-201 and NBH-202) were selected for testing, along with one station (NBH-207) to the west of Pope's Island, a near-shore site that had been identified as a PCB hot-spot (Figure 1). The samples were collected on 10 October 2002, and were shipped in one-gallon polyethylene buckets, filled with no head space, on 11 October, arriving at the toxicity testing laboratory (SAIC's subcontractor, Aquatec Biological in Williston, VT) on 12 October. Standard chain-of-custody procedures were followed. Chain-of custody (CoC) forms were signed and copied. SAIC retains copies of the CoCs, along with test data in experiment binders and project files. Upon arrival, samples were inspected to determine

their temperature and condition (e.g., caps in place or leakage). When coolers were received on 12 October, temperatures slightly exceeded recommended storage conditions (4 $\pm$ 2°C) to varying degrees. However, because the transit time was < 24 hrs and the exceedences were generally small, we believe that results from toxicity tests with the samples are valid.
Samples were stored at 4 $\pm$ 2°C in the dark until testing.

Organism Selection and Source
The test species chosen for SPP testing was the saltwater mysid, *Americamysis bahia.* This species has been shown to be sensitive to New Bedford Harbor sediments in previous studies (Nelson et al. 1991; Ho et al., 1997). The mysid was also selected for its relatively high sensitivity to PCBs, and because their sensitivity to a wide variety of other toxicants has also been documented (USEPA AQUIRE). Mysids for testing were supplied by Aquatic Biosystems in Fort Collins Colorado. They were hatched14 October, received at Aquatec on 16 October and the test was initiated on 17 October. Newly hatched *Artemia* were fed to mysids on each day prior to test initiation, and daily feeding continued during the test.

Mysids were evaluated using a standard reference toxicant water-only test with potassium chloride. In this test, survival is determined in each of two replicate chambers to which ten animals have been added. The reference test uses a six dilution series with concentrations ranging between 0.1 and 1.0 g/L, and is used to determine LC50 values for comparison with Control Chart values. Aquatec's Control Chart for the mysid *(A. bahia)* includes > 20 tests from mysid tests conducted since 1999.

Suspended Particulate Phase Preparation and Testing
Suspended Particulate Phase samples were prepared by adding homogenized sediment to site water in a 1:4 volumetric ratio. The solution was stirred with a mixer for 30 minutes, and every 10 minutes by hand, and then allowed to settle for one hour. The supernatant was siphoned off for toxicity testing as well as for total suspended solids (TSS) and total organic carbon (TOC) analyses. For other chemical analyses (TAL metals, PAHs and PCBs), the supernatant (SPP) was centrifuged for approximately 10 minutes at 6000 rpm. Samples were preserved, as appropriate and were air-freighted to SAIC's subcontractor for chemical Analyses, Severn Trent Laboratories in Burlington, VT. The following EPA-recommended analytical methods (U.S. EPA, 1997) were employed: TOC (9060); TSS (160.2); PCB congeners (8082); TAL metals (6010B). PAHs were measured using NOAA Status and Trends methods (NOAA, 1998).

Dilutions of the SPP for toxicity testing were prepared by mixing the centrifuged supernatant with Forty Fathoms@ artificial seawater. Elutriate dilutions (1%, 10%, 25%, 50%, and 100%) as well as Control Water (artificial seawater) and a Long Island Sound Reference Site SPP were tested using mysid exposures.

Ninety-six hour tests using the mysid *(A. bahia)* were conducted according to the accepted proposal. The test chambers were glass jars. Two hundred milliliters of full strength or diluted elutriate was added to each of five replicate chambers per concentration. In addition, a Forty Fathoms® seawater performance control was tested. The performance control and the LIS reference SPP were tested using 100% SPP only. All other SPP samples were tested using the 1%, 10%, 25%, 50% and 100% dilution series. Test temperature ranged from 24 to 25 °C.

At the beginning of each test series, mysids were transferred from acclimating chambers into test chambers using a wide-bore pipette. Ten mysids were randomly distributed into each chamber. Animals were fed during testing. Test chambers were monitored daily and dead mysids were recorded and removed.

Acceptable dissolved oxygen concentrations were documented to be in the range of 7.8 to 8.2 mg/L at the start of the test, and 5.3 to 6.6 mg/L at the end of the test. Salinity increased by ≤3 mg/Kg, from 31 mg/Kg at test initiation, pH ranged between 7.8 and 8.2, across samples, with no apparent temporal trend. All water quality parameters were acceptable (U.S. EPA/U.S. ACE, 1998; U.S. ACE, 1991). Ambient laboratory lighting was set for a 16 hr light and 8 hr dark photoperiod. Full strength SPP solutions were analyzed for ammonia on day 0. Samples were diluted 1 to 10 with deionized water. Total ammonia was measured spectrophotometrically.

Data Analysis

Data analysis was performed with SPP results using a one-way heteroscedastic t-test (alpha=0.05) assuming normal distribution of the data. In addition, for each of the samples with statistically significant reductions in survival, estimated effect concentrations ("LC" values) were calculated using data from the dilution series. Values were calculated using linear interpolation, with bootstrapping to generate confidence intervals. Statistics were generated with the ToxCalc® statistical package from Tidepool Software. Results of the analyses were interpreted within the context of the following decision points, as follows (also see Fig. 1 of the proposal for this project):

- A finding of no toxicity and chemical measures below water quality criteria (WQC) values indicates that default WQC criteria may be used in monitoring and that no further testing is required.
- A finding of toxicity and chemical concentrations above WQC indicates that a specific chemical is causing toxicity or several chemicals are causing toxicity, or that confounding factors (e.g., ammonia toxicity) are contributing, such that a TIE (Task 2B) should be conducted to resolve the toxicity sources.
- A finding of toxicity but chemical concentrations below WQC will indicate that site-specific toxicity of chemicals is greater than presumed by default WQC. This result, generally indicative of confounding factors such as ammonia, and will also be further evaluated through the Task 2B TIE study.

Results

Quality Assurance/Quality Control

The summary report for reference toxicant (potassium chloride) testing conducted by Aquatec is presented in Appendix A. The LC50 was 0.373 g/L, well within the Control Chart lower and upper boundaries of 0.11 and 0.56 g/L, established the normal response of these organisms (Appendix A). During the SPP testing, water quality measurements of temperature, salinity, pH and dissolved oxygen were within normal the normal range for mysid exposures (U.S. EPA, 1991). All QA/QC parameters measured for chemical analyses were within acceptable ranges. SAIC maintains a copy of the full Toxicity Test Data Report provided by Aquatec and the analytical chemistry data report provided by Severn Trent Laboratories.

Site Sample SPP Toxicity Test Results

Mean survival for mysids was greater than 95% in all but one of the six SPP samples (Table 1). For NBH-202, toxicity was observed in the 100% SPP, but not in any of the dilution series. The calculated LC50 value was 76%; the ToxCalc summary report for the statistical analysis is presented at the end of Appendix B. Time series mortality in the NBH-202 100% SPP over each day of the four day test were as follows: No mortality had occurred by Day 1, while exposures through Day 2, Day 3 and Day 4 resulted in mean survival of 42%, 20% and 2%, respectively. Ammonia concentrations (Table 1) measured as a routine practice at the start of SPP testing indicate that NPH-202 had the highest concentration of total and unionized ammonia (37.9 and 1.6 mg/L, respectively), with the unionized concentration approaching the LC50 value for this species (1.94 mg/L). Relationships between toxicity and chemical exposure concentrations are discussed in the following section.

Analytical Chemistry Results and Exposure Characterization

Comparisons with Aquatic Life Criteria and Species-specific Benchmarks.

Results from chemical analyses of elutriates derived from SPP are presented in Appendix C. Hazard Quotients (HQ) derived from Chronic and Acute Water Quality Criteria values or equivalent are presented in Table 2 and Table 3, respectively. The values presented are simply the quotient of measured chemical concentrations (from Appendix C-1; Metals and PAHs and C-2; PCBs), divided by the respective Water Quality screening value.

In Table 2, chronic HQs for aluminum, copper, nickel, silver, benzo(k)fluoranthene and Total PCBs are > 1 for all stations (except NBH-204 for benzo(k) fluoranthene). Among these, the copper and PCB concentrations are likely to be the most toxicologically relevant; as aluminum, is likely biased by the solids component while nickel and silver concentrations were non-detect. Station NBH-202 had the highest chronic HQs.

Using Acute Water Quality Criteria as benchmarks (Table 3), proportionately lower exceedences (HQs> 1) are calculated to represent risks associated with short duration exposures. Because dilution will occur during dredging operations, these Acute HQs are more appropriate than chronic criteria values for interpretation of elutriate concentrations. Acute HQs for PAHs and Total PCBs are less than unity at all stations other than NBH-202. For NBH-202, the sum PAH HQ is 1.33 and the Total PCBs HQ is 2.31, suggesting probable toxicity. The highest HQ for NBH-202 is for copper (HQ=20). Four of the other five stations also exceeded the acute criteria for copper, with (HQ range 1.48 to 8.13). Only NBH-204 had an elutriate copper concentration less than the Acute Criteria value.

Hazard Quotients based on the known sensitivity of mysids *(A. bahia)* to metals, including copper, as well as PCBs and ammonia, are presented in Table 4. Based on available information (i.e., published LC50 values), the major contributors to toxicity in NHB-202 appear to be PCBs (HQ= 1.36), unionized ammonia (HQ=0.82), and copper (HQ=0.64). The sum HQ was less than unity for the remaining stations, suggesting that acute toxicity is not likely to occur.

The sum HQ for NBH-202 mysid exposures, based on measured concentrations of PCBs, ammonia and metals is 2.9 (Table 4), with PCBs being the largest contributor. There is relatively high uncertainty associated with the HQ for PCBs, given that it is based on exposures to Aroclor 1242 (Ho et al., 1997). While Aroclor 1242 and Aroclor 1254 are believed to be the major PCB mixtures present in New Bedford Harbor sediments, mixtures of congeners changes over time due to natural physical and biological processes. Toxicity of PCB mixtures is also expected to change somewhat over time, but parent compound toxicity is generally used to estimate potential toxicity in field samples because no other approach is practical. The mysid LC50 for Aroclor 1242 was used as a conservative value to derive species-specific HQs, and it is about three times more toxic to mysids than Aroclor 1254 (Ho et al., 1997). The value used is particularly conservative because it was derived from a 96 hr test that was renewed with freshly prepared solution at 48 hrs, while the SPP tests for the present study were not renewed, and reduction in exposure concentrations are expected over time. The estimate of total PCBs (Appendix C-2) used in the HQ calculations was calculated from individual congeners using NOAA Status and Trends protocol (1998).

With regard to ammonia, reported LC50s from a single study range over a factor of two-three, based on total and unionized values, respectively. Therefore, the HQ for ammonia for NBH-202 could be as low as 0.5 or as high as 1.6. For copper, the range between two reported LC50s is relatively narrow (141 μg/L, Bay et al. 1993; 164 μ/L, SAIC 1993). In summary, toxicity and chemical concentrations above WQC indicated a likelihood that toxicity could be attributable to metals, PCBs and confounding factors (e.g., ammonia toxicity), but the relative roles of each in toxicity associated with the NBH-202 sample remains uncertain. Task 2B involving the conduct of a Toxicity Identification Evaluation is directed at resolving the relative sources of toxicity. It is also important to consider that the three most likely sources of toxicity may contribute synergistically to observed effects.

Elutriate Concentrations Relative to Predicted Values

Table 5 presents measured concentrations of metals, PCBs and PAHs for each elutriate tested compared with predictions of elutriate concentrations that used equilibrium partitioning and sediment concentrations to derive computed estimates (ASA, 2001 ;U.S. EPA, 1991). Only one elutriate concentration is reported by ASA, representing the highest sediment loading (Fish Island Area; mean of 16 stations) found in the bulk sediment survey conducted by Lecco (1998). Only metals with measured concentrations above detection limits are presented.

For metals, measured values for copper in FI-A (near NBH-207) were a factor of 4.4 less than the estimated elutriate value. For Total PCBs the measured value was three orders of magnitude higher than the elutriate value based on ASA's reported estimate. A review of the ASA result is underway to evaluate potential causes for this large difference. The sum of measured PAH values (used as a surrogate for TPH) were all much lower than estimated values, and represent lower acute and chronic limits than measured PCBs. Massachusetts currently does not apply a standard for TPH.

Summary of Findings for Site Specific Water Quality Study

Results for the SPP tests determined that only NBH-202 was toxic to mysids. In this sample, the absence of toxicity in any of the dilutions indicates a relatively low level of acute toxicity. None of the other samples were acutely toxic. Given the close range of species-specific HQs (0.6-1.4) for the three predominant toxicants in NBH-202, attendant uncertainties associated with each, and the effects of ambient (site-specific) water quality on each, it is not possible to determine if one, two, or all three of the constituents (copper, Total PCBs, ammonia) are important contributors to toxicity. As described in SAIC's "Proposal for Site Specific Water Quality Criteria Assessment and Hydrographic Data Collection for New Bedford Harbor," sample NBH-202 is in the process of further evaluation, using Toxicity Identification Evaluation (TIE) methods as an effort to resolve the potential sources of the observed toxicity.

In addition, it would be useful to obtain estimates of elutriate concentrations derived from sediments representing areas other than Fish Island, and including the sediment chemistry data recently produced for characterization of sediment cores.

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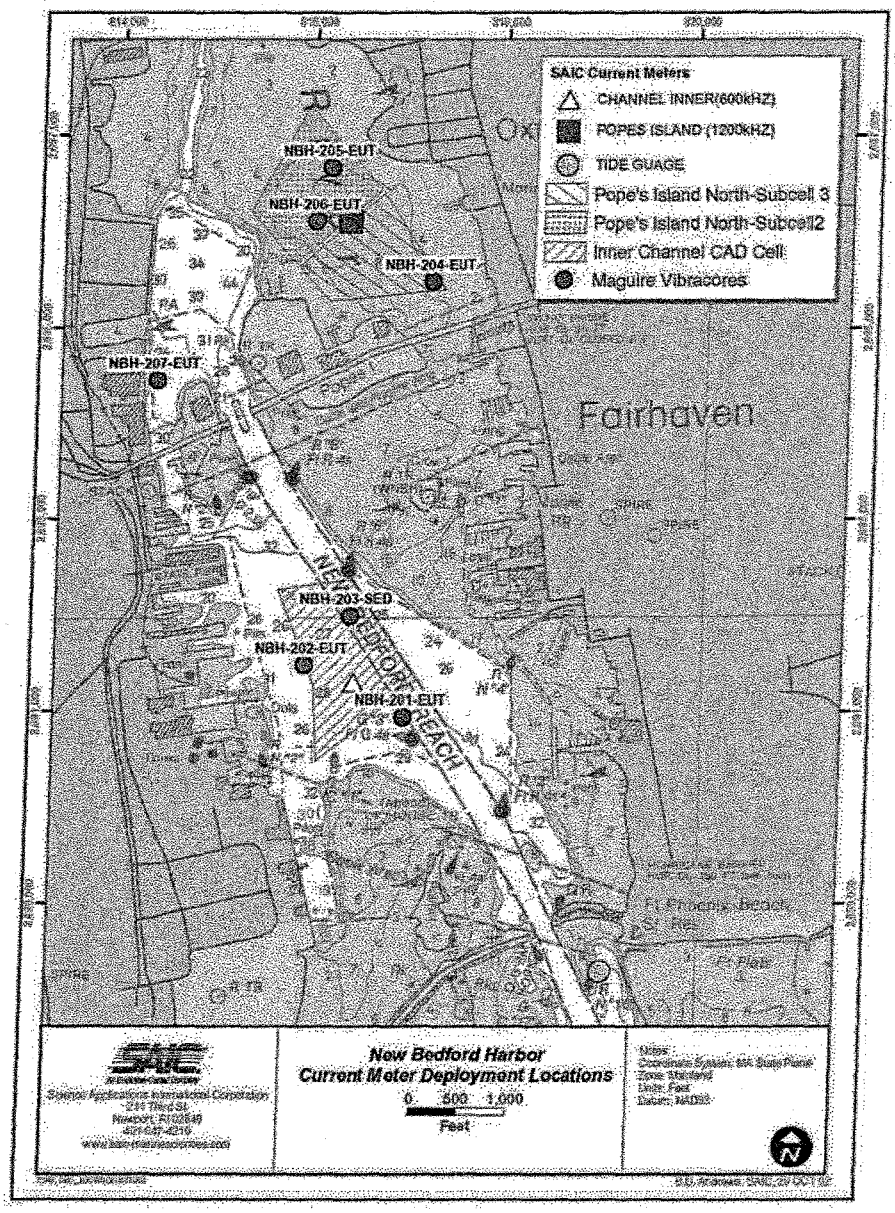


Figure 1. New Bedford Harbor stations selected for the Site Specific Water Quality Criteria Assessment Study (denoted as stations sampled synoptically for sediment core characterization- 'Maguire Vibracores').

Table 1. Results and Test Parameters for 96 hr Acute Suspended Particulate Phase Test using the mysid *Americamysis bahia*, exposed to New Bedford Harbor water and Suspended Particulate Phase samples.

Sample	% Survival[a] (Water only)	% Survival[b] (100% SPP)	% Survival[b] (50% SPP)	Total Ammonia (NH_4, mg/L)	Unionized Ammonia (NH_3, mg/L)
NBH-201	97	96	100	11.3	0.5
NBH-202	100	2	96	37.9	1.6
NBH-204	100	100	100	1.3	0.0
NBH-205	100	98	100	9.1	0.4
NBH-206	100	98	100	6.2	0.3
NBH-207	100	100	100	13.8	0.5
Control [c]	96				
Control [d]		100		1.38	ND

Temperature = 24-25°C ; Salinity = 31-34 mg/Kg; pH = 8.0-8.4; D.O. = 7.8-8.4 mg/L

a = 3 replicates of 10 mysids each per sample

b = 5 replicates of 10 mysids each per sample

c- Control water = Forty Fathoms mix.

d = Control sediment collected from Central Long Island Sound in 2000

Table 2. Hazard Quotients.[1] for CoCs in sediment elutriates for the NBH Water Quality Study

Benchmark = Chronic WQC [2]

Class	Analyte	WQSV Source[2]	NBH-201-ELUT	NBH-202-ELUT	NBH-204-ELUT	NBH-205-ELUT	NBH-206-ELUT	NBH-207-ELUT
MET	Aluminum	87.0	1.85	27	6.63	3.98	2.48	9.80
MET	Antimony							
MET	Arsenic	36.0	0.14	0.50	0.11	0.65	0.37	0.14
MET	Cadmium	9.3	0.03	0.05	0.03	0.03	0.03	0.03
MET	Chromium	50.0	0.09	0.71	0.09	0.09	0.09	0.21
MET	Copper	3.1	2.29	32	1.29	3.48	2.29	13
MET	Iron							
MET	Lead	8.1	0.14	1.65	0.14	0.14	0.14	0.14
MET	Manganese							
MET	Nickel	8.2	1.65	1.65	1.65	1.65	1.65	1.65
MET	Silver	0.1	12	12	12	12	12	12
MET	Zinc	81.0	0.09	0.50	0.09	0.09	0.09	0.20
PAH	1-Methylnaphthalene							
PAH	1-Methylphenanthrene							
PAH	2,3,5-Trimethylnaphthalene							
PAH	2,6- Dimethylnaphthalene							
PAH	2-Methylnaphthalene (L)							
PAH	Acenaphthene (L)	97.00	2.8E-4	1.9E-3	2.2E-4	2.1E-4	2.1E-4	3.6E-4
PAH	Acenaphthylene (L)	49.00	5.5E-4	4.3E-4	4.3E-4	4.1E-4	4.1E-4	4.3E-4
PAH	Anthracene (L)	18.00	1.5E-3	1.8E-3	1.2E-3	1.4E-3	1.3E-3	1.8E-3
PAH	Benzo(a)anthracene (H)	0.66	0.03	0.23	0.02	0.05	0.04	0.14
PAH	Benzo(a)pyrene (H)	0.19	0.11	0.63	0.07	0.22	0.18	0.35
PAH	Benzo(b)fluoranthene	0.04	0.50	3.68	0.42	0.82	0.95	2.89
PAH	Benzo(e)pyrene							
PAH	Benzo(g,h,i)perylene							
PAH	Benzo(k)fluoranthene	0.02	1.24	8.24	0.65	1.76	1.47	4.18
PAH	Biphenyl							
PAH	Chrysene (H)	0.66	0.04	0.27	0.03	0.07	0.06	0.15
PAH	Dibenz(a,h)anthracene (H)							
PAH	Fluoranthene (H)	2.90	0.02	0.04	4.5E-3	0.02	0.02	0.07
PAH	Fluorene (L)	27.00	1.0E-3	1.6E-3	7.8E-4	4.4E-4	4.8E-4	8.9E-4
PAH	Indeno(1,2,3-cd)pyrene							
PAH	Naphthalene (L)	350.00	4.6E-5	9.1E-5	6.0E-5	5.7E-5	5.7E-5	6.3E-5
PAH	Perylene							
PAH	Phenanthrene (L)	24.00	1.0E-3	1.5E-3	8.8E-4	2.0E-3	1.8E-3	2.2E-3
PAH	Pyrene (H)	1.40	0.07	0.16	0.03	0.15	0.12	0.22
PAH	Sum PAH LD_{50}-based TUs[3]		2.01	13	1.22	3.09	2.84	8.01
PCB	Total PCBs	0.03	57	770	11	29	41	190

1 - Hazard Quotient = concentration(Appendix C)/Chronic Water Quality Criteria Value; Benchmark is for Chromium (6). Measured concentration is for total Chromium.

2 - Chronic Water Quality Criteria or Screening Values

3 - Sum PAH-HQ represents the additive toxic effects of PAHs, and equals sum of Toxic Units (PAH conc./LD50) of 13 PAHs (WQSV="F"); Swartz et.al., 1995.

Table 3. Acute Hazard[1] Quotients for CoCs in sediment elutriates for the NBH Water Quality Study.[1]

Benchmark = Acute WQC [2]

Class	Analyte	WQSV Source[2]	NBH-201-ELUT	NBH-202-ELUT	NBH-204-ELUT	NBH-205-ELUT	NBH-206-ELUT	NBH-207-ELUT
MET	Aluminum	750.0	0.21	3.09	0.77	0.46	0.29	1.14
MET	Antimony							
MET	Arsenic	69.0	0.08	0.26	0.06	0.34	0.19	0.07
MET	Cadmium	43.0	7.0E-3	0.01	7.0E-3	7.0E-3	7.0E-3	7.0E-3
MET	Chromium	1100.0	4.2E-3	0.03	4.2E-3	4.2E-3	4.2E-3	9.4E-3
MET	Copper	4.8	1.48	20	0.83	2.25	1.48	8.13
MET	Iron							
MET	Lead	220.0	5.0E-3	0.06	5.0E-3	5.0E-3	5.0E-3	5.0E-3
MET	Manganese							
MET	Nickel	75.0	0.18	0.18	0.18	0.18	0.18	0.18
MET	Silver	1.9	0.74	0.74	0.74	0.74	0.74	0.74
MET	Zinc	90.0	0.08	0.45	0.08	0.08	0.08	0.18
SEM	SEM-AVS	#REF!						
PAH	1-Methylnaphthalene							
PAH	1-Methylphenanthrene							
PAH	2,3,5-Trimethylnaphthalene							
PAH	2,6- Dimethylnaphthalene							
PAH	2-Methylnaphthalene (L)							
PAH	Acenaphthene (L)	970.000	2.8E-5	1.9E-4	2.2E-5	2.1E-5	2.1E-5	3.6E-5
PAH	Acenaphthylene (L)	490.000	5.5E-5	4.3E-5	4.3E-5	4.1E-5	4.1E-5	4.3E-5
PAH	Anthracene (L)	180.000	1.5E-4	1.8E-4	1.2E-4	1.4E-4	1.3E-4	1.8E-4
PAH	Benzo(a)anthracene (H)	6.600	2.7E-3	0.02	2.0E-3	5.0E-3	3.9E-3	0.01
PAH	Benzo(a)pyrene (H)	1.900	0.01	0.06	7.4E-3	0.02	0.02	0.03
PAH	Benzo(b)fluoranthene	0.380	0.05	0.37	0.04	0.08	0.09	0.29
PAH	Benzo(e)pyrene							
PAH	Benzo(g,h,i)perylene							
PAH	Benzo(k)fluoranthene	0.170	0.12	0.82	0.06	0.18	0.15	0.42
PAH	Biphenyl							
PAH	Chrysene (H)	6.600	4.4E-3	0.03	2.6E-3	6.5E-3	5.8E-3	0.02
PAH	Dibenz(a,h)anthracene (H)							
PAH	Fluoranthene (H)	29.000	1.7E-3	4.5E-3	4.5E-4	2.0E-3	1.7E-3	6.6E-3
PAH	Fluorene (L)	270.000	1.0E-4	1.6E-4	7.8E-5	4.4E-5	4.8E-5	8.9E-5
PAH	Indeno(1,2,3-cd)pyrene							
PAH	Naphthalene (L)	3500.000	4.6E-6	9.1E-6	6.0E-6	5.7E-6	5.7E-6	6.3E-6
PAH	Perylene							
PAH	Phenanthrene (L)	240.000	1.0E-4	1.5E-4	8.8E-5	2.0E-4	1.8E-4	2.2E-4
PAH	Pyrene (H)	14.000	7.1E-3	0.02	2.9E-3	0.02	0.01	0.02
PAH	Sum PAH LD_{50}-based TUs[3]		0.20	1.33	0.12	0.31	0.28	0.80
PCB	Total PCBs	10.00	0.17	2.31	0.03	0.09	0.12	0.57

1 - Hazard Quotient = concentration(Appendix C)/Acute Water Quality Criteria Value; Benchmark is for Chromium (6). Measured concentration is for total Chromium.

2 - Acute Water Quality Criteria or Screening Values

3 - Sum PAH-HQ represents the additive toxic effects of PAHs, and equals sum of Toxic Units (PAH conc./LD50) of 13 PAHs (WQSV="F"); Swartz et.al., 1995.

Table 4. Species-specific elutriate Hazard Quotients for chemical exposures to *Americamysis bahia* exposed to New Bedford Harbor Suspended Particulate Phase samples.

	Americamysis bahia[1]						
Analyte	Acute LC_{50}[2]	NBH-201-Elutriate	NBH-202-Elutriate	NBH-204-Elutriate	NBH-205-Elutriate	NBH-206-Elutriate	NBH-207-Elutriate
Cadmium	63	0.00	0.01	0.00	0.00	0.00	0.00
Chromium	2030	0.00	0.02	0.00	0.00	0.00	0.01
Copper	153	0.05	0.64	0.03	0.07	0.05	0.25
Lead	3000	0.00	0.00	0.00	0.00	0.00	0.00
Zinc	498	0.01	0.08	0.01	0.01	0.01	0.03
PCB	17	0.10	1.36	0.02	0.05	0.07	0.33
NH_3	1.94	0.25	0.82	0.02	0.20	0.14	0.00
sum HQs		0.17	2.93	0.07	0.14	0.14	0.63

1 - Hazard Quotient = elutriate concentration (Appendix A-3)/species LC_{50}.

2 - LC_{50} values from Schubauer-Berigan et al (1993) except chromium (U.S. EPA, 1984b) and

3- Spike exposures not performed for mysids.

Table 5. Comparison of measured vs. predicted elutriate concentrations for New Bedford Harbor CAD and navigation channel locations.

	Fish Island (FI-A)		
Analyte[1]	NBH-207-Elutriate[2]	Predicted interstitial FIA-CAD[3]	Predicted Elutriate F1A-CAD[4]
Arsenic	5.1	6.7	1.34
Cadmium	0.3	5.5	1.1
Chromium	10.3	335	67
Copper	39	**866**	**173.2**
Lead	1.1	162	32.4
Zinc	15.8	**444**	88.8
			0
Total PCBs	*5.69*	0.0276	0.00552
Sum PAH or TPH	0.979	3795	759

1- units: ug/L.
2- Elutriate represents supernatant from centrifuged Suspended Particulate Phase.
2- interstitial water concentrations reported as 'elutriate' in ASA 2002
3- Predicted elutriate concentration estimated to approximate toxicity test elutriate (sediment to water mixture = 1:4). 20% factor applied is slight over-estimate of dilution.
Italicized value indicates that measured concentrations were greater than predicted
Bold values indicate concentrations higher than Acute Water Quality Criteria.

Appendix A
Reference Toxicant (potassium chloride) Test Results

Appendix B
Summary Report for SPP Tests

Appendix B. Acute Mysid Test-96 Hr: ToxCalc Results

Start Date:	10/17/02	Test ID:	MYS_101702	Sample ID:	NBH
End Date:	10/21/02	Lab ID:		Sample Type:	AMB1-Ambient water
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	MY-Mysidopsis bahia
Comments:	S-Control = Forty Fathoms Lab Water, I-Control = REF (CLIS) 100% SPP				

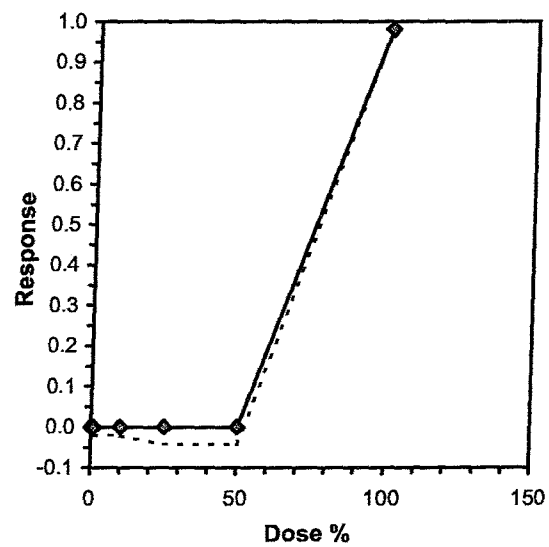
Conc-%	1	2	3	4	5
S-Control	10.000	10.000	9.000	9.000	10.000
I-Control	10.000	10.000	10.000	10.000	10.000
1	9.000	10.000	10.000	10.000	10.000
10	10.000	10.000	10.000	10.000	9.000
25	10.000	10.000	10.000	10.000	10.000
50	10.000	10.000	10.000	10.000	10.000
100	0.000	0.000	1.000	0.000	0.000

			Transform: Untransformed					Isot
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Mean
S-Control	9.600	0.9600	9.600	9.000	10.000	5.705	5	9.600
I-Control	10.000	1.0000	10.000	10.000	10.000	0.000	5	9.840
1	9.800	0.9800	9.800	9.000	10.000	4.563	5	9.840
10	9.800	0.9800	9.800	9.000	10.000	4.563	5	9.840
25	10.000	1.0000	10.000	10.000	10.000	0.000	5	9.840
50	10.000	1.0000	10.000	10.000	10.000	0.000	5	9.840
100	0.200	0.0200	0.200	0.000	1.000	223.607	5	0.200

Auxiliary Tests	Statistic	Critical	Skew
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.881041	0.91	-0.65189
Equality of variance cannot be confirmed			
The control means are not significantly different (p = 0.14)	1.632993	2.306006	

Linear Interpolation (200 Resamples)

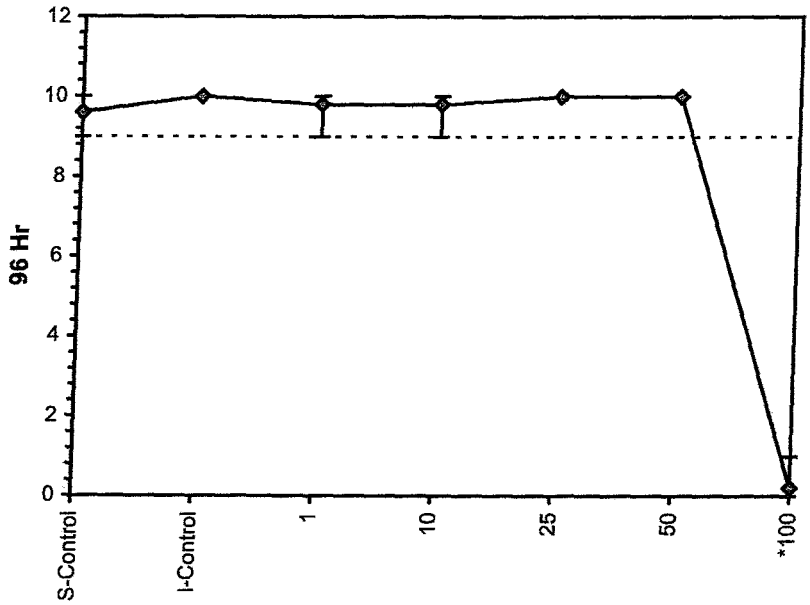
Point	%	SD	95% CL(Exp)		Skew
IC01	50.510	22.216	0.000	50.510	-0.8463
IC05	52.552	0.284	51.224	52.552	-0.3090
IC10	55.104	0.279	53.775	55.105	-0.2784
IC15	57.656	0.284	56.326	57.785	-0.1967
IC20	60.207	0.299	58.877	60.479	-0.0699
IC25	62.759	0.321	61.427	63.119	0.0757
IC40	70.415	0.422	69.080	71.268	0.4239
IC50	75.519	0.505	74.181	76.702	0.5483
IC60	80.622	0.595	79.283	82.135	0.6184
IC75	88.278	0.738	86.935	90.284	0.6713
IC80	90.830	0.787	89.486	93.001	0.6813
IC85	93.382	0.836	92.036	95.718	0.6891
IC90	95.934	0.886	94.587	98.434	0.6950
IC95	98.485				
IC99	>100				



Appendix B. Acute Mysid Test-96 Hr: ToxCalc Results

Start Date:	10/17/02	Test ID:	MYS_101702	Sample ID:	NBH
End Date:	10/21/02	Lab ID:		Sample Type:	AMB1-Ambient water
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	MY-Mysidopsis bahia
Comments:	S-Control = Forty Fathoms Lab Water, I-Control = REF (CLIS) 100% SPP				

Dose-Response Plot



ToxCalc v5.0.23

Reviewed by:_____

Appendix C
Chemistry Data

Appendix C-1. Results of elutriate chemical analyses for the NBH Water Quality Study: Metals and PAHs.

Class	Analyte	NBH-201-ELUT	NBH-202-ELUT	NBH-204-ELUT	NBH-205-ELUT	NBH-206-ELUT	NBH-207-ELUT
MET	Aluminum	161 B	2320	577	346	216	853
MET	Antimony	3.50 U	3.50 U	3.50 U	3.50 U	3.50 U	5.80 B
MET	Arsenic	5.20 B	18	3.80 B	24	13	5.10 B
MET	Cadmium	0.30 U	0.45 B	0.30 U	0.30 U	0.30 U	0.30 U
MET	Chromium	4.60 U	35	4.60 U	4.60 U	4.60 U	10
MET	Copper	7.10 B	98	4.00 B	11 B	7.10 B	39
MET	Iron	214	2630	587	218	212	995
MET	Lead	1.10 U	13	1.10 U	1.10 U	1.10 U	1.10 U
MET	Manganese	2.50 U	2.50 U	27	2.50 U	2.50 U	2.50 U
MET	Mercury						
MET	Nickel	14 U	14 U	14 U	14 U	14 U	14 U
MET	Silver	1.40 U	1.40 U	1.40 U	1.40 U	1.40 U	1.40 U
MET	Zinc	6.90 U	40	6.90 U	6.90 U	6.90 U	16 B
PAH	1-Methylnaphthalene	0.03 U	0.01 J	0.02 U	0.02 U	0.02 U	0.01 J
PAH	1-Methylphenanthrene	0.03 U	0.05	0.02 U	0.01 J	0.01 J	0.02
PAH	2,3,5-Trimethylnaphthalene	0.03 U	0.07	0.02 U	0.02 U	0.02 U	0.02 J
PAH	2,6- Dimethylnaphthalene	0.03 U	0.01 J	0.02 U	0.02 J	0.02 J	0.02
PAH	2-Methylnaphthalene (L)	0.03 U	0.02 J	0.02 U	0.02 J	0.01 J	0.02 J
PAH	Acenaphthene (L)	0.03 U	0.18	0.02 U	0.02 U	0.02 U	0.04
PAH	Acenaphthylene (L)	0.03 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
PAH	Anthracene (L)	0.03 U	0.03	0.02 U	0.03	0.02	0.03
PAH	Benzo(a)anthracene (H)	0.02 J	0.15	0.01 J	0.03	0.03	0.10
PAH	Benzo(a)pyrene (H)	0.02 J	0.12	0.01 J	0.04	0.04	0.07
PAH	Benzo(b)fluoranthene	0.02 J	0.14	0.02 J	0.03	0.04	0.11
PAH	Benzo(e)pyrene	0.02 J	0.08	0.02 U	0.04	0.03	0.07
PAH	Benzo(g,h,i)perylene	0.02 J	0.09	0.01 J	0.04	0.03	0.06
PAH	Benzo(k)fluoranthene	0.02 J	0.14	0.01 J	0.03	0.03	0.07
PAH	Biphenyl	0.03 U	0.01 J	0.02 U	0.01 J	0.01 J	0.02 J
PAH	Chrysene (H)	0.03	0.18	0.02 J	0.04	0.04	0.10
PAH	Dibenz(a,h)anthracene (H)	0.03 U	0.03	0.02 U	0.02 U	0.02 U	0.01 J
PAH	Fluoranthene (H)	0.05	0.13	0.01 J	0.06	0.05	0.19
PAH	Fluorene (L)	0.03 U	0.04	0.02 U	0.01 J	0.01 J	0.02
PAH	Indeno(1,2,3-cd)pyrene	0.02 J	0.07	0.02 U	0.03	0.02 J	0.05
PAH	Naphthalene (L)	0.02 J	0.03	0.02 U	0.02 U	0.02 J	0.02
PAH	Perylene	0.03 U	0.02	0.02 U	0.02 U	0.02 U	0.02 J
PAH	Phenanthrene (L)	0.02 J	0.04	0.02 U	0.05	0.04	0.05
PAH	Pyrene (H)	0.10	0.22	0.04	0.21	0.17	0.31
PAH	Total LMW (L) PAHs	0.18	0.36	0.15	0.16	0.15	0.21
PAH	Total HMW (H) PAHs	0.24	0.83	0.12	0.41	0.34	0.77
PAH	Total LMW+HMW PAHs	0.42	1.19	0.27	0.57	0.49	0.98

Units: µg/L.
LMW PAH = sum of 7 2-ring & 3-ring PAHs included in NOAA ER-L/ER-M benchmarks (Long et al. 1995); (methylnaphthalene, acenaphthene, acenaphthylene, anthracene, fluorene, naphthalene, phenanthrene)
HMW PAH = sum of 6 4-ring and 5-ring PAHs included in NOAA ER-L/ER-M benchmarks (Long et al. 1995); (benzo(a)anthracene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, fluoranthene, pyrene)
Total PAHs - sum of LMW & HMW PAHs;
Data Qualifiers: "B" (metals)=< Contract Detection Limit but >Instrument Detection Limit;
"J"=estimated (result between 1/2 reporting limit (RL) and RL); "U"=not detected above reporting limit.

Appendix C-2. Results of elutriate chemical analyses for the NBH Water Quality Study: PCBs, TOC and Total Suspended Solids.

Class	Analyte	NBH-201-ELUT	NBH-202-ELUT	NBH-204-ELUT	NBH-205-ELUT	NBH-206-ELUT	NBH-207-ELUT
PCB	PCB 101	0.12	0.90	0.01	0.05	0.08	0.40
PCB	PCB 105	0.04	0.04 U	5.9E-3	0.01	0.02	0.10
PCB	PCB 118	0.09	0.54	0.01	0.04	0.07	0.34
PCB	PCB 126	4.4E-3 U	0.04 U	4.1E-3 U	4.0E-3 U	4.1E-3 U	8.1E-3 U
PCB	PCB 128	0.03	0.23	4.1E-3 U	6.7E-3	0.01	0.05
PCB	PCB 138	0.10	0.92	7.6E-3	0.03 P	0.04 P	0.24
PCB	PCB 153	0.08 P	0.93 P	8.5E-3 P	0.03 P	0.05 P	0.27 P
PCB	PCB 156	0.01	0.11	4.1E-3 U	5.5E-3	7.5E-3	0.03 P
PCB	PCB 169	4.4E-3 U	0.04 U	4.1E-3 U	4.0E-3 U	4.1E-3 U	8.1E-3 U
PCB	PCB 170	0.01	0.15	4.1E-3 U	4.2E-3	6.5E-3	0.04
PCB	PCB 18	0.04	0.96	0.02	0.03	0.04	0.14
PCB	PCB 180	0.01	0.21	4.1E-3 U	5.9E-3	8.4E-3	0.05
PCB	PCB 183	4.9E-3	0.07	4.1E-3 U	4.0E-3 U	4.1E-3 U	0.01
PCB	PCB 184	4.4E-3 U	0.04 U	4.1E-3 U	4.0E-3 U	4.1E-3 U	8.1E-3 U
PCB	PCB 187	8.7E-3 P	0.15 P	4.1E-3 U	4.0E-3 U	4.9E-3 P	0.03 P
PCB	PCB 195	4.4E-3 U	0.04 U	4.1E-3 U	4.0E-3 U	4.1E-3 U	8.1E-3 U
PCB	PCB 206	4.4E-3 U	0.04 U	4.1E-3 U	4.0E-3 U	4.1E-3 U	8.1E-3 U
PCB	PCB 209	4.4E-3 U	0.04 U	4.1E-3 U	4.0E-3 U	4.1E-3 U	8.1E-3 U
PCB	PCB 28	0.05	1.52	0.02	0.06	0.07	0.31
PCB	PCB 44	0.05	1.06	0.01	0.03	0.04	0.17
PCB	PCB 49	0.07	1.92	0.02	0.05	0.06	0.31
PCB	PCB 52	0.10	2.41 E	0.02	0.06	0.07	0.30
PCB	PCB 66	0.09	1.13	0.02	0.05	0.08	0.35
PCB	PCB 77	4.4E-3 U	0.04 EU	4.1E-3 U	4.0E-3 U	4.1E-3 U	8.1E-3 EU
PCB	PCB 8	0.01	0.28	4.1E-3 U	8.0E-3	8.2E-3	0.04
PCB	PCB 87	0.08	0.68	7.9E-3	0.02	0.03	0.13
PCB	PCB 114	5.8E-3 P	0.06 P	4.1E-3 U	4.0E-3 U	4.7E-3 P	0.02 P
PCB	PCB 123	0.07	0.93	9.1E-3	0.03	0.04	0.20
PCB	PCB 157	4.5E-3	0.04 U	4.1E-3 U	4.0E-3 U	4.1E-3 U	0.01
PCB	PCB 167	6.7E-3	0.07	4.1E-3 U	4.0E-3 U	4.5E-3	0.02
PCB	PCB 189	4.4E-3 U	0.04 U	4.1E-3 U	4.0E-3 U	4.1E-3 U	8.1E-3 U
PCB	PCB 81	0.08	0.68	7.9E-3	0.02	0.03	0.13
PCB	Total PCBs	1.72	23	0.34	0.88	1.22	5.69
TOC	TOC - Elutriate, mg/L	4.6	12	2.3	7.3	5.4	6.8
TOC	TOC - SPP, mg/L	6.0	8.8	2.6	6.1	4.8	6.8
TSS	Total Susp. Solids, mg/L	525	1020	384	240	610	506

Units: µg/L (except where noted).

Total PCBs - Sum PCB congeners (8, 18, 28, 44, 52, 66, 101, 105, 118, 128, 138, 153, 170, 180, 187, 195, 206, 209) x 2 list of congeners analyzed by NOAA Status and Trends Program (listed in NOAA, 1993; revised NOAA, 1998).

Data Qualifiers: "E" = exceeds calibration range;

"P"=>25% difference between 2 analytical columns (lower value reported); "U"=not detected above reporting limit.

TOC - Elutriate: TOC of supernatant measured after centrifugation;

TOC - SPP (Suspended Particulate Phase): TOC of sediment/water mixture measured prior to centrifugation.

Appendix C-3. Results of elutriate particulate metals analysis for the NBH Water Quality Study.[1]

Class	Analyte	NBH-201-ELUT	NBH-202-ELUT	NBH-204-ELUT	NBH-205-ELUT	NBH-206-ELUT	NBH-207-ELUT
MET	Aluminum	6530	12400	3630	10900	11600	8400
MET	Antimony	0.56 B	1.1 B	0.31 B	0.57 B	0.61 B	1.1 B
MET	Arsenic	4.7	9.8	2.8	5.7	6	7.3
MET	Cadmium	1	3.7	0.16	0.29	0.23	2.6
MET	Chromium	85.2	276	31.5	55.6	54.8	236
MET	Copper	198	621	74.3	138	117	623
MET	Iron	11600	21300	6300	16800	18200	15100
MET	Lead	64.1	155	21.9	55.4	40.3	159
MET	Manganese	142	194	71.9	154	163	129
MET	Nickel	11.4	25.6	5.2	13	13.6	25
MET	Silver	1.6	4.3	0.19 B	0.25 B	0.25 B	2.3
MET	Zinc	129	289	44.3	92.7	72.4	409

1 - Elutriate particulate sample consisted of sediment pellet remaining after elutriate centrifugation.
Units: µg/g.
Data Qualifiers (assigned by laboratory): "B" = < Contract Detection Limit but >Instrument Detection Limit.

APPENDIX H

TOXITY IDENTIFICATION EVALUATION TESTING WITH MYSIDS AND SEA URCHINS

Laboratory Testing In Support of *Site Specific Water Quality Criteria Assessment and Hydrographic Data Collection for New Bedford Harbor*

TASK 2B
TOXICITY IDENTIFICATION EVALUATION TESTING WITH MYSIDS AND SEA URCHINS

Data Report

Prepared for:

Massachusetts Coastal Zone Management Agency
251 Causeway Street, Suite 900
Boston, MA 02202

Submitted by:

Maguire Group Inc.

July 2003

Laboratory Testing In Support of *Site Specific Water Quality Criteria Assessment and Hydrographic Data Collection for New Bedford Harbor*

TASK 2B
TOXICITY IDENTIFICATION EVALUATION TESTING WITH MYSIDS AND SEA URCHINS

Data Report

Prepared for:

Maguire Group Inc.

Prepared by:

Science Applications International Corporation
221 Third Street
Newport, RI 02840

January 13, 2003

NEW BEDFORD HARBOR TOXICITY IDENTIFICATION EVALUATION

Introduction and Background

Task 2B of SAIC's Site Specific Water Quality Assessment Study is a follow-on study conducted to resolve cause(s) of toxicity observed in Suspended Particulate Phase testing (SPP; Task 2A). Task 2A found that only one of six site samples, NBH-202, was found to be toxic to *Americamysis bahia,* the species chosen for SPP testing. Hence, SPP from NBH-202 was further evaluated using a sequential toxicity identification evaluation (TIE) testing approach (SAIC, 2002). TIEs are used to identify cause and affect relationships between toxicity observed in toxicity tests and factors that have contributed to the observed effects. These relationships are revealed through manipulations that remove the toxicity of individual toxicant classes (e.g., metals, organics, or ammonia) from (e.g., SPP and elutriates). Associated reductions in toxicity are used to characterize causative factors. It was expected that the cause of acute toxicity in the NBH-202 sample would be due principally to copper, PCBs, confounding factors, or a combination of factors. Per EPA Marine TIE methodology (EPA, 1994) two species were tested, as differential sensitivity to specific toxicants provide additional evidence regarding the factors causing toxicity. For this study, the mysid *(A. bahia)* survival test and the sea urchin *(Arbacia punctulata)* larval development test were selected because they were previously used in monitoring of potential dredging-related water column impacts in Upper New Bedford Harbor (Nelson, 1991), and because they are relatively sensitive to PCBs and copper, respectively. Results from the TIE tests will contribute to the basis for an approach to derive Water Effect Ratios (Task 2C) and site specific protective exposure limits for New Bedford Harbor aquatic life.

Methods

Sample Collection, Preparation and Transport

Sediment and water collection for the TIE conducted with NBH-202 were described in the Task 2A report, "Suspended Particulate Phase Acute Toxicity Tests with Myids" (SAIC, 2002). The samples were stored (4 ± 2° C) at the toxicity testing laboratory (SAIC's subcontractor, Aquatec Biological in Williston, VT) from 12 October to 28 October 2002. On 28 October 2002, new SPP was prepared for TIE manipulations and testing. Suspended Particulate Phase samples were prepared as described in the Task 2A report (SAIC, 2002) except that GP-2 artificial sea salts were substituted for the commercial Forty Fathoms® artificial seasalt mixture because GP-2 may be more reliable with the sea urchin larval development test used in the TIE (Aquatec, personal communication). The volume of prepared SPP required for mysid testing was sub-sampled, and the remaining SPP was prepared for the sea urchin larval development tests with *Arbacia punctulata* by centrifuging for approximately10 minutes at 6000 rpm to remove fine particulates that may inhibit larval development. SPP was shipped overnight to SAIC's Newport, RI laboratory for TIE manipulations (see below), and TIE samples were subsequently shipped back to Aquatec for toxicity testing to commence on 30 October 2002.

To serve as a positive control for the TIE tests, SAIC prepared a spiked solution using GP-2 artificial seawater, neat copper chloride (Sigma Chemical) and neat Arochlor 1242 (PP-310) standard from Ultra Scientific, North Kingstown, RI. The copper was spiked from a 10 mg/L stock solution prepared in deionized water manipulated to a pH of 2.0 with nitric acid to result in a test concentration of 120 ug copper/L. Aliquots of 100 mg Aroclor 1242/L in methanol were added to the copper-spiked sample to result in a nominal concentration of 200 μg/L. The copper spike is expected to be largely dissolved and stable (Lussier et al., 1999), while the nominal Aroclor concentration would be expected to be approximately an order of magnitude higher than the actual exposure concentration (Ho et al., 1997). Concentrations were chosen to approximate those that would affect approximately 50% of at least on of the test species (based on known LCs0 or ECs0). While copper and PCBs were the only constituents in the spiked sample for sequential TIE treatments (see TIE Manipulations and Testing, below), ammonia was added from a 1,000 mg/L standard solution (Orlon) to produce a 14 mg/L concentration in the spike prior to the final individual TIE treatments. The ammonia was added immediately prior to the TIE treatments that affect ammonia so that that the effects of treatments to reduce copper and PBC toxicity would not be obscured by ammonia toxicity.

Upon arrival at each laboratory, samples were inspected to determine their temperature and condition (e.g., caps in place or leakage). All samples met transit protocols. Standard chain-of-custody procedures were followed. Chain-of custody (CoC) forms were signed and copied. SAIC retains copies of the CoCs, along with test data in experiment binders and project files.

Organism Selection and Source

Mysids for testing were supplied by Aquatic Biosystems in Fort Collins Colorado. They were hatched on 28 October, received at Aquatec on 30 October, and the test was initiated on the same day. Newly hatched Artemia were fed to mysids on each day prior to test initiation, and daily feeding continued during the test.

Mysids were evaluated using a standard reference toxicant water-only test with potassium chloride. In this test, survival is determined in each of two replicate chambers to which ten animals have been added. The reference test uses a six dilution series with concentrations ranging between 0.1 and 1.0 g/L, and is used to determine LCs0 values for comparison with Control Chart values. Aquatec's Control Chart for the mysid *(A. bahia)* includes > 20 tests from mysid tests conducted since 1999. Sea Urchins used in TIE tests were from Aquatec's in-house cultures. Along with the TIE tests, sea urchin larval development was tested in a standard reference toxicant series with copper sulfate as the toxicant.

Toxicity Identification Evaluation Manipulations and Testing

In all, four samples, GP-2 control water, spiked water, SPP site sample, and centrifuged SPP site sample were used in TIE testing. The GP-2 control water served as a negative control to monitor for potential ancillary effects associated with the TIE manipulations described below. The spiked water served as a positive control to document the effectiveness of the

manipulations in reducing toxicity as intended, and the two site samples were prepared to resolved contributors to toxicity in mysids and sea urchins respectively. For the spiked sample, in addition to the 100% undiluted samples, the untreated samples and sodium thiosulfate-treated samples were diluted in a series to include 50%, 25% and 10% dilutions. These extra samples served to discriminate the expected reduction in toxicity that would occur with the first TIE treatment, and to characterize the over-all sensitivity of the organisms to the untreated sample (e.g., to demonstrate differences in sensitivity between the two test species). Centrifuged samples were used for the sea urchin test because physical damage to these organisms may occur when exposed to high concentrations of particulate matter.

Sample Manipulations

As illustrated in Figure 1, the TIE manipulations involved a series of sequential manipulations followed by two independent treatments. The principle of the sequential approach is that as each sample is treated and tested for toxicity, a potential source of toxicity can be identified or eliminated. The procedure begins with untreated samples, followed by the most specific treatments and ends with the most general. For SPP constituents, STS and EDTA act quite specifically on certain groups of common heavy metal contaminants. By treating the metals first, and then applying filtration and Solid Phase Extraction (SPE) to remove organic contaminants, reductions in toxicity following each individual treatment can be associated with specific toxicant groups.

By applying the independent *Ulva* treatment and associated pH adjustments at the end of the sequential treatments, the role of ammonia as a contributor to toxicity can be more clearly discerned. The *Ulva* addition is best suited as a final treatment because it could also remove metals and organics to varying degrees. Its application as final treatment limits uncertainty in the interpretation of results. Similarly, pH adjustments can affect the toxicity of multiple potential contaminants, including certain metals and potentially toxic organic compounds. The elimination or reduction of toxicity due to these groups prior to pH adjustment facilitates the direct association between pH change and commensurate changes in the relative toxicity of both ammonia and sulfides due to ionic shift.

Untreated SPP is sub-sampled to determine baseline toxicity for the SPP, provide a starting point to assess relative changes in toxicity associated with each subsequent treatment. Likewise, sub-sampling occurs after each treatment for TIE toxicity testing. The objective of each treatment step is described below.

<u>Sequential Treatments</u>

Establish Baseline Toxicity with Untreated sample: For this step, sub-samples of untreated SPP are tested to assess toxicity relative to TIE-manipulated sub-samples. Even though SPP tests was performed during toxicity screening (Task 2A) new baseline samples should still be collected and tested to correspond temporally with the manipulated treatments for each sample.

Reduce Metals Concentrations with STS and EDTA: Two treatments are conducted in sequence to reduce bioavailability of metals, specifically by rendering them unavailable for direct uptake into cell tissues. First is the addition of sodium thiosulfate (STS; Na2S203) and second is the addition of ethylenediaminetetraacetic acid (EDTA). Reduction in toxicity of the sample after either or both treatments indicates the presence of metals in toxic concentrations.

a. Reduce Cationic Metals and Oxidants with STS: Sodium thiosulfate addition was performed as the first metals reduction step because it is generally effective with a smaller subset of metal contaminants relative to EDTA. It is reported by EPA to be most effective in reducing toxicity due to Cd^{2+}, Cu^{2+}, Ag^{1+} and Hg (with lesser affinity for Ni^{2+}, Zn^{2+}, Pb^{2+} and Mn^{2+} (U.S. EPA 1994)). Reduction in toxicity of the sample after STS treatment indicates the above metals are present in toxic concentrations. Sodium thiosulfate is added at the rate of 50 mg/L with no apparent effects on test species (U.S. EPA, 1996).

b. Chelate Cationic Metals with EDTA: This reducing agent chelates divalent cationic metals (i.e., AI^{2+}, Ba^{2+}, Fe^{2+}, Mn^{2+}, Sr^{2+}, Cu^{2+}, Ni^{2+}, Pb^{2+}, Cd^{2+}, 002+, and Zn^{2+}) (U.S. EPA., 1996). Reduction in toxicity of the sample after EDTA treatment indicates that members of the above listed group of metals are present in toxic concentrations. If reduction in toxicity does not occur with STS, but does occur with EDTA addition, there are two potential explanations. One possibility is that the metals causing toxicity are amongst the group that is less reactive with STS (NI , Zn , Pb and Mn) and the other is that the magnitude of toxicity was high enough that the addition of both reducing agents was required to affect toxicity. Generally, a fully or partially toxic response following the sequential EDTA treatment indicates that something other than divalent cationic metallic compounds are a major contributor to sediment toxicity. In other words, either metals are not toxic, or alternatively, if the samples remain fully toxic (i.e., no normal response is observed), other toxic agents may be masking the reductions in toxicity associated with metals. EDTA is added at the rate of 60 mg/L with no apparent effects on test species. According to the marine TIE guide (1996) this could potentially chelate 26 mg of divalent metal per liter.

The absence of reduction in toxicity indicates that metals are not toxic in the sample, and/or that remaining constituents are present at levels that still influence toxicity and/or that the toxic load of metals in the sample exceeded the binding capacity of the TIE agents.

Extract Particulate-associated Contaminants with Filtration: Because filtration may remove metals and organics, the placement of the filtration step after the treatments for

metals (STS and EDTA) reduces ambiguity of interpretations associated with filtration effects. Filtration is operationally defined by filter type and the filtration procedure used. To assure the removal of all suspended particles that could clog or compromise the integrity of the SPE column used in the following procedure, samples were filtered with 0.45 mm membrane filter (i.e., polyvinylidene fluoride to minimize sorption of organics). Toxicity tests conducted on the pre- and post-filtered fraction permit elucidation of potential toxicity associated with large colloids or particulates in the SPP. Filtration has not been found to affect the concentrations of sample ammonia. Filters used in this step were retained for any subsequent analyses that would be helpful if reduction in toxicity occurred due to filtration.

Extract Organics with a Solid-phase Extraction (SPE) Column: In this step, filtered SPP samples were eluted through a SPE column (Waters C18) to remove organic compounds (Waters, 2001). According to general recommended manufacturer's procedures, the samples were eluted through the column at a rate of 10 ml/min. For each sample, the column was exchanged after 500 ml was eluted. The column was monitored visually to limit the possibility that its capacity would be exhausted prior to elution of 500 ml. Nevertheless, prevention of column break-through cannot be assured for samples with unknown constituents, and removal of toxic organic toxicants may be incomplete.

Independent Treatments

Remove Ammonia with Ulva: For saltwater samples, treatment with the green seaweed *(Ulva lactuca)* is generally more effective than zeolite in removing ammonia. However, this treatment may also remove other residual sources of toxicity to varying degrees, including metals and organics. *Ulva* is a cosmopolitan macroalgae, and is generally found in estuarine lagoons, often floating on mudflats. It inhabits the upper to mid-intertidal, and in some locations may be found up to the subtidal zone and is associated with nutrient-enriched conditions. For this study, the algae was collected on the day prior to test treatments and held in aerated seawater at 15°C. Batches of *Ulva* to be added to each sample were prepared by weighing out lg of *Ulva* per 15 ml sample. Whole leaves of *Ulva* were used to treatment each sample. The pre-weighed batches were held together with skewer sticks and stored in seawater until addition. After addition, the samples were incubated for 5 hours at 15°C (Ho et al., 1997; 1999).

Manipulate Ammonia and Sulfide with Adjusted pH: As noted above, methods to remove ammonia, while generally effective, may provide inconclusive evidence to deduce ammonia toxicity. Hence, it is useful to conduct pH manipulations to provide additional evidence of ammonia toxicity, as well as discriminate between ammonia and hydrogen sulfide as potential toxicants. To achieve a reduction in pH, dilute hydrochloric acid (e.g. 1N) is added in small increments (μLs), followed by mixing, and measurement, repeating the procedure until the target (pH= 7.0 to 7.5) is achieved. If toxicity decreases with

decreased sample pH, ammonia is suspected, while an increase in toxicity with lower pH would implicate hydrogen sulfide or residual metals.

TIE Exposures

Mysids were exposed with ten animals in each of three replicates. In all other respects, the mysid tests with each treatment were conducted as described in the report for Task 2A.

Tests with the sea urchin, *Arbacia punctulata,* were conducted according to methods developed by SAIC, as reported in "Laboratory Testing In Support of Environmental Assessment NAE O&M Projects" (U.S. EPA and U.S. ACE, 2002). The test chambers were 20 mL polyethylene scintillation vials. Ten milliliter aliquots of elutriate were added to each of three replicate chambers per sample. Tests were conducted in a temperature-controlled chamber at 20 ± 1°C. Gametes for the test were collected and mixed as follows:

> Four male urchins were placed in seawater in shallow bowls. Males were stimulated to release sperm by touching the shell for about 30 seconds with the steel electrodes of a 12 V transformer. Sperm were collected using a 1 mL disposable syringe fitted with an 18-gauge, blunt tipped needle. The sperm were diluted with seawater to achieve approximately 1 X 10^8 sperm/ml, held on ice and used within 1 hr of release.
>
> Four female urchins were placed in seawater in shallow bowls. Females were stimulated to release eggs by touching the shell as described above. Eggs were collected and held at room temperature for up to two hours with aeration. The eggs were washed two times with seawater by gentle centrifugation (500xg) for two minutes in a conical centrifuge tube. The eggs were diluted with seawater to a concentration of 2,000 eggs/mL and were aerated until used. Sperm and egg suspensions were mixed to a final concentration of 1:500 egg: sperm ratio.

After 60 minutes, fertilization was confirmed (100% in this case) and 1 mL of fertilized egg suspension was added to 10 mL of sample in each of three replicates and was incubated for 72 hours at 20 ± 1EC. The test was terminated by adding 2 mL of preservative to each vial.

One mL of suspension from each of the three replicates was transferred to a Sedgwick-Rafter counting chamber. Embryos were examined using a compound microscope (100X). One hundred embryos were examined for normal (i.e., not delayed) development as indicated by the presence of the pluteus larva.

The number of normal pluteii larvae and the number of abnormal pluteii larvae per 100 organisms were counted, as well as the total number of surviving organisms per ml.

For both tests, acceptable dissolved oxygen concentrations were documented to be in the range of 7.8 to 8.2 mg/L at the start of the test, and 5.3 to 6.6 mg/L at the end of the test. Salinity increased by = 3 mg/Kg, from 31 mg/Kg at test initiation, pH ranged between 7.8 and

8.2, across samples, with no apparent temporal trend. All water quality parameters were acceptable (U.S. EPA/U.S. ACE, 1998; U.S. ACE, 1991). Ambient laboratory lighting was set for constant light during the test exposure period.

Full strength SPP solutions were analyzed for ammonia on day 0. Samples were diluted 1 to 10 with deionized water. Total ammonia was measured spectrophotometrically.

Data Analysis

Mean responses to baseline and TIE treatments were calculated, for mysids and sea urchins. Responses are presented for performance control, the spiked sample and NBH-202 samples. For mysids, results are expressed for both 48 hr and 96 hr responses. For sea urchins, results are expressed as percent normal development and survival relative to controls.

Results

Quality Assurance/Quality Control

Up to 96 hrs, control responses for mysids through all treatments remained > 90%. For sea urchins, control responses, normal development ranged from 98 to 100% and survival counts ranged from 83 to 92 per ml. These results, along with documentation of acceptable water quality, confers validity of test results.

The summary report for reference toxicant testing with mysids and sea urchins using potassium chloride and copper sulfate is presented at the end of the Toxicity Test Data Report provided by Aquatec (Appendix A). The LC_{50} for *A. bahia* was 0.360 g/L (as potassium), well within the Control Chart lower and upper boundaries of 0.11 and 0.83 g/L, established the normal response of these organisms. The EC_{50} calculated for *A punctulata* was 30.9 µL (as copper) is equivalent to the value reported previously reported for this test (SAIC, 1994).

Chemical Exposure Concentrations

Results from the toxicity testing component of the TIE study are best interpreted in the context of the chemical exposure levels present in the untreated toxic sample under investigation. This is accomplished by using hazard Quotients (HQ= measured chemical concentrations divided by species-specific LC_{50}s or EC_{50}s) to represent expected sensitivity of the test species to the chemical exposure. In a single toxicant exposure, HQs less than 1 would result in less than 50% adverse affect while HQs > 1 would generally result in higher percentage of exposed organisms affected; the higher the HQ, the greater and more likely the observation of high percentage effects. For the current study, HQs were derived using chemical concentrations presented in the Task 2A report, Appendix C, and literature values that to represent effect concentrations for each of the toxicants of concern.

Table 1 presents HQs for the spike sample and the site sample (NBH-202), for the two species. Based on the chemical exposure concentrations, the mysid is expected to be more sensitive to PCBs in the TIE testing with NBH-202 (HQ=1.36 vs. 0.02, respectively) given

the lower *(i.e.,* more sensitive) LC_{50} value, while sea urchins would be more sensitive to copper (HQ = 5.43 vs. 0.64, respectively) and ammonia (HQ = 17.7 vs. 0.82, respectively). The comparison of the spike sample and the NBH sample HQs show that the test concentrations in the spike approximated the concentrations of the toxicants of concern in the site sample, except for ammonia, where a reduced potency was chosen to increase the likelihood of demonstrating an effective treatment for the more sensitive sea urchin response.

In summary, the analyses of the chemical exposures suggest that both copper and PCB concentrations are in the exposure range were toxicity could occur, depending on species sensitivity and site-specific water quality conditions. Also, the spike concentrations are in the proper range to adequately assess the effectiveness of the TIE treatments in mitigating the toxic response.

Toxicity Identification Evaluation Test Results and Interpretation

Summaries of the TIE toxicity tests with mysids and sea urchins are provided in Tables 1 and 2, respectively, synthesized from the raw data presented in Appendix A (Aquatec data report). Changes in toxicity are highlighted in yellow, and are indicative of reduction/removal of bioavailability of a toxic constituent that was present in the untreated sample.

The most relevant findings from TIE treatments for each of the targeted toxicant classes are reviewed below, particularly with regard to the relationship between expected toxicity based on species-specific HQs, and observed responses. The results from the spike sample are presented first, to establish the interpretive process.

Results for the Spiked Sample

Metal treatments (STS, EDTA): Tables 2a and 2b show TIE results from 48 hour and 96 hour tests with mysids. Untreated sample results show complete mortality in both 100% and 50% exposures. STS completely removed toxicity in the 50% dilution, and in the undiluted sample survival reached 90% following STS treatment, and 100% following EDTA treatment. This indicates that copper was causing the majority of the toxicity in the untreated sample, given that the metal treatments alone were successful in improving survival to 100% despite the presence of PCBs in the sample. The mysid results also indicate that toxicity of copper was greater than would be expected for exposures to copper alone (i.e., no survival, but HQ was <1; see Table 1), indicating that copper was more toxic in the presence of Aroclor).

Sea urchin results are presented in Tables 3a (survival) and 3b (larval development). While larval development is generally the more sensitive endpoint, and the one most commonly reported for the embryo-larval test (U.S. EPA, 2002), both endpoints demonstrated responses to TIE treatments of the spiked sample. Unlike mysids, only partial mortality was observed in sea urchins exposed to the spike samples. The survival endpoint was less reliable, as a clear dose-response pattern (survival proportional to

concentration) was not observed. Where survival responses were low in untreated samples (25% and 50% dilutions), the metal treatments appeared to increase survival, indicating that toxic forms of copper were removed (one anomaly occurred, with lower survival in the STS treatment than in the untreated sample, but EDTA restored survival to 91%). Sea urchin larval development was more affected by copper than expected, with high toxicity occurring in all untreated samples, including the 10% dilution (HQ= 0.7). Copper effects on sea urchin normal development in the spike was removed by STS in the 10% dilution, and by the combination of STS and EDTA in the 100% dilution, indicating that, even for this more sensitive endpoint, the TIE treatments were effective in removing copper from the sample.

Organics Treatment (PCBs): In mysid 48 and 96 hr exposures (Table 2), PCB in the spike was not toxic. This indicates that after available copper was bound the concentration of PCB was insufficient to cause toxicity. Because the estimated HQ was 1.2 for PCB in the sample, it is possible that the estimated concentration was less toxic to mysids than predicted. However, the actual exposure concentration of Aroclor used to derive the HQ (10% of the nominal concentration; losses expected to result largely from sorption to exposure chambers) is uncertain, such that the expectation of toxicity was equally uncertain. Results from the TIE treatments for particulates and organics were similar to control responses, indicating that the treatments had no adverse affect on survival. Similarly, the sea urchin normal development was not affected by either the particulate or organic treatments of the spiked sample.

Ulva Treatment: Ammonia was added to the non-toxic C18 -treated sample to demonstrate efficiency of ammonia removal. For mysids, the concentration of ammonia added (HQ= 0.3) was not be expected to result in toxicity, and the absence of toxicity in the spike sample (90%) indicates that *Ulva* had no adverse affect on survival (Table 2). For the sea urchin, the *Ulva* treatment did not improve larval development (0.3%), indicating that the treatment did not reduce ammonia to a non-toxic level (Table 3b). For the survival endpoint (Table 3a), the 41% survival response at the spike concentration can be used for comparison with results obtained in the site sample (see below), where ammonia is a natural constituent of the sediment matrix.

Low pH (Independent Post-C18 Treatment): As with the *Ulva* treatment, ammonia was added to the non-toxic C18 -treated sample to reduce the proportion of the more toxic unionized ammonia form through pH reduction. In the mysid tests, the ammonia-spiked low-pH sample was not toxic, as expected, although the finding is somewhat uncertain due to variability of pH over time. Similarly, the spiked low-pH sample was non-toxic to sea urchin survival and larval development, indicating that the reduction in unionized ammonia was sufficient to remove toxicity.

Site sample NBH-202

Metal treatments (STS, EDTA): Table 2a shows that for mysids at 48 hours, the EDTA increased survival from 20 to 37%, indicating that metal(s) have likely contributed to toxicity in the filed sample. The 96 hour results (Table 2b) indicate an increased level of toxicity in the untreated sample could not be mitigated by the metal treatments. It also suggests the possibility that reductions in toxicity due to the metal treatments were masked by other sample constituents that remained at highly toxic levels after the STS and EDTA treatments (discussed below).

Table 3a shows that the elutriate prepared from the Harbor sediment was highly toxic, both in survival and development of sea urchin larvae. Sea urchin survival and larval development did not improve following treatments to bind metals, even though the copper concentration appears to be similar to the spiked sample where reduction in toxicity did occur. This indicates a presence of residual contributors to toxicity, including organics, ammonia and/or copper and other metals that were not completely bound by the TIE treatments.

Organics treatment (PCBs): For mysids, the filtration and C18 steps each sequentially removed site sample toxicity at 48 hours (increasing survival to 70 and 93%, respectively; Table 2a), indicating that organics were the principal contributors the toxicity observed at this exposure interval. As with the metal treatment, the 96 hour results (Table 2b) indicate a residual source of toxicity (discussed below) that precluded observed reductions in toxicity due to the metal treatments.

For sea urchins, larval development was not improved by filtration and C_{18} treatments of the site sample (Table 3b), while a slight trend of increasing survival was observed (count per ml increasing from 9% in the untreated sample to 16% in the filtered sample and 21% after the C18 treatment; Table 3b).

Ulva Treatment: Ulva treatment of the site sample was performed to remove ammonia as a source of toxicity. In the NBH-202 sample, *Ulva* completely removed toxicity to mysids at 96 hrs (Table 2b). survival remained at <10% prior to the *Ulva* treatment. This indicates that the mortality due to ammonia did likely mask potential chemical toxicity removed by previous sequential TIE treatments. *Ulva* may also reduce residual toxicity associated with metals and organics. This fact will be important in interpreting the results of the Low pH treatment discussed below.

In the sea urchin exposures to the site sample, the *Ulva* treatment had a large impact on sea urchin survival (increased to 65% from 21%; Table 3a). This indicates that survival was affected by ammonia, and possibly other residual toxicants, as noted above. *Ulva* did not increase normal development (the principal, and more sensitive endpoint for this test; Table 3b). The concentration of total ammonia through the C_{18} treatment was 37 mg/L and was reduced by the *Ulva* treatment to 7.8 mg/L (as unionized, 0.06 mg/L). Reported EC_{50}s for this

species exposed to ammonia are as low as1.7 mg/L and 0.06 mg/L as total and unionized ammonia respectively, indicating that the treatment may not have removed enough ammonia; hence ammonia most likely remained a factor contributing to toxicity.

Low pH (independent post-C_{18} treatment): Mysid survival at 48 hours was lower with the low pH treatment than it was following the C_{18}-treatment. Normally, ammonia toxicity would be reduced by this treatment, but in this case, an increased toxicity could be due to residual copper. Copper toxicity may is inversely related to pH in some marine organisms (Ho et al., 1999b) not sequestered by the STS and EDTA treatments. The low pH shift can increase the proportion of the toxic Cu^{2+} ion by an order of magnitude within the pH range evaluated for this study (Leckie and Davis, 1979)

The low pH treatment resulted in 27% sea urchin survival (indicating that unionized ammonia may not have been the principal toxicant for this endpoint. Larval development did not improve with the low pH treatment, most likely due to residual ammonia and other residual toxicants.

Summary of Findings for Site Specific Water Quality Study

The TIE conducted in this study addressed the relative roles of metals, organic constituents and ammonia are contributors to toxicity associated with SPP generated from a New Bedford Harbor sediment (NBH 202). The sequential TIE method relies on evaluation of results from multiple treatments and multiple species. Results with spiked samples demonstrated that the sea urchin (particularly larval development) is more sensitive to copper and ammonia relative to the mysid, in fact, too sensitive for the purposes of this study. Accordingly, the 48 hour mysid results were determined to be most useful in identifying sources of toxicity prior to the *Ulva* treatment. For mysids following 48-hour exposures to 100% SPP, survival gradually increased from 20% to 90%, apparently due to treatments for both metals and organics.

The SPP and elutriate for NBH-202 at 100% strength was highly toxic to both species. *Ulva* eliminated and reduced toxicity, respectively in the 96-hour mysid and sea urchin survival results, where prior treatments had been ineffective. This indicates that ammonia toxicity masked the removal of toxicity that would have been occurred in prior sequential steps that target metals and organics.

Specific Hazard Quotients and TIE results generally both support the finding of multiple sources of toxicity. Copper and ammonia toxicity to sea urchins appeared to have exceeded the capacity of the TIE treatments to sufficiently limit observed effects. Mysids were most affected by PCBs and ammonia, but their sensitivity to copper appears to increase with near-toxic levels of PCBs, as seen with the spike sample responses. The role of PCBs is the most uncertain of the three toxicants due to the need to use toxicity values derived for specific PCB mixtures (e.g. Aroclor 1242) that are different from the mixture presented in the NBH sediment sample.

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Figure 1. Simplified Flow Diagram for Sequential TIE: Fractionation, Testing and Interpretation

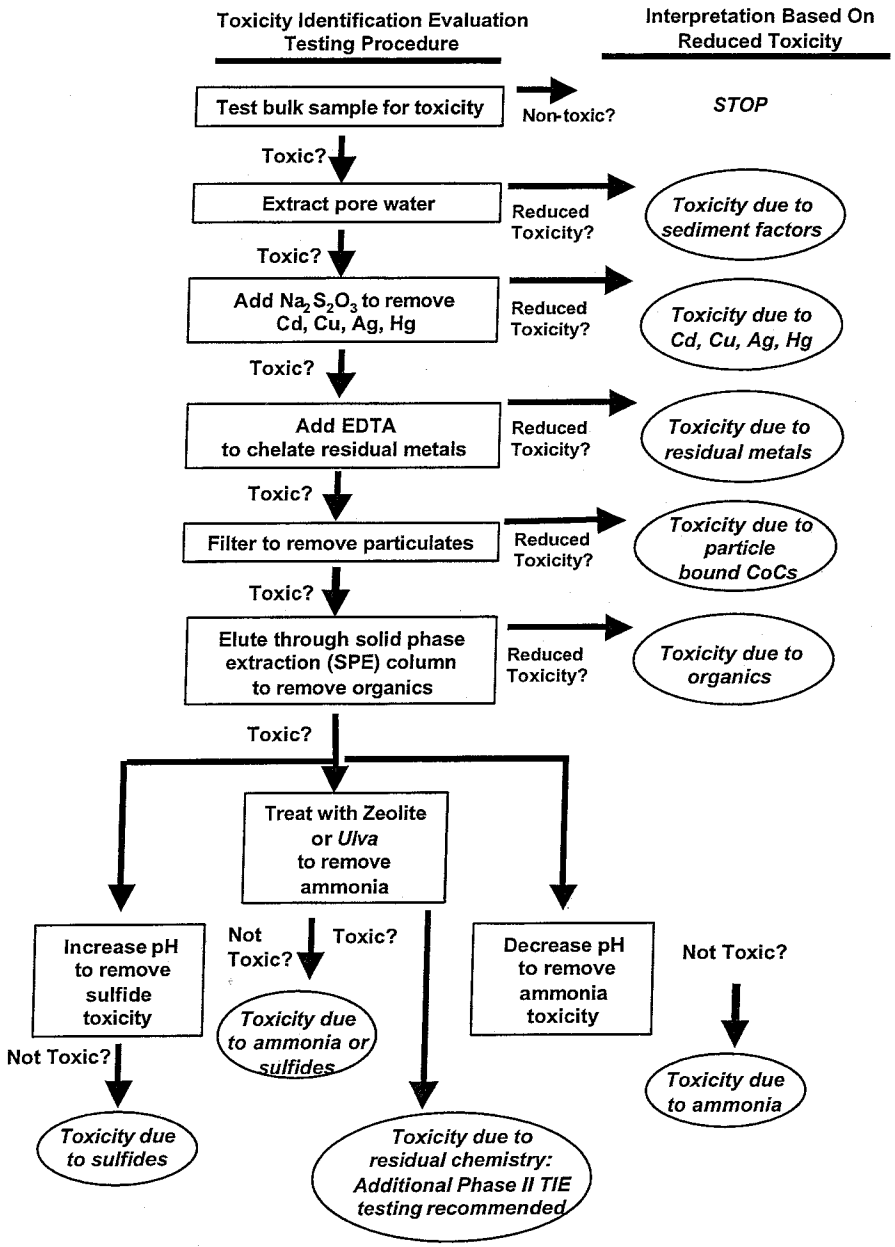

Table 1. Species-specific elutriate Hazard Quotients for chemical exposures to *Americamysis bahia* and *Arbacia punctulata* exposed to New Bedford Harbor Suspended Particulate Phase samples.

	Mysid (*Americamysis bahia*[1])			
Analyte	Acute LC_{50} (ug/L)	Reference for Acute value	HQ for Spike[1,2,3]	HQ for NBH-202-Elutriate
Copper	153	a,g	0.78	0.64
PCB	17	c	1.18	1.36
Unionized ammonia	1.94	f	0.26	0.82

	Sea Urchin (*Arbacia punctulata*[1])			
Analyte	Acute EC_{50} (ug/L)	Reference for Acute value	HQ for Spike[1,2,3]	HQ for NBH-202-Elutriate
Copper	18	g	6.67	5.43
PCB	1000	d	0.02	0.02
total ammonia	4.06	e	3.45	9.33
Unionized ammonia	0.09	b, e	5.56	17.71

1 - Hazard Quotient = elutriate concentration/species LC_{50} (larval development for sea urchin)

2 - Hazard Quotients for spiked sample based on estimate from nominal concentrations

3 Copper = 100% nominal concentration and PCB =10% nominal concentration[h]

a Nacci, Jackim and Walsh. 1986.

b. Bay, S. R. Burgess and D. Nacci. 1993.

c Ho, K.T., R.A. McKinney, A.Kuhn, M.C. Pelletier, and R.M. Burgess.1997.
Value for Aroclor1242; Aroclor 1254 = 57 ug/L

d Adams and Slaughter-Williams. 1988.

e National Beological Service. 1996. Value used is geometric mean of values from Bay et al. and NBS.

f Miller, D.C., S. Poucher, J.A. Cardin and D. Hansen. 1990.

geo. Mean = 1.94 mg/L unionized ammonia

g. SAIC 1993.

h. Ho et al., 1999b.

Table 2 Survival in the mysid, *Americamysis bahia*, after exposures to Spiked Water and Suspended Particulate Phase sediment in the New Bedford Harbor TIE study.

A. 48 hour results

	TIE Treatment[1] Result (% Survival)						
		Metals		Particulates	Organics	Ammonia	
Sample-dilution %	Untreated	STS	EDTA	Filtered	C_{18}	*Ulva*	Low pH[2]
Spike - 50 %	0	100					
Spike - 100 %	0	90	100	100	93	90	100
STA 202 100%	20	20	37	70	93	90	23
PC-100 %	100	100	100	100	93	90	100

B. 96 hour results

	TIE Treatment[1] Result (% Survival)						
		Metals		Particulates	Organics	Ammonia	
Sample-dilution %	Untreated	STS	EDTA	Filtered	C_{18}	*Ulva*	Low pH[2]
Spike - 50 %	0	100					
Spike - 100 %	0	80	97	100	93	90	97
STA 202 100%	0	0	0	0	3	90	3
PC-100 %	100	100	97	97	100	90	100

[1] Treatments were sequential, from left to right (except Low pH, which followed C_{18}- *Ulva*).
Blank cell indicate that no sample was tested.
Yellow highlighting indicates apparent reduction (> 15%) in toxicity.
Bold outline indicates statistically significant change in toxicitiy (a= 0.05).
No toxicity tests were conducted on Spike dilutions after the STS treatment.

Table 3. Responses of the sea urchin, *Arbacia punctulata,* after exposures to spiked water and sediment elutriate in the New Bedford Harbor TIE study.

A. Survival at 72 hrs.

	TIE Treatment[1] Result (% Survival)[2]						
		Metals		Particulates	Organics	Ammonia	
Sample-dilution %	Untreated	STS	EDTA	Filtered	C_{18}	*Ulva*	Low pH
Spike - 10 %	82.0	85.0					
Spike - 25 %	26.0	76					
Spike - 50 %	54.7	79					
Spike - 100 %	81.0	35.0	91	90.0	87.7	41.3	84.0
STA 202 100%	8.7	17	4.7	16	21	65	27.0
PC-100 %	90	88.0	82.3	87.7	92.3	83.0	93.3

B. Normal development at 72 hours.

	TIE Treatment[1] Result (% Normal Development)[3]						
		Metals		Particulates	Organics	Ammonia	
Sample-dilution %	Untreated	STS	EDTA	Filtered	C_{18}	*Ulva*	Low pH
Spike - 10 %	0.7	99					
Spike - 25 %	0.0	0.0					
Spike - 50 %	0.0	0.0					
Spike - 100 %	0.0	0.0	98	98.3	98.0	0.3	96.7
STA 202 100%	0.0	0.0	0.3	3.0	1.3	0	0.0
PC-100 %	100	99.7	99.7	99.7	97.7	98.7	99.3

[1] Treatments were sequential, from left to right (except Low pH, which followed C_{18}- *Ulva*).

[2] The survival endpoint is defined as number of larvae present in 1 ml.

[3] The normal larval development endpoint is defined as achievement of the pluteus stage

Blank cell indicate that no sample was tested.

Yellow highlighting indicates apparent reduction (> 15%) in toxicity.

Bold outline indicates statistically significant change in toxicitiy (a= 0.05).

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December 2, 2002

Ms. Sherry Poucher
SAIC
221 Third Street
Newport, Rhode Island 02840

Dear Ms. Poucher:

Enclosed please find a report (two copies, one bound, one unbound) of the toxicity test results for TIE preparations with *Americamysis bahia* and *Arbacia puntulata* completed on samples received on October 31, 2002 (New Bedford).

If you have any questions regarding the report, please contact Dr. Philip C. Downey or me.

Sincerely,

John Williams
Manager, Environmental Toxicology

273 Commerce Street, Williston, VT 05495 Tel: 802.860.1638 Fax: 802.658.3189

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Toxicity Detail Report

Science Applications International Corp
221 Third Street

Newport, RI 02840

Date: 12/2/2002
Project: 02065
SDG 6560
Site: New Bedford

Method Description Sea Urchin, Arbacia punctulata, 72-h embryo development
Method: TIEAP
Species: *Arbacia punctulata*

Number	Treatment	Conc(%)	Day	Replicate Normal Development (normal/counted) A	B	C	Average Normal (%)
023135	Control-Filtered	100	3	99 / 100	99 / 100	98 / 100	98.7
023136	NBH_SPP_Cent-C18	100	3	1 / 50	3 / 100	0 / 100	1.6
023138	Spike-C18	100	3	96 / 100	99 / 100	99 / 100	98.0
023139	Control-C18	100	3	96 / 100	98 / 100	99 / 100	97.7
023140	NBH_SPP_Cent-Ulva	100	3	0 / 100	0 / 100	0 / 100	0.0
023142	Spike-Ulva	100	3	0 / 100	0 / 100	1 / 100	0.3
023143	Control-Ulva	100	3	99 / 100	100 / 100	97 / 100	98.7
023144	NBH_SPP_Cent-LOpH	100	3	0 / 100	0 / 100	0 / 100	0.0
023146	Spike-LOpH	100	3	96 / 100	97 / 100	97 / 100	96.7
023147	Control-LOpH	100	3	99 / 100	100 / 100	99 / 100	99.3
023148	NBH_SPP_Cent-Untreat	100	3	0 / 50	0 / 50	0 / 50	0.0
023150	Spike-Untreated	10	3	1 / 100	1 / 100	0 / 100	0.7
023150	Spike-Untreated	25	3	0 / 100	0 / 100	0 / 100	0.0
023150	Spike-Untreated	50	3	0 / 100	0 / 100	0 / 100	0.0
023150	Spike-Untreated	100	3	0 / 100	0 / 100	0 / 100	0.0
023151	Control-Untreated	100	3	100 / 100	100 / 100	99 / 100	99.7
023152	NBH_SPP_Cent-STS	100	3	0 / 50	0 / 100	0 / 50	0.0
023154	Spike-STS	10	3	99 / 100	99 / 100	98 / 100	98.7
023154	Spike-STS	25	3	0 / 100	0 / 100	0 / 100	0.0
023154	Spike-STS	50	3	0 / 100	0 / 100	0 / 100	0.0
023154	Spike-STS	100	3	0 / 100	0 / 100	0 / 100	0.0
023155	Control-STS	100	3	100 / 100	100 / 100	99 / 100	99.7
023156	NBH_SPP_Cent-EDTA	100	3	0 / 50	1 / 50	0 / 28	0.8
023158	Spike-EDTA	100	3	95 / 100	99 / 100	100 / 100	98.0
023159	Control-EDTA	100	3	99 / 100	100 / 100	100 / 100	99.7
023160	NBH_SPP_Cent-Filtered	100	3	3 / 100	6 / 100	0 / 100	3.0
023162	Spike-Filtered	100	3	100 / 100	100 / 100	95 / 100	98.3
023163	Seawater	0	3	100 / 100	99 / 100	100 / 100	99.7

Submitted By:

273 Commerce Street, Williston, VT 05495 Tel: 802.860.1638 Fax: 802.658.3189

Aquatec Biological Sciences

Ecology | Environmental Toxicology | Natural Resource Assessments | Microbiology

Toxicity Detail Report

Science Applications International Corp
221 Third Street

Newport, RI 02840

Date: 12/2/2002
Project: 02065
SDG 6560
Site: New Bedford

Method Description: TIE Using Mysidopsis bahia
Method: TIEMY
Species: *Mysidopsis bahia*

		Conc (%)	Test End Day	Start Count	Replicate Survival A	B	C	Average Survival (%)
23135	Control-Filtered	100	4	10	10	10	9	96.7
23137	NBH_SPP_202-C18	100	4	10	0	1	0	3.33
23138	Spike-C18	100	4	10	9	9	10	93.3
23139	Control-C18	100	4	10	10	10	10	100
23141	NBH_SPP_202-Ulva	100	4	10	10	9	8	90
23142	Spike-Ulva	100	4	10	10	9	8	90
23143	Control-Ulva	100	4	10	10	9	8	90
23145	NBH_SPP_202-LOpH	100	4	10	3	0	0	10
23146	Spike-LOpH	100	4	10	10	9	10	96.7
23147	Control-LOpH	100	4	10	10	10	10	100
23149	NBH_SPP_202-Untreated	100	4	10	0	0	0	0
23150	Spike-Untreated	100	4	10	0			
23151	Control-Untreated	100	4	10	10	10	10	100
23153	NBH_SPP_202-STS	100	4	10	3	0	0	10
23154	Spike-STS	50	4	10	10			
23154	Spike-STS	100	4	10	8			
23155	Control-STS	100	4	10	10	10	10	100
23157	NBH_SPP_202-EDTA	100	4	10	0	0	0	0
23158	Spike-EDTA	100	4	10	10	9	10	96.7
23159	Control-EDTA	100	4	10	10	10	9	96.7
23161	NBH_SPP_202-Filtered	100	4	10	0	0	0	0
23162	Spike-Filtered	100	4	10	10	10	10	100
23163	Seawater	0	4	10	10	10	10	100

Submitted By: _____

273 Commerce Street, Williston, VT 05495 Tel: 802.860.1638 Fax: 802.658.3189

Aquatec Biological Sciences

Ecology | Environmental Toxicology | Natural Resource Assessments | Microbiology

Quality Assurance Report

Science Applications International Corporation	Date:	12/2/2002
221 Third Street	Project:	02065
	SDG	6560
Newport, RI 02840	Site:	New Bedford

Qualifiers and Special Conditions

For the untreated spike sample (sample 23150) and the STS-treated spike sample (sample 23154) dilutions of 10%, 25%, 50%, and 100% sample were tested with Arbacia. For the mysids there was only enough sample to run the 100% (one replicate for the untreated spike) or the 50% and 100% (one replicate each for the STS-spike).

Dissolved oxygen concentrations were low in two treatments, sample 23156 and sample 23160 and were aerated briefly before starting the toxicity tests.

For the Arbacia punctulata embryo development test, a subsample of 100 embryos was counted and scored for normal/abnormal developnment. When it was evident that few embryos survived in some test solutions, only 50 embryos were scored. These replicates were sample 23136 replicate A; sample 23148 replicates A,B,C; and sample 23152 replicates A,C.

273 Commerce Street, Williston, VT 05495 Tel: 802.860.1638 Fax: 802.658.3189

Supportive Documentation

Chain-Of-Custody

Toxicity Test Methods

Sea Urchin, Arbacia Punctulata, 72-h embryo development

TIE Using Mysidopsis bahia

Standard Reference Toxicant Control Charts

Chain-Of-Custody

Aquatec Biological Sciences
Chain-of-Custody Record

273 Commerce Street
Williston, VT 05495
TEL: (802) 860-1638
FAX: (802) 658-3189

COMPANY INFORMATION	COMPANY'S PROJECT INFORMATION	SHIPPING INFORMATION	VOLUME/CONTAINER TYPE/ PRESERVATIVE (NOTE 4)
Name: Sherry Powner	Project Name: New Bedford	Carrier: Fed Ex	
Address: 221 Third Street			
	Project Number:	Airbill Number: 8383 0250 4326	
City/State/Zip: Newport, R.I. 02840	Sampler Name(s):		
Telephone: (401) 847-4210	John Williams	Date Shipped: 10/29/02	
Facsimile:	(SPP Prep)		
Contact Name: Sherry	Quote #: Client Code:	Hand Delivered: ☐ Yes ☐ No	

SAMPLE IDENTIFICATION (NOTE1)	COLLECTION DATE	COLLECTION TIME	GRAB	COMPOSITE	MATRIX	ANALYSIS/REMARKS (NOTE 2,3)	NUMBER OF CONTAINERS					
NBH-202-SPP	10/29/02	1305			SPP	TIE Manipulations	1 (partial)					
NBH-202-SPP-Clarified by centrifuge	10/29/02	4:00			SPP clear	TIE Manipulations		2 (1 full 1 partial)				

Relinquished by: (signature)	DATE	TIME	Received by: (signature)
[signature]	10/29/02	13:13	Parked for Fed Ex.
Relinquished by: (signature)	DATE	TIME	Received by: (signature)
Relinquished by: (signature)	DATE	TIME	Received by: (signature)

NOTES TO SAMPLER(S): (1) Limit Sample Identification to 30 characters, if possible; (2) Indicate designated Lab Q.C. sample and type (e.g.:MS/MSD/REP) and provide sufficient sample; (3) Field duplicates are separate sample; (4) e.g.: 40 ml/glass/H_2SO_4

Notes to Lab:

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

An Employee-Owned Company Science Applications International Corporation

Chain of Custody Record

Science Applications International Corporation/ 221 Third Street/ Admiral's Gate/ Newport RI 02840 phone (401)847-4210 fax (401)849-9786

Project: NBH - Dredging

Client Name and Contact: Maguire / ACE. : Sherry Poucher

Sample No.	Containers No.	Containers Type	Collection Date	Collection Time	Sample Description	Requested Parameters
Control	1	185mL	10/30/02	14.00	Filtered	TIE
NBH_SPP_Cent	1	60mL	↓	15:00	C18	↓
NBH_SPP_202	1	150mL	↓	↓	C18	↓
Spike	1	185mL	↓	↓	C18	↓
Control	1	185mL	↓	↓	C18	↓
NBH_SPP_Cent	1	60mL	↓	1530	UVA	↓
NBH_SPP_202	1	150mL	↓	↓	UVA	↓
Spike	1	185mL	↓	↓	UVA	↓
Control	1	185mL	↓	↓	UVA	↓
NBH_SPP_Cent	1	60mL	↓	↓	10 PH	↓
NBH_SPP_202	1	150mL	↓	↓	10 PH	↓
Spike	1	185mL	↓	↓	10 PH	↓
Control	1	185mL	↓	↓	10 PH	↓
Sea water	1	1 Gal	11/30/02		~~Sea~~ EPA AED Sea Water	Use for Dilutions

Total : 13

Packed/Released By	Date	Time	Received By	Date	Time	Remarks:
Signature: Kate A. Montgomery Printed Name: Kate A. Montgomery	10/30/02	16:00	Signature: Printed Name:			
Released By	**Date**	**Time**	**Received By**	**Date**	**Time**	
Signature: Kate A. Montgomery Printed Name: Kate A. Montgomery	10/30/02	16:00	Signature: Printed Name: J. Williams	10/31/02	09:30	

Final Destination:	Contact Name and Phone Number:	Shipping Method: Fed-Ex
Aquatec Williston, VT	John Williams 802 860 1638	Page 2 of 2

An Employee-Owned Company Science Applications International Corporation

Chain of Custody Record

Science Applications International Corporation/ 221 Third Street/ Admiral's Gate/ Newport RI 02840 phone (401)847-4210 fax (401)849-9786

Project: NBH - Dredging

Client Name and Contact: Maguire/ACE : Sherry Poucher

Sample No.	Containers No.	Containers Type	Collection Date	Collection Time	Sample Description	Requested Parameters
NBH_SPP-Cent.	1	60mL	10/30/02	11:00	Untreated (unt.)	TIE
NBH_SPP_202	1	150mL			Untreated (unt.)	
Spike	1	150mL			Untreated (unt.)	
Control	1	150mL			Untreated (unt.)	
NBH_SPP_Cent	1	60mL		12:00	Sodium Thiosulfate (STS)	
NBH_SPP_202	1	150mL			Sodium Thiosulfate (STS)	
Spike	1	150mL			Sodium Thiosulfate (STS)	
Control	1	150mL			Sodium Thiosulfate (STS)	
NBH_SPP_Cent	1	60mL		13:00	EDTA	
NBH_SPP_202	1	150mL			EDTA	
Spike	1	150mL			EDTA	
Control	1	150mL			EDTA	
NBH_SPP_Cent	1	60mL		14:00	Filtered	
NBH_SPP_202	1	150mL			Filtered	
Spike	1	185mL			Filtered	

Total: 15

Packed/Released By	Date	Time	Received By	Date	Time	Remarks:
Signature: Kate A. Montgomery Printed Name: Kate A. Montgomery	10/30/02	16:00	Signature: Printed Name:			Rec. Temp 1.3°C
Released By	**Date**	**Time**	**Received By**	**Date**	**Time**	
Signature: Kate A. Montgomery Printed Name: Kate A. Montgomery	10/30/02	16:00	Signature: Printed Name: John Williams	10/31/02	09:30	

Final Destination:	Contact Name and Phone Number:	Shipping Method: Fed-Ex
Aquatec Williston, VT	John Williams 8028601638	Page 1 of 2

Toxicity Test Methods

Science Applications International Corporation

Test Protocol

Client: SAIC	Project: 02065, New Bedford TIE	SDG: 6560
Test Description: *Arbacia punctulata* Embryo development Toxicity Test		

ASSOCIATED PROTOCOL: EPA/ACE 1998. *Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. – Inland Testing Manual* (EPA-823-B-98-004)

1. Test type:	Static, no renewal
2. Test temperature:	20 ± 1°C
3. Light quality:	Ambient laboratory illumination
4. Photoperiod:	Continuous illumination
5. Test chamber size:	20-mL HDPE scintillation vials
6. Test solution volume:	20 ml / replicate
7. Renewal of test concentrations:	None
8. Age of test organisms:	Embryos, approximately 1-h old
9. No. embryos / test chamber:	~ 2000
10. No. of replicate chambers / concentration:	3
11. No. of embryos / concentration:	~ 6000
12. Feeding regime:	None
13. Cleaning:	None during test
14. Aeration:	None
15. Dilution water:	Seawater
16. Test concentrations:	100% for SPP and spike; 10%, 25%, 50%, %100% for spiked untreated and spiked STS treatment
17. Controls:	Seawater
18. Test duration:	72 hours
19. Monitoring:	Daily: Temperature Day 0: DO, temperature, pH, salinity.
19. End points:	Embryo development
20. Reference toxicant test:	Copper sulfate 48-h embryo development
21. Test acceptability (control performance):	70% or greater normal development in control
22. Data interpretation:	Embryo development

Reviewed by: _____ Date: 10/31/02

Test Protocol

Client: SAIC	Project: 02065, New Bedford TIE	SDG: 6560
Test Description: *Americamysis bahia* 96-h acute toxicity		

ASSOCIATED PROTOCOL: EPA/ACE 1998. *Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. – Inland Testing Manual* (EPA-823-B-98-004)

1. Test type:	Static, no renewal
2. Test temperature:	25 ± 1°C
3. Light quality:	Ambient laboratory illumination
4. Photoperiod:	16 h light, 8 h dark
5. Test chamber size:	250-mL disposable polystyrene
6. Test solution volume:	Nominally, 200 ml / replicate
7. Renewal of test concentrations:	None
8. Age of test organisms:	1 – 5 days
9. No. mysids / test chamber:	10
10. No. of replicate chambers / concentration:	3
11. No. of mysids / concentration:	30
12. Feeding regime:	Daily, 0.2 mL *Artemia* nauplii
13. Cleaning:	None during test
14. Aeration:	None during test
15. Dilution water:	Seawater
16. Test concentrations:	100% for SPP and spike. Insufficient sample available to test 10% or 25% spiked sample.
17. Controls:	Seawater
18. Test duration:	96 hours
19. Monitoring:	Daily: Temperature Days 0, 4: DO, temperature, pH, salinity.
19. End points:	Survival
20. Reference toxicant test:	Potassium chloride
21. Test acceptability (control performance):	90% or greater survival in control
22. Data interpretation:	Survival (%)

Sea Urchin, Arbacia Punctulata, 72-h embryo development

Science Applications International Corporation

For the *Arbacia punctulata* embryo development test, percent survival may be estimated by using the number of embryos (including normal and abnormal) from a 1-mL aliquot removed from each test vial (preserved embryos) after the test was ended. Presence of any embryo material, no matter how undeveloped or degraded, was scored as "a live embryo" (Actual survival could not be verified because the embryos were preserved.). Data were recorded on the bench sheet labeled as "# in 1-mL".

Percent surviving may be calculated by:

[("# in 1-mL" X 23) / 2000] X 100 = percent survival

23 = the total volume of solution per vial, including preservative

2000 = the nominal number of embryos added per test vial when the test was started.

One exception to this is for Sample 23152 ("Cent SPP-STS") Replicate B. The total volume in this vial was 13 mL after preservation.

Percent surviving = [(29 X 13) / 2000] X 100 = 18.8%

Client: SAIC	Project: 02065, New Bedford TIE	SDG: 6560

Test Description: *Arbacia punctulata* Embryo development Toxicity Test

72-h BIOLOGICAL DATA

Sample	# Normal	# Abnormal	# in (2) 1-mL
23136 A	1	49	10
Cent SPP B	3	97	29
C-18 C	0	100	24
23138 A	96	3	89
SPIKE B	99	1	91
C-18 C	99	1	83
D			
23139 A	96	4	101
Control B	98	2	85
C-18 C	99	1	91
I/D	J 11/6/02		

WATER CHEMISTRY DATA

	Day 0	Day 1	Day 2	Day 3
pH	7.9			
DO	6.9			
Temp	19.2			20.3
Salinity	30			
pH	7.6			
DO	8.6			
Temp	20.3			20.4
Salinity	30			
pH	7.8			
DO	7.7			
Temp	~~20.9~~	19.9		20.3
Salinity	30			
	10/31/02	11/1	11/2	11/3 JW

72-h BIOLOGICAL DATA

Sample	# Normal	# Abnormal	# in 1-mL
23140 A	0	100	73
Cent SPP B	0	100	70
ULVA C	0	100	51
23142 A	0	100	35
SPIKE	0	100	53
ULVA C	1	99	36
23143 A	99	1	88
Control	100	0	79
ULVA C	97	3	82
I/D	J 11/6/02		

WATER CHEMISTRY DATA

	Day 0	Day 1	Day 2	Day 3
pH	7.3			
DO	4.1			
Temp	21.6			20.5
Salinity	30			
pH	7.5			
DO	5.1			
Temp	20.2			20.4
Salinity	30			
pH	7.3			
DO	5.2			
Temp	20.4			20.5
Salinity	30			
	10/31/02	11/1	11/2 JG	11/3 JW

72-h BIOLOGICAL DATA

Sample	# Normal	# Abnormal	# in 1-mL
23144 A	0	100	38
Cent SPP B	0	100	24
LO PH C	0	100	19
23146 A	96	4	90
SPIKE	97	3	76
LO PH C	97	3	86
23147 A	(1) 99	1	97
Control	100	0	98
LO PH C	99	1	85
D			
I/D	J 11/6/02		

WATER CHEMISTRY DATA

	Day 0	Day 1	Day 2	Day 3
pH	7.2			
DO	5.7			
Temp	21.0			20.6
Salinity	30			
pH	8.6			
DO	8.8			
Temp	19.8			20.6
Salinity	30			
pH	7.1			
DO	8.0			
Temp	20.4		20.3	20.3
Salinity	30			
	10/31/02	11/1	11/2 JG	11/3 JW

(2) # in 1-mL = 1 mL aliquot of well mixed vial content. Target loading = 2000 embryos per vial. Vial volume = 23 mL (20 mL test sol. + 1 mL embryos + 2 mL preservative)

Aquatec Biological Sciences Williston, Vermont — ApTIEToxForms

Reviewed by: J Date: 11/16/02

Abnormals are spherical multicellular/granular masses.

(1) Considered marginally normal. Plutens large, small, slightly

Embryo count × 23 = estimated # of embryos

BIOLOGICAL AND WATER CHEMISTRY DATA

Client: SAIC	Project: 02065, New Bedford TIE	SDG: 6560
Test Description: *Arbacia punctulata* Embryo development Toxicity Test		

72-h BIOLOGICAL DATA

Sample	# Normal	# Abnormal	# in 1-mL
23148 A	0	50	11
Cent SPP B	0	50	8
UNT C	0	50	5
I/D	[illegible]	11/8/02	

WATER CHEMISTRY DATA

	Day 0	Day 1	Day 2	Day 3
pH	7.9			
DO	8.4			
Temp	20.3			20.2
Salinity	30			
	10/31/02	11/1	11/2	11/3

72-h BIOLOGICAL DATA

Sample	# Normal	# Abnormal	# in 1-mL
23150 A	1	99	70
SPIKE B	1	99	89
UNT C	0	100	87
10%			
23150 A	0 (1)	100	18 (1)
SPIKE B	0	100	30
UNT C	0	100	80
25%			
23150 A	0 (1)	100	68 (1)
SPIKE B	0	100	57
UNT C	0	100	39
50%			
23150 A	0 (1)	100	69 (1)
SPIKE B	0	100	75
UNT C	0	100	99
100%			
I/D	[illegible]	11/8/02	

WATER CHEMISTRY DATA

	Day 0	Day 1	Day 2	Day 3
pH				
DO				
Temp				20.3
Salinity				
pH				
DO				
Temp				20.5
Salinity				
pH				
DO				
Temp				20.5
Salinity				
pH	7.6			
DO	8.7			
Temp	19.9	20.5	20.5	20.5
Salinity	30			
	10/31/02	11/1	11/2	11/3

72-h BIOLOGICAL DATA

Sample	# Normal	# Abnormal	# embryos in 1mL
23151 A	100	0	Not counted
Control	100	0	93
UNT C	99	1	87
I/D	[illegible]	11/6/02	

WATER CHEMISTRY DATA

	Day 0	Day 1	Day 2	Day 3
pH	8.0			
DO	8.2			
Temp	20.5			20.5
Salinity	30			
	10/31/02	11/1	11/2	11/3

(1) Abnormal embryos are undeveloped spheres - arrested development at very early stage.

Solution vol = 23 mL, unless otherwise noted
(20 mL original test vol + 1 mL embryos + 2 mL formalin)

Reviewed by: [illegible] Date: 11/11/02

BIOLOGICAL AND WATER CHEMISTRY DATA

Client: SAIC	Project: 02065, New Bedford TIE	SDG: 6560
Test Description: *Arbacia punctulata* Embryo development Toxicity Test		

72-h BIOLOGICAL DATA

Sample	# Normal	# Abnormal	# in 1-mL
23152 A	0	50	11
Cent SPP B ①	0	100	29
STS C	0	50	11
I/D	0	11/8/02	

① Total vol Rep B = 13 mL.

WATER CHEMISTRY DATA

	Day 0	Day 1	Day 2	Day 3
pH	7.7			
DO	8.4			
Temp	20.9			20.6
Salinity	31			
	10/31/02	11/1	11/2	11/3 JW
	0			

72-h BIOLOGICAL DATA

Sample	# Normal	# Abnormal	# in 1-mL
23154 A	99	1	87
SPIKE B	99	1	79
STS C	98	2	89
10%			
23154 A	0	100	85
SPIKE B	0	100	76
STS C	0	100	66
25%			
23154 A	0	100	87
SPIKE B	0	100	69
STS C	0	100	81
50%			
23154 A	0	100	39
SPIKE B	0	100	46
STS C	0	100	24
100%			
I/D	0	11/8/02	

WATER CHEMISTRY DATA

	Day 0	Day 1	Day 2	Day 3
pH				
DO				
Temp				20.6
Salinity				
pH				
DO				
Temp				20.6
Salinity				
pH				
DO				
Temp		20.3	20.7	20.5
Salinity				
pH	7.8			
DO	8.6			
Temp	20.1			20.6
Salinity	30			
	10/31/02	11/1	11/2 JG	11/3 JW
	0	0		

72-h BIOLOGICAL DATA

Sample	# Normal	# Abnormal	# in 1-mL
23155 A	100	0	99
Control	100	0	81
STS C	99	1	84
I/D	0	11/8/02	

WATER CHEMISTRY DATA

	Day 0	Day 1	Day 2	Day 3
pH	8.0			
DO	8.7			
Temp	20.3			20.5
Salinity	30			
	10/31/02	11/1	11/2	11/3 JW
	0			

BIOLOGICAL AND WATER CHEMISTRY DATA

Client: SAIC	Project: 02065, New Bedford TIE	SDG: 6560
Test Description: *Arbacia punctulata* Embryo development Toxicity Test		

72-h BIOLOGICAL DATA

Sample	# Normal	# Abnormal	# in 1-mL
23156 A	0	50	8
Cent SPP B	1	49	10
EDTA C	0	28	5
23158 A	95	5	107
SPIKE B	99	1	81
EDTA C	100	0	84
23159 A	99	1	76
Control B	100	0	90
EDTA C	100	0	81
I/D	[illegible]	11/11/02	

WATER CHEMISTRY DATA

	Day 0	Day 1	Day 2	Day 3
pH	7.4			
DO	1.7/7.2			
Temp	20.6			20.6
Salinity	30			
pH	7.8			
DO	8.6			
Temp	20.1			20.6
Salinity	30			
pH	7.8			
DO	8.3			
Temp	20.5			20.6
Salinity	30			
	10/31/02 [illegible]	11/1	11/2	11/3 [illegible]

Aerated before resting.

72-h BIOLOGICAL DATA

Sample	# Normal	# Abnormal	# in 1-mL
23160 A	3	97	20
Cent SPP B	6	94	17
FILT C	0	100	11
23162 A	100	0	92
SPIKE B	100	0	90
FILT C	95	5	88
23135 A	99	1	88
Control B	99	1	97
FILT C	98	2	78
I/D	[illegible]	11/11/02	

WATER CHEMISTRY DATA

	Day 0	Day 1	Day 2	Day 3
pH	7.9			
DO	3.4/7.0			
Temp	20.5			20.6
Salinity	30			
pH	7.6			
DO	8.0			
Temp	19.9			20.6
Salinity	30			
pH	7.7			
DO	7.4			
Temp	20.5			20.6
Salinity	30			
	10/31/02 [illegible]	11/1	11/2	11/3 [illegible]

Aerated before resting.

72-h BIOLOGICAL DATA

Sample	# Normal	# Abnormal	# in 1-mL
23163 A	100	0	83
Seawater B	99	1	75
C	100	0	85
I/D	[illegible]	11/11/02	

WATER CHEMISTRY DATA

	Day 0	Day 1	Day 2	Day 3
pH	8.0			
DO	8.6			
Temp	20.4	20.4	20.7	20.5
Salinity	33			
	10/31/02 [illegible]	11/1 [illegible]	11/2 JG	11/3 [illegible]

Client: SAIC Project: New Bedford 02065 SDG: 6560

Egg Collection and Dilution

Egg injection time: 12:45 No. females used: 4

#eggs in 9:1 dilution of egg stock = 327 = 3270 eggs/mL

Egg dilution:

Volume egg stock = 200 mL

Egg count / 200 = DF = 1.635

(DF X vol. Egg stock) – vol. Egg stock = = 127

volume of FSW added to egg stock = 127

Recount = 227 eggs – added 40 mL.

Confirmation: #eggs in 9:1 dilution of egg stock. Final egg count =

Final volume of egg stock: 367

Total number of eggs in egg stock: 367 x 2000 = 734,000 eggs

Total number of eggs X 500 = number of sperm required: = 367,000,000 (3.67×10^8)

Sperm Collection and Dilution

Sperm injection time: 12:10 No. males used: 4

Add ~~0.25~~ 0.4 mL sperm to Vial A (containing ~~10~~ 20 mL mL seawater. Serially dilute to Vials B, C, and D. Add 5 mL 10% acetic acid/seawater to vial C. Transfer 1 mL from Vial C to Vial E (contains 4 mL seawater).

Hemacytometer count:, Vial E X 10^4 = Side 1: 171 Side 2: 187 Avg. 179.

Avg. X 0.001 = X sperm X 10^7 = 0.179 X 10^7 = 0.0179 X 10^8

Sperm concentration Vial A = 40 X Vial E = 0.716 X 10^8

Sperm concentration Vial B = 20 X Vial E = X 10^8

Sperm concentration Vial D = 5 X Vial E = X 10^8

Vial selected for sperm stock = Vial

Sperm dilution to obtain 500:1 (sperm:egg)

Number of eggs in egg stock X 500 = 3.67×10^8

Vial selected as sperm stock = A 0.716×10^8 sperm per mL

Target #sperm / sperm stock per mL = volume of sperm stock to add to egg stock. 3.67 / 0.716 = 5.12 mL

Date / Time Sperm added to egg stock	Fertilization in 1:9 dilution of embryo stock	Time Embryo Development Test Started
13:54	100/100 = 100%	15:00

Initials: [illegible] Date: 10/31/02.

Test preserved 11/3/02 JW 15:00

Reviewed by: [illegible] Date 11/11/02

Laboratory: Aquatec Biological Sciences, Inc. Williston, Vermont

ApEmbryoE&SP

Peak Table: ammonia

File name: A:\110502A.RST
Date: November 05, 2002
Operator: JJG

Peak	Cup	Name	Type	Dil	Wt	Height	Calc. (mg/L)	Flags
1	6	Sync	SYNC	1	1	174482	1.034395	
2	0	CarryOver	CO	1	1	2415	0.011859	
3	0	CarryOver	CO	1	1	182	-0.001407	LO
B	0	Baseline	RB	1	1	0	-0.002491	BL
B	0	Baseline	RB	1	1	0	-0.002491	BL
6	1	Cal 0	C	1	1	134	-0.001694	LO
7	2	Cal 1	C	1	1	35152	0.206406	
8	3	Cal 2	C	1	1	67995	0.401583	
9	4	Cal 3	C	1	1	167974	0.995725	
10	5	Cal 4	C	1	1	841872	5.000472	
11	0	Blank	U	1	1	-1383	-0.010710	LO
B	0	Baseline	RB	1	1	0	-0.002491	BL
13	6	ICV	U	1	1	171595	1.017242	
14	1	ICB	U	1	1	-300	-0.004271	LO
15	31	22621CTEND	U	1	1	13549	0.078027	
16	32	22622CTEND	U	1	1	2548	0.012652	
17	33	22623CTEND	U	1	1	1827	0.008364	
18	34	22624CTEND	U	1	1	865	0.002650	
19	35	22625CTEND	U	1	1	1336	0.005449	
20	36	22626CTEND	U	1	1	1742	0.007861	
21	37	22643CTEND	U	1	1	9685	0.055061	
22	38	22644CTEND	U	1	1	3578	0.018770	
23	39	22645CTEND	U	1	1	12628	0.072553	
24	40	22646CTEND	U	1	1	2160	0.010347	
25	5	CCV	U	1	1	845598	5.022618	
26	1	CCB	U	1	1	-1442	-0.011063	LO
B	0	Baseline	RB	1	1	0	-0.002491	BL
28	41	22647CTEND	U	1	1	420	0.000003	
29	42	22648CTEND	U	1	1	3940	0.020925	
30	43	22655CTEND	U	1	1	3573	0.018741	
31	44	22656CTEND	U	1	1	91378	0.540535	
32	45	22657CTEND	U	1	1	12101	0.069422	
33	46	22658CTEND	U	1	1	3716	0.019593	
34	47	22659CTEND	U	1	1	3217	0.016628	
35	48	22660CTEND	U	1	1	8246	0.046514	
36	49	22661CTEND	U	1	1	9784	0.055649	
37	50	22662CTEND	U	1	1	6265	0.034737	
38	5	CCV	U	1	1	841834	5.000246	
39	1	CCB	U	1	1	-1163	-0.009403	LO
B	0	Baseline	RB	1	1	0	-0.002491	BL
41	51	22663CTEND	U	1	1	8469	0.047840	
42	52	22668CTEND	U	1	1	25019	0.146189	
43	53	23035SPP (201)	U	10	1	191119	11.332678	SPP
44	54	23036SPP (202)	U	10	1	637458	37.857109	Ammonias
45	55	23037SPP (204)	U	10	1	21825	1.272105	10/17/02
46	56	23038SPP (205)	U	10	1	154015	9.127696	
47	57	23039SPP (206)	U	10	1	105337	6.234899	
48	58	23040SPP (207)	U	10	1	232029	13.763792	
49	59	23059SPP (REF)	U	10	1	23615	1.378450	
50	60	23137TIE – (202)	U	end of mysid test, C-18 10	1	628496	37.323933	TIE
51	5	CCV	U	1	1	852664	5.064609	
52	1	CCB	U	1	1	-1146	-0.009300	LO Ammonia
B	0	Baseline	RB	1	1	0	-0.002491	BL 11/4/02
54	61	23141TIE – (202)	U	end of mysid test, ULVA 1	1	1315797	7.816853	

Peak	Cup	Name	Type	Dil	Wt	Height	Calc. (mg/L)	Flags
55	62	23153TIE (202) end of mysid test, STS		1	1	610643	36.263691	
56	5	CCV	U	1	1	850516	5.051842	
57	1	CCB	U	1	1	-1047	-0.008715	LO
B	0	Baseline	RB	1	1	0	-0.002491	BL

Suspended Particulate Phase Preparation for TIE

Client: SAIC	Project: 02065, New Bedford FEIR	SDG: 6519

SPP / Elutriate Preparation:

Quantitatively mix Site Sediment with matched Site Water in a 1:4 ratio. Mix this solution 30 minutes with a mixer. At approximately 10 min intervals, manually stir to ensure complete mixing. Allow the solution to settle 1 hour. At 1 hour remove the SPP for the toxicity tests. Ideally, approximately 4.7 L or SPP is needed for the TIE, however, we may be limited by sediment quantity. Approximately 4.2 L of SPP will be shipped to SAIC for the mysid TIE. A sub-sample of approximately 500 mL will be centrifuged (10 min @ 6000 RPM) for the *Arbacia* TIE and shipped to SAIC. The SPP prep water will be the matched site water for Sample 202: Our lab numbers 23024 (sediment) and 23030 (water).

SPP / Elutriate Preparation (October 29, 2002)

Water & Sediment Samples	Volume Sediment: Water (mL)	SPP Mix Time	SPP Settle Time	SPP TOX Vol for Mysid	SPP TSS Vol For *Arbacia*	Spin 1 Time 6000 RPM 10 min 4°C
					+ mysid	
23030 202-W-ELUT 23024 202-ELUT	4800 mL H_2O, 1200 mL Sed = 6L	11:35 – 12:05	12:05 – 13:05	≈1200	baseline.	13:50 – 14:00
	JW 10/29/02					

TIE Using Mysidopsis bahia

Science Applications International Corporation

BIOLOGICAL AND WATER CHEMISTRY DATA

Client: SAIC	Project: 02065, New Bedford TIE	SDG: 6560
Test Description: *Americamysis bahia* Acute Toxicity Test		

Temp probe T2 P25C 10/31/02 22:22

NUMBER SURVIVING

Sample	Day 0	Day 1	Day 2	Day 3	Day 4
23137 A	10	6	1	0	0
SPP B	10	8	4	3	1 ~~0~~
C-18 C	10	6	1	0	0
23138 A	10	10	10	9	9
SPIKE B	10	10	10	9	9
C-18 C	10	10	10	10	10
D					
23139 A	10	10	10	10	10
Control B	10	10	10	10	10
C-18 C	10	10	10	10	10
	10				
I/D/T	10/31/02	11/1 15:00	11/2 JG	11/3 JW	11/4

20:30

WATER CHEMISTRY DATA

	Day 0	Day 1	Day 2	Day 3	Day 4
pH	7.7			8.1	8.4
DO	8.1	6.7		7.4	7.2
Temp	20.1		25.0	24.2	24.9
Salinity	30			33	33
pH	7.6				7.1
DO	8.6				5.4
Temp	20.3			24.2	24.7
Salinity	30				32
pH	7.8				7.2
DO	7.7				4.4
Temp	~~20.4~~	25.5			24.7
Salinity	30				32
	10/31/02	11/1	11/2 JG	11/3 JW	11/4

Ammonia sample 11/4/02

20:05

NUMBER SURVIVING

Sample	Day 0	Day 1	Day 2 JG	Day 3	Day 4
23141 A	10	10	~~9~~ 10	10	10
SPP B	10	9	9	9	9
ULVA C	(1) ~~10~~ 9	9	9	8	8
23142 A	10	10	10	10	10
SPIKE B	10	9	9	9	9
ULVA C	10	10	9	9	8
23143 A	10	10	10	10	10
Control B	10	~~10~~ 9	9	9	9
ULVA C	10	9	9	9	8
D	10	~~10~~	~~10~~		
I/D/T	10/31/02	11/1 15:15	11/2 JG	11/3 JW	11/4 20:20

(1) One stuck on petri dish top

20.40

WATER CHEMISTRY DATA

	Day 0	Day 1	Day 2	Day 3	Day 4
pH	7.3				8.4
DO	6.1				7.5
Temp	20.4	24.7		24.1	24.6
Salinity	30				32
pH	7.5				7.2
DO	5.1				3.5
Temp	20.2		24.5		24.6
Salinity	30				30
pH	7.3				7.6
DO	5.2				5.9
Temp	20.4				24.7
Salinity	30				31
	10/31/02	11/1	11/2 JG	11/3 JW	11/4

Ammonia sample 11/4/02

NUMBER SURVIVING

Sample	Day 0	Day 1	Day 2	Day 3	Day 4
23145 A	10	6	5	5	3
SPP B	10	6	1	0	0
LO PH C	10	7	1	0	0
23146 A	10	10	10	10	10
SPIKE B	10	10	9	9	9
LO PH C	10	10	10	10	10
23147 A	10	10	10	10	10
Control B	10	10	10	10	10
LO PH C	10	10	10	10	10
~~D~~	~~10~~				
I/D/T	10/31/02	11/1 15:30	11/2 JG	11/3 JW	11/4 20:28

20.50

WATER CHEMISTRY DATA

	Day 0	Day 1	Day 2	Day 3	Day 4
pH	7.7			8.0	7.8
DO	not measured	6.9		7.3	6.7
Temp	21.0	24.9	24.4	24.1	24.9
Salinity	30			32	34
pH	8.6				7.5
DO	8.8				4.9
Temp	19.8			24.2	24.8
Salinity	30				32
pH	7.1				7.6
DO	8.0				7.3
Temp	20.4				24.8
Salinity	30				32
	10/31/02	11/1	11/2 JG	11/3 JW	11/4

No ammonia sample

14:30 10:00

Aquatec Biological Sciences Williston, Vermont Fed✓ Fed✓ SPPToxForms

Reviewed by: _____ Date: 11/5/02

10/31/02 22.10 - all replicates

12/6/02 All reps fed during monitoring

0 written in wrong space 11/1 + 11/2

11/4/02 FINAL CHEMS MEASURED WITH TEST CONTAINERS JUST PRIOR TO FINAL COUNTS

BIOLOGICAL AND WATER CHEMISTRY DATA

Client: SAIC	Project: 02065, New Bedford TIE	SDG: 6560
Test Description: *Americamysis bahia* Acute Toxicity Test		

NUMBER SURVIVING

Sample	Day 0	Day 1	Day 2	Day 3	Day 4
23149 A	10	9	5	0	0
SPP B	10	7	1	0	0
UNT C	10	6	0	0	0
I/D/T	10/31/02	11/1	11/2 JG	11/3 JW	11/4

21:09 15:35

WATER CHEMISTRY DATA

	Day 0	Day 1	Day 2	Day 3	Day 4
pH	7.9		8.5	8.5	—
DO	9.0	6.6	6.5	7.3	—
Temp	20.0		24.3	24.2	—
Salinity	30		30	31	—
	10/31/02	11/1	11/2 JG	11/3 JW	11/4

NUMBER SURVIVING

Sample	Day 0	Day 1	Day 2	Day 3	Day 4
23150 A	10				
SPIKE B	10				
UNT C	10				
10%					
23150 A	10				
SPIKE B	10				
UNT C	10				
25%					
23150 A	10				
SPIKE B	10				
UNT C	10				
50%					
23150 A	10	0	0	0	0
SPIKE B	10				
UNT C	10				
100%					
I/D/T	10/31/02	11/1	11/2 JG	11/3	11/4

Insufficient sample to run dilutions (10%, 25%, 50%)

One rep. only at 100%

21:10

SPIKE UNT - only enough solution for one rep - 100%

WATER CHEMISTRY DATA

	Day 0	Day 1	Day 2	Day 3	Day 4
pH					
DO					
Temp					
Salinity					
pH					
DO					
Temp					
Salinity					
pH					
DO					
Temp					
Salinity					
pH	7.6	7.8			—
DO	8.7	6.9			—
Temp	19.9				—
Salinity	30	30			—
	10/31/02	11/1	11/2	11/3 JW	11/4

NUMBER SURVIVING

Sample	Day 0	Day 1	Day 2	Day 3	Day 4
23151 A	10	10	10	10	10
Control B	10	10	10	10	10
UNT C	10	10	10	10	10
I/D/T	10/31/02	11/1	11/2 JG	11/3 JW	11/4

21:15 15:50 14:00 Fed 14:00 Fed 20:30

WATER CHEMISTRY DATA

	Day 0	Day 1	Day 2	Day 3	Day 4
pH	8.0				8.0
DO	8.2				7.3
Temp	20.5	25.2	24.5	24.2	24.9
Salinity	30				34
	10/31/02	11/1	11/2 JG	11/3 JW	11/4

Reviewed by: _____ Date: 11/5/02

BIOLOGICAL AND WATER CHEMISTRY DATA

Client: SAIC	Project: 02065, New Bedford TIE	SDG: 6560
Test Description: *Americamysis bahia* Acute Toxicity Test		

NUMBER SURVIVING

Sample	Day 0	Day 1	Day 2	Day 3	Day 4
23153 A	10	10	6	5	3
SPP B	10	7	0	0	0
STS C	10	6	0	0	0
I/D/T	10/31/02	11/1 J	11/2 JG	11/3 JW	11/4

J 21:20 15:57

WATER CHEMISTRY DATA

	Day 0	Day 1	Day 2	Day 3	Day 4
pH	7.6		8.4		8.3
DO	7.1		6.4		7.1
Temp	19.8		24.5	24.2	24.9
Salinity	30		30		32
	10/31/02 J	11/1	11/2 JG	11/3 JW	11/4 J

Ammonia sample ✓ 11/4/02 J

NUMBER SURVIVING

Sample	Day 0	Day 1	Day 2	Day 3	Day 4
23154 A	10				
SPIKE B	10				
STS C	10				
10%					
23154 A	10				
SPIKE B	10				
STS C	10				
25%					
23154 A	10	10	10	8	10
SPIKE B	10				
STS C	10				
50%					
23154 A	10	10	9	9	8
SPIKE B	10				
STS C	10				
100%					
I/D/T	10/31/02	11/1 J 15:57	11/2 JG	11/3 JW	11/4 J 20:36

Insufficient sample to run 10% or 25%. One rep only at 50% & 100%

WATER CHEMISTRY DATA

	Day 0	Day 1	Day 2	Day 3	Day 4
pH					
DO					
Temp					
Salinity					
pH					
DO					
Temp					
Salinity					
pH					7.7
DO					5.6
Temp					25.0
Salinity					32
pH	7.8				7.4
DO	8.6				6.4
Temp	20.1			24.2	25.3
Salinity	30				31
	10/31/02 J	11/1	11/2 JG	11/3 JW	11/4 J

SPIKE STS - only enough for 50% - one rep; 100% - one rep.

J 21:20

NUMBER SURVIVING

Sample	Day 0	Day 1	Day 2	Day 3	Day 4
23155 A	10	10	10	10	10
Control B	10	10	10	10	10
STS C	10	10	10	10	10
I/D/T	10/31/02	11/1 J	11/2 JG	11/3 JW	11/4 J

J 21:20 16:06 14:00 Fed ✓ 13:50 Fed ✓ 20:40

WATER CHEMISTRY DATA

	Day 0	Day 1	Day 2	Day 3	Day 4
pH	8.0				~~7.4~~ 7.9 J
DO	8.7				~~7.4~~ 7.0 J
Temp	20.3			24.1	25.1
Salinity	30				31
	10/31/02 J	11/1	11/2 JG	11/3 JW	11/4 J

BIOLOGICAL AND WATER CHEMISTRY DATA

Client: SAIC	Project: 02065, New Bedford TIE	SDG: 6560
Test Description: *Americamysis bahia* Acute Toxicity Test		

NUMBER SURVIVING

Sample	Day 0	Day 1	Day 2	Day 3	Day 4
23157 A	10	10	8	0	0
SPP B	10	7	0	0	0
EDTA C	10	6	3	0	0
23158 A	10	10	10	10	10
SPIKE B	10	10	10	10	9
EDTA C	10	10	10	10	10
23159 A	10	10	10	10	10
Control B	10	10	10	10	10
EDTA C	10	10	10	10	9
I/D/T	10/31/02	11/1	11/2 JG	11/3 JW	11/4
	21:28	16:30			20:35

WATER CHEMISTRY DATA

	Day 0	Day 1	Day 2	Day 3	Day 4
pH	7.4		8.3	8.2	
DO	8.0	6.4	6.8	7.2	
Temp	20.3	24.7		24.2	
Salinity	31		30	31	~~33~~
pH	7.8				7.5
DO	8.6				4.0
Temp	20.1		24.3		25.2
Salinity	30				32
pH	7.8				7.8
DO	8.3				6.9
Temp	20.5			24.2	25.3
Salinity	30				~~32~~ 31
	10/31/02	11/1	11/2 JG	11/3 JW	11/4

NUMBER SURVIVING

Sample	Day 0	Day 1	Day 2	Day 3	Day 4
23161 A	10	10	8	0	0
SPP B	10	9	7	0	0
FILT C	10	10	6	0	0
23162 A	10	10	10	10	10
SPIKE B	10	10	10	10	10
FILT C	10	10	10	10	10
23135 A	10	10	10	10	10
Control B	10	10	10	10	10
FILT C	10	10	10	10	9
I/D/T	10/31/02	11/1	11/2 JG	11/3 JW	11/4
	21:35	16:27			20:47

WATER CHEMISTRY DATA

	Day 0	Day 1	Day 2	Day 3	Day 4
pH	7.6			8.3	
DO	6.0			6.6	
Temp	20.3	25.1		24.2	
Salinity	31			34	32
pH	7.6				7.2
DO	8.0				4.6
Temp	19.9		24.2		25.2
Salinity	30				~~32~~ 31
pH	7.7				7.8
DO	7.4				6.8
Temp	20.5			24.2	25.4
Salinity	30				31
	10/31/02	11/1	11/2 JG	11/3 JW	11/4

NUMBER SURVIVING

Sample	Day 0	Day 1	Day 2	Day 3	Day 4
23163 A	10	10	10	10	10
Seawater B	10	10	10	10	10
C	10	10	10	10	10
I/D/T	10/31/02	11/1	11/2 JG	11/3 JW	11/4
	21:38	16:30	14:15 Fed	13:30 Fed	20:50

WATER CHEMISTRY DATA

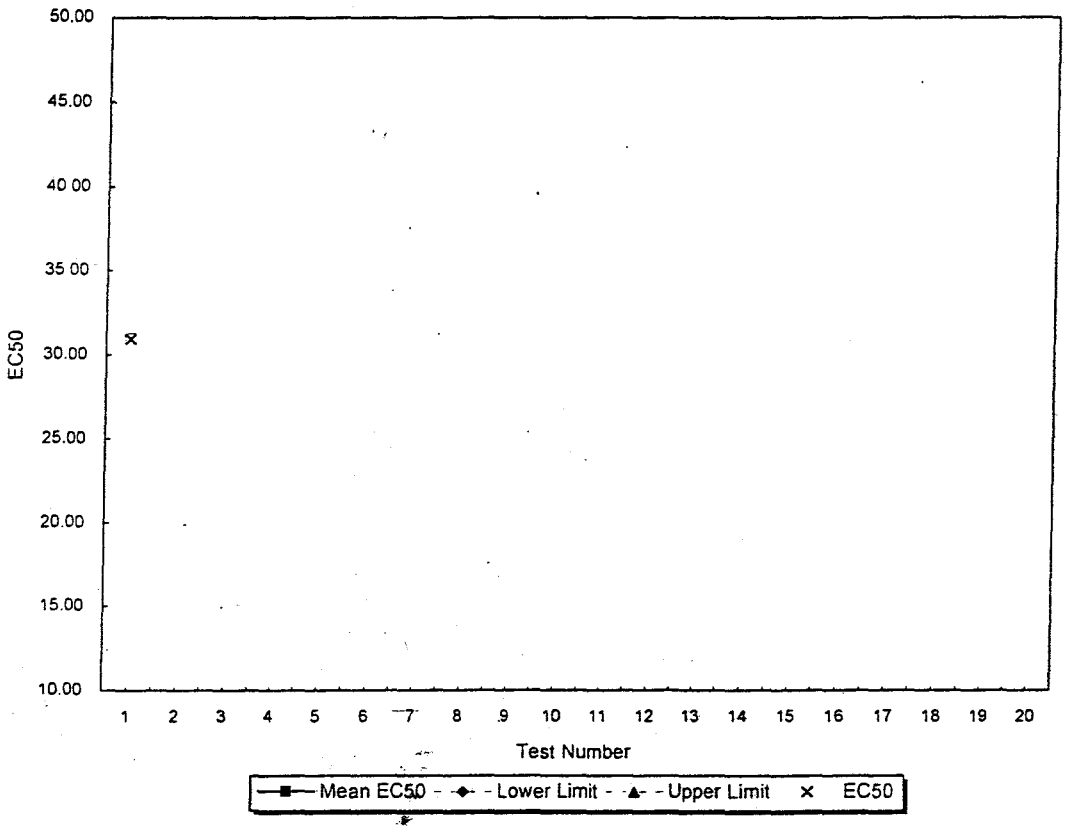
	Day 0	Day 1	Day 2	Day 3	Day 4
pH	8.0				8.0
DO	8.6				6.9
Temp	20.4			24.1	25.0
Salinity	33				31
	10/31/02	11/1	11/2	11/3 JW	11/4

Standard Reference Toxicant Control Charts

Science Applications International Corporation

Reference Toxicant Control Chart
Arbacia punctulata Embryo Development
in Copper sulfate (ug/L)

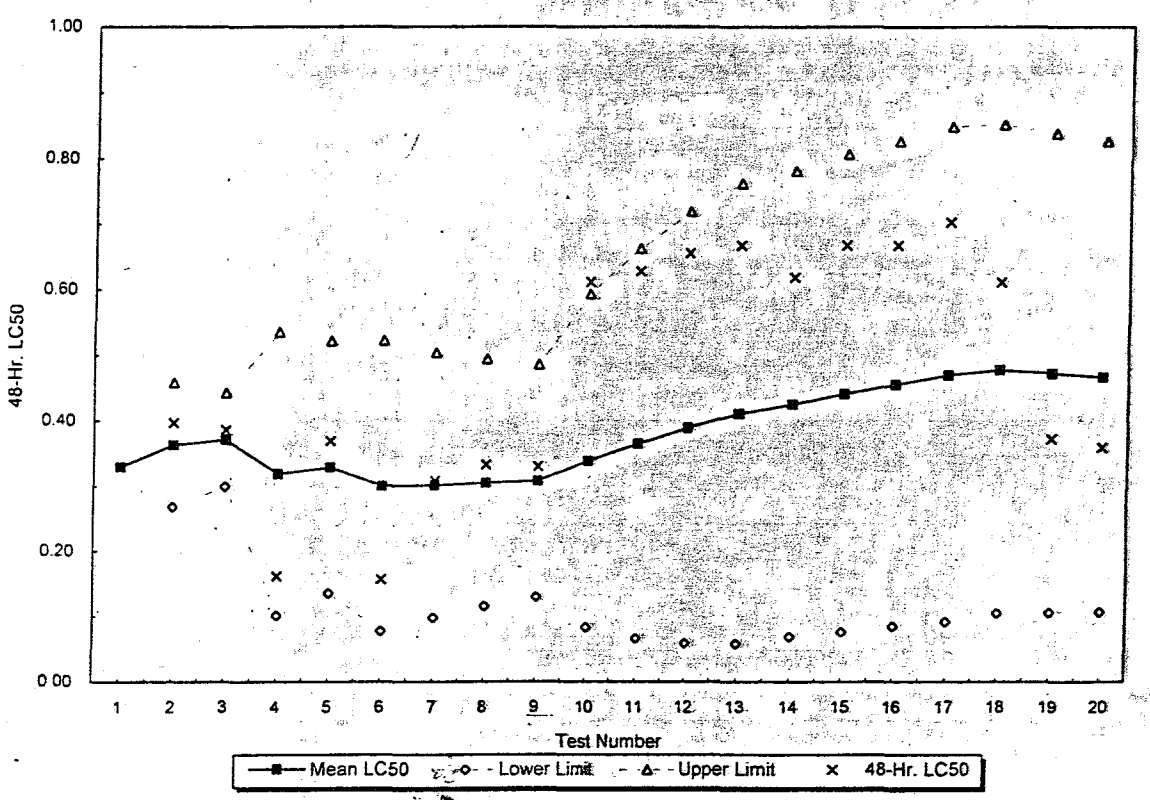
Test Number	Test Date	48-h EC50	Mean EC50	Lower Limit	Upper Limit	Organism Source
1	10/31/02	30.935	30.94			Aquatec Biological Sciences
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						



\qaqc\srts\APEmbDevCUSO

Reference Toxicant Control Chart
Americamysis bahia
in Potassium chloride (g/L)

Test Number	Test Date	Organism Age (Days)	48-Hr. LC50	Mean LC50	Lower Limit	Upper Limit	Organism Source
1	05/24/01	3	0.330	0.33			Aquatic Research Organisms
2	06/06/01	3	0.397	0.36	0.27	0.46	Aquatic BioSystems
3	07/06/01	4	0.386	0.37	0.30	0.44	Aquatic BioSystems
4	08/15/01	3	0.162	0.32	0.10	0.54	Aquatic Research Organisms
5	09/12/01	4	0.369	0.33	0.14	0.52	Aquatic BioSystems
6	10/05/01	3	0.157	0.30	0.08	0.52	Aquatic BioSystems
7	12/05/01	2	0.308	0.30	0.10	0.50	Aquatic BioSystems
8	01/04/02	2	0.333	0.31	0.12	0.49	Aquatic Research Organisms
9	01/04/01	3	0.330	0.31	0.13	0.49	Aquatic BioSystems
10	03/07/02	3	0.612	0.34	0.08	0.59	Aquatic BioSystems
11	03/19/02	2	0.628	0.36	0.07	0.66	Aquatic BioSystems
12	04/08/02	5	0.656	0.39	0.06	0.72	Aquatic BioSystems
13	04/10/02	4	0.668	0.41	0.06	0.76	Aquatic BioSystems
14	06/03/02	4	0.619	0.43	0.07	0.78	Aquatic BioSystems
15	08/15/02	5	0.668	0.44	0.08	0.81	Aquatic BioSystems
16	09/11/02	4	0.668	0.46	0.08	0.83	Aquatic BioSystems
17	09/21/02	5	0.703	0.47	0.09	0.85	Aquatic BioSystems
18	09/30/02	5	0.612	0.48	0.10	0.85	Aquatic BioSystems
19	10/18/02	4	0.373	0.47	0.11	0.84	Aquatic BioSystems
20	11/01/02	3	0.360	0.47	0.11	0.83	Aquatic BioSystems



Appendix A

Toxicity Testing Data Report and Statistical Analyses

Mysid Survival, Growth and Fecundity Test-48 Hr

Start Date:		Test ID:	NBHMYS48	Sample ID:	NBH MYS 48
End Date:		Lab ID:		Sample Type:	AMB1-Ambient water
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	AB-Americamysis bahia
Comments:	New Bedford Harbor, 48hr Americamysis bahia				

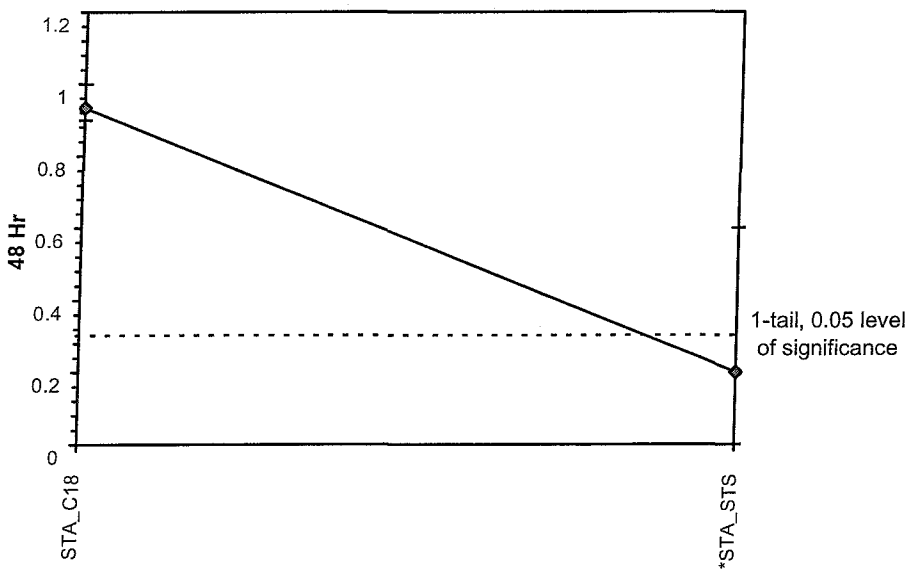
Conc-%	1	2	3
STA_C18	1.0000	0.9000	0.9000
STA_STS	0.6000	0.0000	0.0000

			Transform: Untransformed						1-Tailed	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
STA_C18	0.9333	1.0000	0.9333	0.9000	1.0000	6.186	3			
*STA_STS	0.2000	0.2143	0.2000	0.0000	0.6000	173.205	3	3.617	2.920	0.5921

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.860401	0.713	1.320255	2.03981
F-Test indicates equal variances (p = 0.05)	36	199.012		

Hypothesis Test (1-tail, 0.05)	MSDu	MSDp	MSB	MSE	F-Prob	df
Heteroscedastic t Test indicates significant differences	0.592053	0.634342	0.806667	0.061667	0.022421	1, 4

Dose-Response Plot



ToxCalc v5.0.23

Reviewed by: SP

Mysid Survival, Growth and Fecundity Test-48 Hr

Start Date:		Test ID:	NBHURC72	Sample ID:	NBH URC 72hr
End Date:		Lab ID:		Sample Type:	AMB1-Ambient water
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	AP-Arbacia punctulata
Comments:	New Bedford Harbor, 72hr Urchin Survival				

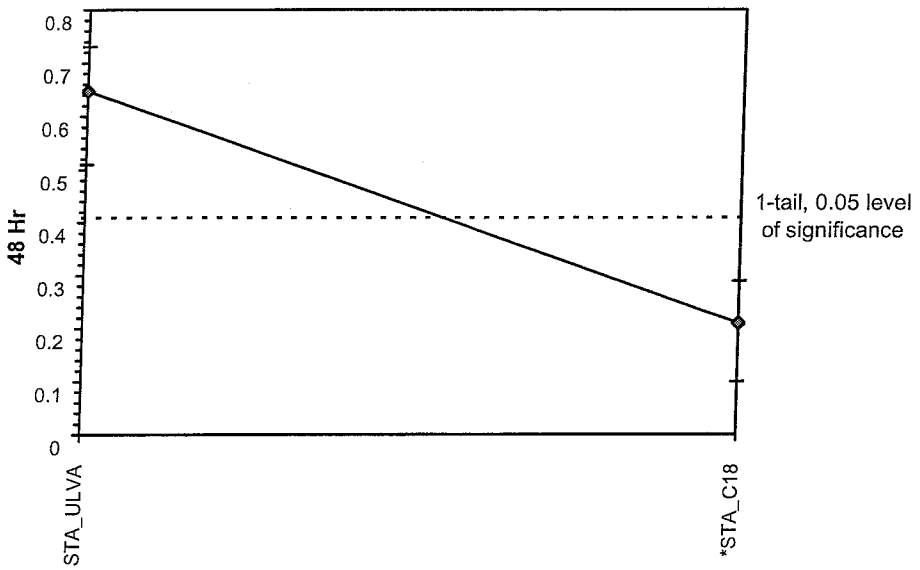
Conc-%	1	2	3
STA_ULVA	0.7300	0.7000	0.5100
STA_C18	0.1000	0.2900	0.2400

			Transform: Untransformed						1-Tailed	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
STA_ULVA	0.6467	1.0000	0.6467	0.5100	0.7300	18.449	3			
*STA_C18	0.2100	0.3247	0.2100	0.1000	0.2900	46.899	3	4.889	2.353	0.2102

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.809437	0.713	-0.83728	-1.71803
F-Test indicates equal variances (p = 0.81)	1.467354	199.012		

Hypothesis Test (1-tail, 0.05)	MSDu	MSDp	MSB	MSE	F-Prob	df
Heteroscedastic t Test indicates significant differences	0.210199	0.325049	0.286017	0.011967	0.008109	1, 4

Dose-Response Plot



ToxCalc v5.0.23

Reviewed by: SP

Mysid Survival, Growth and Fecundity Test-48 Hr

Start Date:		Test ID:	NBHURC	Sample ID:	NBH URC
End Date:		Lab ID:		Sample Type:	AMB1-Ambient water
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	AP-Arbacia punctulata
Comments:	New Bedford Harbor, Arbacia punctulata, Normal Development				

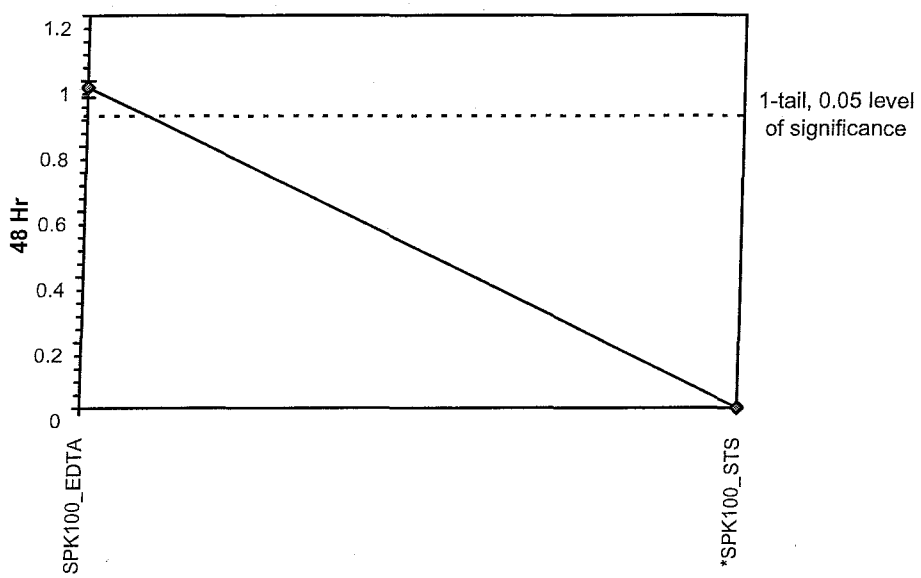
Conc-%	1	2	3
SPK100_EDTA	0.9500	0.9900	1.0000
SPK100_STS	0.0000	0.0000	0.0000

			Transform: Untransformed						1-Tailed	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
SPK100_EDTA	0.9800	1.0000	0.9800	0.9500	1.0000	2.700	3			
*SPK100_STS	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	3	64.156	2.920	0.0446

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.873051	0.713	-1.15254	2.5
Equality of variance cannot be confirmed				

Hypothesis Test (1-tail, 0.05)	MSDu	MSDp	MSB	MSE	F-Prob	df
Heteroscedastic t Test indicates significant differences	0.044604	0.045514	1.4406	0.00035	3.5E-07	1, 4

Dose-Response Plot



ToxCalc v5.0.23

Reviewed by: SP

Mysid Survival, Growth and Fecundity Test-48 Hr

Start Date:		Test ID:	NBHURCS48	Sample ID:	NBH URC 48
End Date:		Lab ID:		Sample Type:	AMB1-Ambient water
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	AP-Arbacia punctulata
Comments:	New Bedford Harbor, Arbacia punctulata, Normal Development				

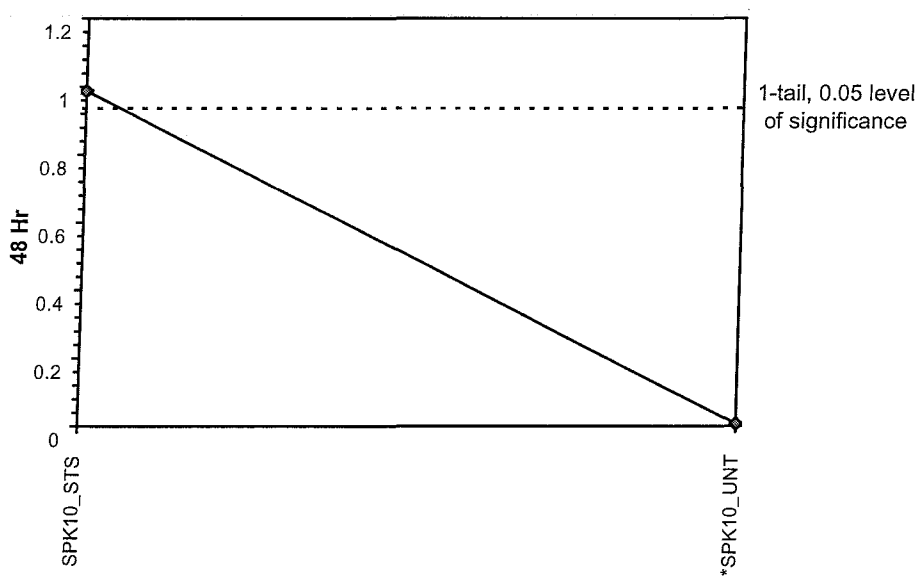
Conc-%	1	2	3
SPK10_STS	0.9900	0.9900	0.9800
SPK10_UNT	0.0100	0.0100	0.0000

			Transform: Untransformed						1-Tailed	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
SPK10_STS	0.9867	1.0000	0.9867	0.9800	0.9900	0.585	3			
*SPK10_UNT	0.0067	0.0068	0.0067	0.0000	0.0100	86.603	3	207.889	2.132	0.0100

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.639916	0.713	-0.96825	-1.875
F-Test indicates equal variances (p = 1.00)	1	199.012		

Hypothesis Test (1-tail, 0.05)	MSDu	MSDp	MSB	MSE	F-Prob	df
Heteroscedastic t Test indicates significant differences	0.01005	0.010185	1.4406	3.33E-05	3.2E-09	1, 4

Dose-Response Plot



ToxCalc v5.0.23

Reviewed by:

APPENDIX I

WATER EFFECT RATIO STUDY

Laboratory Testing In Support of Site Specific Water Quality Criteria Assessment and Hydrographic Data Collection for New Bedford Harbor

TASK 2C
WATER EFFECT RATIO STUDY

Data Report

Prepared for:

Massachusetts Coastal Zone Management Agency
251 Causeway Street, Suite 900
Boston, MA 02202

Submitted by:

Maguire Group Inc.

July 2003

Laboratory Testing In Support of Site Specific Water Quality Criteria Assessment and Hydrographic Data Collection for New Bedford Harbor

TASK 2C
WATER EFFECT RATIO STUDY

Data Report

Prepared for:

Maguire Group Inc.

Prepared by:

Science Applications International Corporation
221 Third Street
Newport, RI 02840

January 28, 2003

Water Effect Ratio Study with New Bedford Harbor Site Water

Background

Task 2C of SAIC's Site Specific Water Quality Assessment Study is to develop a "Water-Effect Ratio; WER" that can be used to derive site-specific criteria for New Bedford Harbor. Site-specific criteria can provide a more accurate assessment of risks to aquatic life through testing with ambient water, and may be less restrictive than default water quality criteria values. Currently, the applicable saltwater criteria values are 4.8 μg/L (1 hr average) for protection from acute effects and 3.1 μg/L (4 day average) for protection from more persistent exposure effects (U.S. EPA, 1995). Site specific criteria may employ an adjustment of default criteria based on the ratio of toxicity in site water versus toxicity in standard laboratory water, as prescribed by the EPA Water-Effect Ratio (WER) methods (US EPA, 2001 ;1994). The theoretical basis for the site effect is that copper may be bound in non-bioavailable forms, most notably organic ligands (DiToro et al., 2001). Water effect ratios are generally applied to effluents and/or receiving waters. In the case of the New Bedford Harbor navigation dredging project, the harbor can be considered a receiving water in the sense that it will be receiving exposure to resuspended sediment during dredging operations.

Recent Suspended Particulate Phase Testing (SPP; Task 2A) followed by a Toxicity Identification Evaluation Study (TIE; Task 2B) revealed that, in the samples tested, acute exposure to copper was likely to be most limiting water quality factor in instantaneous releases of dredged material. Findings from Tasks 2A and 2B also suggested that ammonia present a confounding factor in toxicity associated with these suspended sediments. In the TIE with suspended sediment from Station NBH-202 the sea urchin, *Arbacia punctulata,* was more sensitive than the mysid, *Americamysis bahia.* This is likely due to its relative sensitivity to both ammonia and copper.

The EPA's streamlined protocol for developing Water-Effect Ratios for copper (U.S. EPA, 2001), testing emphasizes that the species used needs to be sensitive to copper, and that the Acute Value presented in the Copper Criteria Document (in this case, the Ambient Water Quality Criteria- Saltwater Copper Addendum, US. EPA, 1995) for the chosen species has a strong technical basis. The sea urchin value presented in the 1995 Addendum is the fifth most sensitive of 26 species for which acute values are available. The EC_{50} value was derived using measured concentrations established with clean techniques, and using the most recent methodology for sea urchin larval development testing (U.S. EPA and U.S. ACE, 2002). The present study was conducted with sea urchins exposed to copper in order to determine a WER for the most limiting water quality factor associated with dredged material from New Bedford Harbor upon the instantaneous release of sediments (e.g., to proposed CAD cell sites).

Methods

Sample Collection and Testing. The study design followed procedures outlined in EPA's document for streamlined derivation of WERs for copper (2001). As in Tasks 2A and 2B, biological testing was conducted by SAIC's subcontractor, Aquatec Biological of Williston, VT, following SAIC's experimental design. New Bedford Harbor site water was collected on 16

December from an eastward-facing pier on Fish Island (Figure 1). Eight one-liter Niskin bottle samples were collect from approximately one meter off the bottom and were transferred into clean 2.5 gal. Cubitainers®. The sample was collected at 0845 EST on an outgoing tide, approximately two and one half hours prior to low tide. Site water was shipped to Aquatec in iced coolers via overnight express mail. For laboratory water exposures, Aquatec prepared GP-2 artificial seawater two days prior to use, to allow sufficient time for equilibration (U.S. EPA, 2002). Site water and GP-2 were spiked with analytical grade copper sulfate 5-hydrate (Fisher Scientific, Lot No. 986340) to result in concentrations that bracketed known effect concentrations. There was no pretreatment (e.g., filtration) of either the site water or the GP-2 formulated water. Dilutions were achieved by mixing a large volume of the highest concentration to be tested, and by using this stock to prepare serial dilutions to result in 0.7x incremental reductions in concentration. The small range in concentrations is desirable to achieve tight resolution in effect concentrations that may differ by less than a factor of two. Six concentrations were tested with each water, and the concentration in artificial water was 0.7x lower than the lowest treatment in site water. Sea urchin test methods were as described in the report for Task 2B, and gametes were obtained from the same Aquatec in-house cultures that were used in Task 2B.

ChemicalAnalyses. Each dilution was subsampled and preserved with analytical grade nitric acid on 18 December, and then overnight air-freighted to SAIC's subcontractor for analytical chemistry, Severn Trent Laboratories. These samples, representing concentrations at test initiation, were held at 4°C until they were analyzed on 11 January. A single set of measurements of copper is permissible for static testing, where the analyses is for total recoverable copper (U.S. EPA, 2001). The samples were digested by EPA SW846 Method 3010A, and were analyzed by ICP-MS using EPA SW846 Methods 6010B for total recoverable copper.

StatisticalAnalyses. As recommended in the procedures (U.S. EPA, 2001), EC_{50}s were calculated by probit analysis, using Toxcalc®, a software package available through Tidepool Software, McKinleyville, CA. Toxcalc®, was also used to determine which individual dilution treatments were different from controls, using Dunnett's test.

Results

Quality Assurance/Quality Control. All QA/QC requirements for sampling, storage and holding time limitations were achieved. Upon arrival at the laboratory, samples were inspected to determine their temperature and condition (e.g., caps in place or leakage). All samples met transit protocols. Standard chain-of-custody procedures were followed. Chain-of custody (CoC) forms were signed and copied. SAIC retains copies of the CoCs, along with test data in experiment binders and project files. Testing was initiated within 32 hrs of sample collection, well within the recommended limit of 96 hrs. Q.A. checks conducted for chemical analyses included two matrix spikes in the laboratory water treatments of 18.0 μg/L and 25.7 pg/L, and each resulted in 113% recovery. A serial dilution analysis was also conducted with digestates of the18.0 μg/L and 25.7 μg/L samples, yielding no indication of matrix interferences specific to copper. A follow-on post-digestion spike with the 25.7 μg/L sample yielded 115% recovery, consistent with the pre-digestion spikes. Measured concentrations of copper in control water were 2.1 and 2.2 μg/L for

GP-2 and site water, respectively, above the reporting limit of 1.7 μg/L. SAIC retains electronic and paper copies of Severn Trent's complete QA/QC package for analytical chemistry results.

Acceptability of Toxicity Tests. Tests were completed in accordance with all QA/QC requirements, as presented in the Inland Testing Manual (U.S.EPA/ACE, 1991) and in the Draft Regional Implementation Manual (U.S.EPA/ACE, 2002). All water quality monitoring and test condition requirements were acceptable, and control responses in both GP-2 and Site water (96.5% and 98%, respectively) exceeded the minimum requirement for 70% normal development. The test temperature was constant at 20 "1 °C, pH was constant at 7.8 "1, and the lowest dissolved oxygen, measured at the end of the 48 hr exposure, was 6.5 mg/L.

Results from Biological Testing and Chemical Analyses. Raw data from toxicity tests are presented as statistical summaries in the Appendix. Measured concentrations of copper and sea urchin larval development results for each of the dilution series are presented in Table 1. The chemistry results show that both the laboratory spiked water and the site spiked water were equivalent, with analytical measurements averaging 119% of nominal concentrations in both dilution series.

The Streamlined Water Effect Procedure (U.S. EPA, 2001) stipulates that both the study-specific laboratory water EC_{50} and the EC_{50} published in the Water Quality Criteria document should considered in deriving the WER, and the higher of the two values should be used. In the current study for New Bedford Harbor, the laboratory EC_{50} was 21.2 μg/L (total recoverable copper) and the published value was 21.4 μg/L (dissolved metal). To convert the published value to a total recoverable equivalent, a factor of 1.2 is applied (U.S., EPA, 1995), yielding a value of 25.7 μg/L. Using this value and the site water LC50 of 35.1 μg/L, the WER is 1.37.

A case can be made that it is more appropriate to use the lab water and site water results from the current tests because chemical analyses were consistent, and therefore, are more directly comparable. In this case, the WER, calculated as EC_{50} (site) / EC_{50} (tab) is 1.7 (Table 1). This is very similar to the copper WER value of 1.76 derived for New York Harbor using the *Arbacia punctulata* larval development test (SAIC, 1993). In that study, *Arbacia* and three other species were tested to derive WERs. The *Arbacia* WER was higher than the WER for mysids (1.47) and *Mulinia lateralis* (WER = 1.55) but lower than the WER for green seaweed, *Champia parvula,* the most sensitive species tested (WER = 3.23) when all four were evaluated at the same time in the same water. Based on the above results, the WER for *Arbacia* can be considered a reasonable representation of the responses to be expected over a range of test species. While only EC_{50}s are used to calculate the site-specific WERs, EC_{25}s and EC_{75}s are presented in Table 1 to show how the ratios vary over the exposure: response range. There is an apparent trend that the WER is inversely related to the magnitude of response; at concentrations nearer the response threshold (and therefore closer to the criteria values) the ratio is higher than were more severe effects were observed.

Summary of Findings and Conclusions Regarding Site Specific Water Quality Study

The WER for copper derived using the EPA Streamlined WER Procedure (U.S. EPA 2001) applied to New Bedford Harbor water is 1.4. An alternative value of 1.7, based on the results

from laboratory water tests conducted for this study may serve as an acceptable alternative WER. The selected WER value could be used as a multiplier to increase the current default 1 hr and 4 day Water Quality Criteria Values for saltwater. These values are presented as dissolved concentrations in the Ambient Water Quality Criteria Document - Saltwater Addendum (U.S. EPA, 1995).

References

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APPENDIX J

CURRENT, WATER LEVEL AND TURBIDITY

Laboratory Testing In Support of *Site Specific Water Quality Criteria Assessment and Hydrographic Data Collection for New Bedford Harbor*

TASK 3

CURRENT, WATER LEVEL, AND TURBIDITY

Data Report
and
Total Suspended Solids Data Report

Prepared for:

Massachusetts Coastal Zone Management Agency
251 Causeway Street, Suite 900
Boston, MA 02202

Submitted by:

Maguire Group Inc.

July 2003

Laboratory Testing In Support of *Site Specific Water Quality Criteria Assessment and Hydrographic Data Collection for New Bedford Harbor*

TASK 3

CURRENT, WATER LEVEL, AND TURBIDITY

Data Report
and
Total Suspended Solids Data Report

Prepared for:

Maguire Group Inc.

Prepared by:

Science Applications International Corporation
221 Third Street
Newport, RI 02840

December 31, 2002

TASK 3A AND 3B
CURRENT, WATER LEVEL, AND TURBIDITY SURVEY AND DATA REPORT

Methods

In support of numerical modeling of hydrodynamics within New Bedford harbor, two current meter arrays were deployed at sites determined to be suitable for Confined Aquatic Disposal facilities. At each site, an RD Instruments Acoustic Doppler Current Profiler measured water column currents, and a Nortek Aquadopp Acoustic Doppler Current Meter measured near-bottom currents, temperature, and turbidity (with Optical Back Scatter). The Aquadopp also collected pressure data. The shallow water site, Popes Island, was equipped with a 1200kHz ADCP set to record in 0.25m vertical bins, whereas the deeper CAD site, Channel Inner, was equipped with a 600kHz ADCP set to record in 0.5m vertical bins. ADCP data were recorded every 15 minutes, from an average of 120 individual pings, and ADCM data was recorded at the same interval, from an average of 60 seconds of continuous sampling. In addition to these two sites, water level data were obtained just outside the hurricane barrier of New Bedford, utilizing a SeaBird SBE-19 CTD recorder (which was also outfitted with an OBS sensor). Pressure was recorded by the CTD every 3 minutes, and the data were averaged to 15-minute intervals to coincide with the current measurements. Table 3-1 lists the deployment locations, dates of deployment, and instruments used at each site.

Results

Complete, 29-day records were obtained for all instruments deployed. Current data were checked for obvious spikes and errors (there were none), and the pressure and turbidity data was checked as well. There were isolated turbidity measurements that were several orders of magnitude above the mean. This is not uncommon with the Optical Backscatter Sensor, as it can give readings this high when solid matter passes through the sensing region (such as a piece of seaweed or a fish). Thus, these spurious spikes in the data (four values, constituting 0.1% of the data) were removed and replaced with values derived using linear interpolation. The data were output into ASCII text files for use by the numerical modelers and are provided on the enclosed CD.

Table 3-1. Current Meter Deployment Locations and Schedules

STATION	CHANNEL INNER	TIDE GAUGE	POPES ISLAND
EastSPM83MA	248883.39	249698.02	248836.18
NorthSPM83MA	820308.23	819390.83	821775.06
Latitude83	41.63149607	41.62318557	41.64470532
Longitude83	-70.91335844	-70.90365942	-70.91380403
Deployed	10/23/2002	10/23/2002	10/23/2002
Recovered	11/22/2002	11/22/2002	11/22/2002

ADCP (water column currents)	X		X
Aquadopp (near-bottom Currents)	X		X
Pressure	X	X	X
Temperature	X	X	X
Turbidity	X	X	X

TASK 3C
TOTAL SUSPENDED SOLIDS
DATA REPORT

Methods

In association with the hydrographic data collection plan for New Bedford Harbor, SAIC performed analyses for TSS at two stations (Pope's Island and Channel-Inner) on five sampling dates over a four week period. Collection was conducted synoptically with field tasks associated with the mooring for OBS sensors. TSS samples were also taken at the Tide Gage Station on each sampling date. Samples were collected in a Niskin bottle from a depth of 1 meter above bottom. For each station three samples were collected at each date, except on 11/1/02, when four samples were collected. Measurements were made according to standard methods (APHA, 1995): Water samples of measured volume (approximately 1 L) were filtered through pre-weighted 1 g glass fiber filters, and dried at 105 °C until a constant weight was established (≥ 24 hrs). TSS was calculated by subtraction of the filter weight from the total weight, and divided by the measured volume in liters.

Results

TSS values are presented in Table 3-2 and in Figure 3-1. With one exception, measured TSS values were all < 10 mg/L, and generally similar across the three stations, and over the four week sampling period. For replicate samples across all stations and dates the mean of all calculated standard error values was 25% (Appendix A), indicating relatively low variability associated with sampling methods. For a single date and station (Pope's Island, 11/14/02) the mean TSS values was 84 mg/L, with a high standard error associated with the three replicate samples (72%). This represents conditions at Pope's Island immediately following a rainstorm and coincident with high winds. The Pope's Island station is shallow relative to the other two stations, and therefore the spike in TSS at this station and not at the other two was expected.

Table 3-2. Total Suspended Solids (TSS) one meter from the bottom at NBH current meter deployment locations.

Average of TSS mg/L Station Name

Survey Date	Channel Inner	Popes Island	Tide Gauge
10/23/2002	9.89	6.77	
11/1/2002	4.31	4.20	2.24
1 I/6/2002	3.31	4.89	2.79
11/14/2002	5.78	84.25	3.00
11/22/2002	2.57	2.19	2.05

References

APHA, 1995. Standard Methods for the Examination of Water and Wastewater. Method 2540D. Total Suspended Solids Dried at 103-105 °C. American Public Health Association, Washington, D.C. pp. 2.56-2.57.

New Bedford Harbor Current Meter Data, October-November 2002

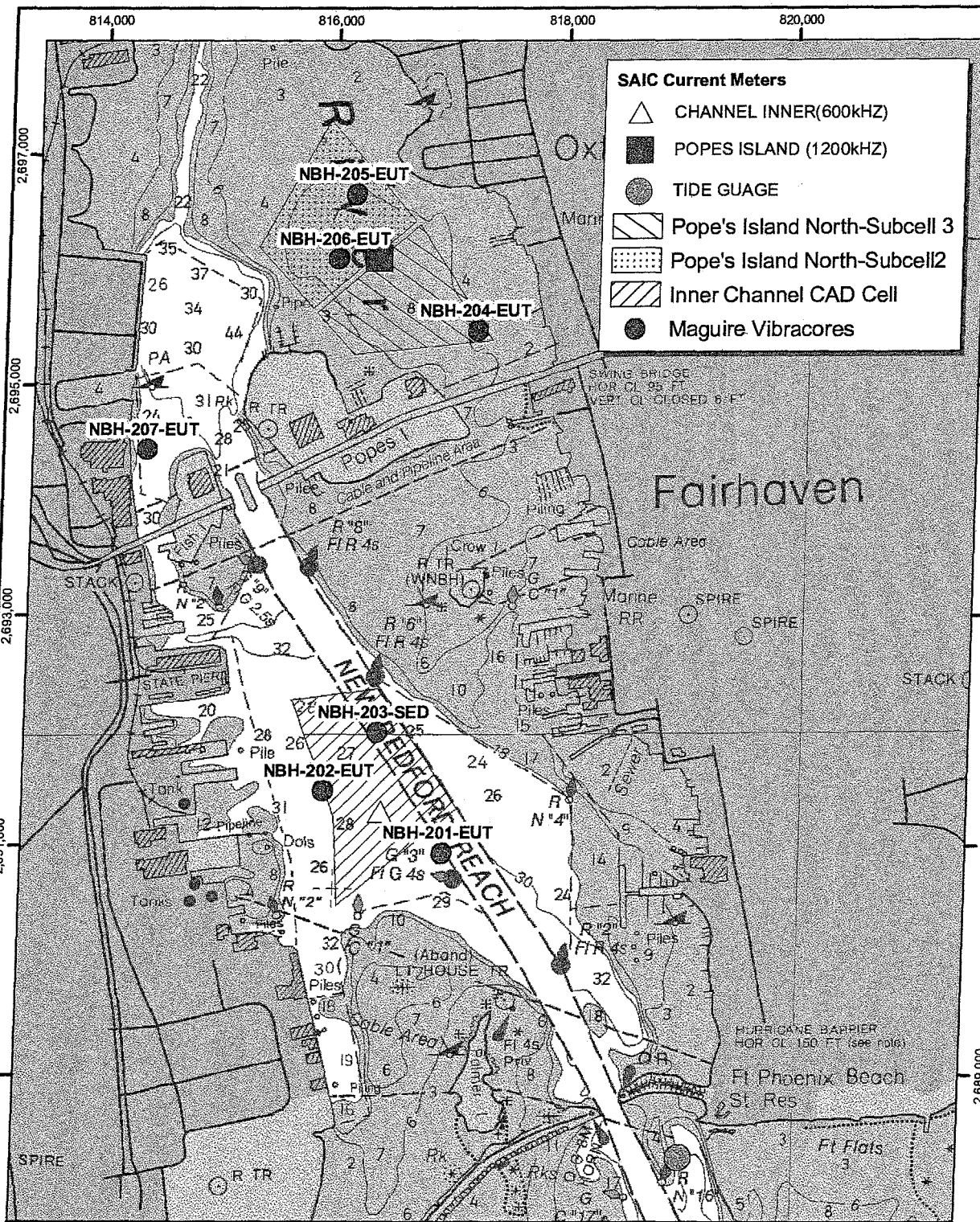
This CD contains data collected at two locations within New Bedford Harbor and one just outside of the hurricane barrier during the fall of 2002. Water column currents were collected within the harbor utilizing a 600 kHz RD Instruments Acoustic Doppler Current Profiler (ADCP) at the Channel Inner site, and a 1200kHz ADCP at the Popes Island Site. The current meters were run through standard testing by SAIC utilizing the software provided by the manufacturer to ensure proper sensor performance. For near-bottom currents, a Nortek side-looking Aquadopp Acoustic Doppler Current Meter was used at each station. Each Aquadopp instrument was equipped with a D+A Optical Backscatter Sensor (OBS), set to record at the same interval as the ADCM. The Aquadopp instruments were tested by the owner Orders and Associates prior to shipment to SAIC for deployment.

The ADCP folders contain the raw data files collected by the RDI instrument, as well as the setup files used to set the recording. It should be noted that the instrument time was incorrectly set to local time plus 5 hours (should have been 4 hours for Daylight Savings time). Thus, one hour will need to be subtracted to obtain Greenwich Mean Time for the ADCP ONLY.

The Aquadopp folders contain the setup files, and an ascii text file containing the current, pressure, temperature and OBS data. The current, pressure and temperature data have not been edited, as there were no obvious outliers. The pressure data has NOT been corrected for changes in atmospheric pressure. The OBS data contained a few individual data points that were orders of magnitude above the mean. These were most likely the result of erroneous measurements (i.e., solid matter floating in the sensor region), and were therefore removed. Although the instrument has the capability to record vertical velocities, SAIC makes no warranty on the quality of this data, as it has not been proven within the industry, and SAIC does not routinely use these data to characterize velocities.

The tide gauge folder contains the pressure, temperature, salinity and OBS measurements made just outside of the hurricane barrier. Again, the pressure data has NOT been corrected for changes in atmospheric pressure. Each folder contains an information text file with the position and depth information at each site. Positions are also listed in "NewBedfordCurrentMeterDeploy.xls". Positions are given in State Plane coordinates, Massachusetts Mainland 2001 Zone referenced to North American Datum of 1983 in meters ('EastSPM83MA') and in feet ('EastSPF83MA'), as well as in Latitude and Longitude, also referenced to NAD83.

Data on total suspended solids collected approximately one meter above the bottom at weekly intervals is contained in a Microsoft Excel spreadsheet titled "NBH total suspended sotids.xls".



SAIC
An Employee-Owned Company

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Newport, RI 02840
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www.saic-marinesciences.com

New Bedford Harbor
Current Meter Deployment Locations

0 500 1,000
Feet

Notes:
Coordinate System: MA State Plane
Zone: Mainland
Units: Feet
Datum: NAD83

N

File: NB_locations.mxd

B.D. Andrews, SAIC, 28 OCT 02

APPENDIX K

DREDGED MATERIAL TRANSPORT MODELING ANALYSIS

DREDGED MATERIAL TRANSPORT MODELING ANALYSIS IN NEW BEDFORD HARBOR

ASA Project 01-100

Prepared for:

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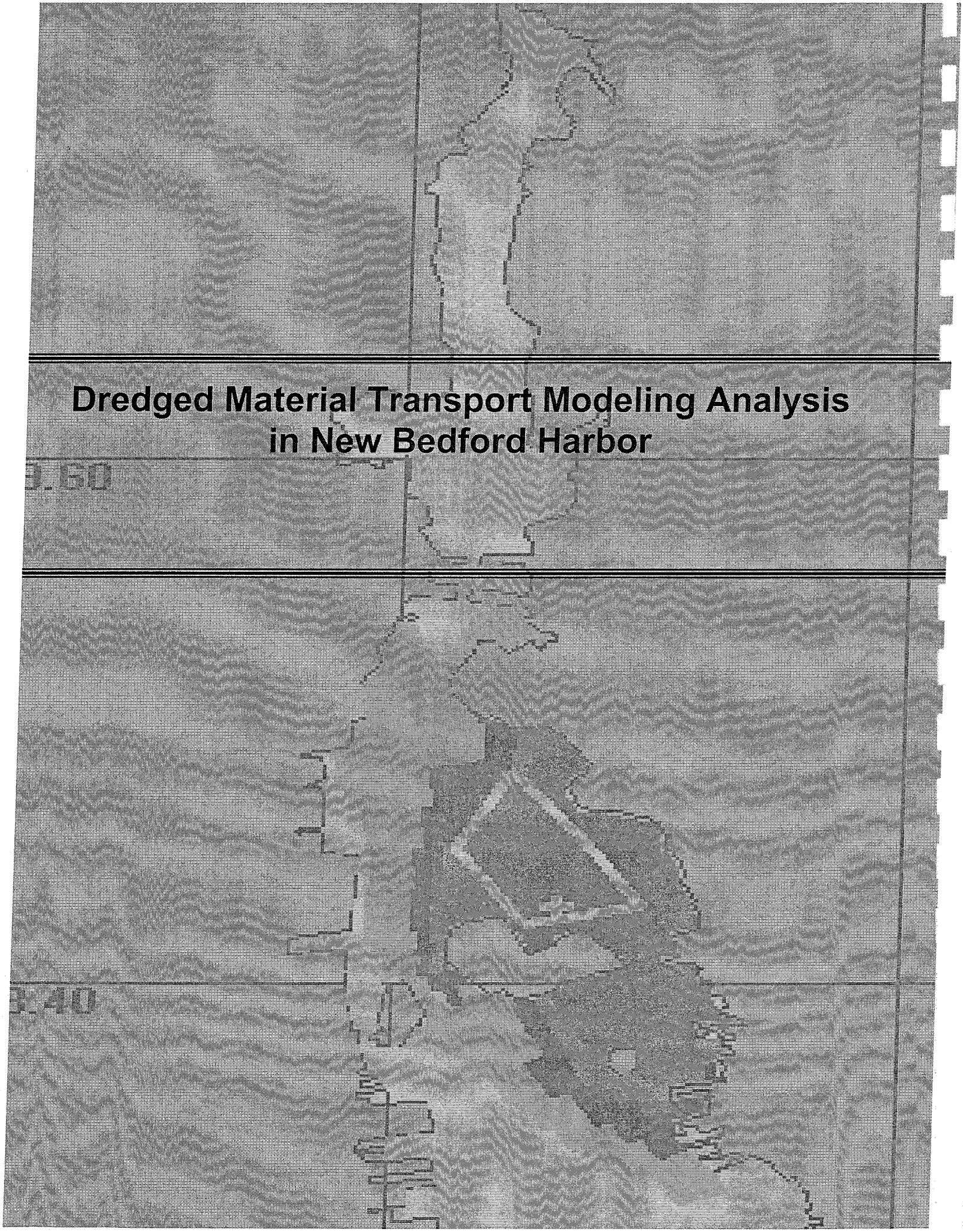
July 2003

Dredged Material Transport Modeling Analysis in New Bedford Harbor



Executive Summary

A series of computer simulations were performed to estimate the water quality from dredging and disposal operations at a proposed Confined Aquatic Disposal (CAD) site in the New Bedford Inner Harbor. The computer models BFHYDRO (Boundary Fitted Hydrodynamic model), SSFATE (Suspended Sediment FATE model), STFATE (Short-Term FATE dredged material disposal model) and BFMASS (Boundary Fitted Mass Transport model), were employed for hydrodynamic, dredging and disposal modeling, respectively.

This study consisted of two parts: 1, a field program to monitor present conditions and 2, extension of previous modeling that characterized the transport and fate of the dredged sediment and associated pollutants during disposal operations. Additional modeling of dredging operations was also conducted.

The physical field data that included surface elevations and velocities at multiple sites were examined to identify primary forces that drive the circulation in New Bedford Harbor, which was found to be winds and tides. Hydrodynamic simulations were conducted to verify the model performance during the period of the field measurement program. A set of simulations were then performed, based on the combination of three tidal ranges (neap, mean and spring) and three wind conditions (calm, southwesterly [SWS] and northwesterly [NWW]). These nine hydrodynamic conditions were used to provide three-dimensional velocity predictions to the pollutant and sediment transport model both before and after excavation of the CAD facility.

The SSFATE model was used to simulate TSS (Total Suspended Solids) concentrations due to excavation of the proposed CAD cells to be located north of Popes Island and disposal operations into the cells. Combinations of the wind-induced circulation and bathymetry were found to play a key role. When the sediment plumes were carried into the deeper sections of the Harbor, the duration and size of sediment cloud were more extensive than the case in which the sediment plumes were carried into shallower sections, where the sediment settled to the bottom more quickly.

A series of pollutant fate and transport simulations were performed to estimate the water quality impacts using BFMASS. Simulations were run using measured pollutant levels found at six representative sites for constituents whose elutriate concentrations exceeded the U. S. EPA water quality criteria. These included metals (aluminum, copper, nickel and silver), and polychlorinated biphenyls (PCBs). The dredged material disposal operation was assumed to last for 6 days with disposal taking place twice a day following the M_2 tidal cycle period of 12.42 hrs. Each release volume of dredged material was assumed to be 1,530 m^3 (2,000 yd^3), a typical barge capacity.

None of pollutant elutriate concentrations exceeded the U. S. EPA water quality acute criteria except copper (4.8 ug/L) at two stations. Al, Cu, Ni, Ag, and PCB exceed chronic levels. The dilution of elutriate concentration for PCB to meet the chronic criteria ranged between 11 and 767, Cu had the next highest required dilutions (1 to 32) followed by Al (2 to 27), Ag (14) and Ni (2). One proposed site, Station NBH-202, located at another proposed CAD site denoted

Channel Inner (CAD-CI), had the highest concentrations for all constituents. Station NBH-207, located north of Fish Island, was second highest.

The BFMASS simulation results indicated that the contaminant distribution patterns in the horizontal and vertical were similar for the three tide ranges. Concentration levels, however, were higher in the near field for neap tides than for spring tides because more energetic currents during the spring tides promote more dispersion and mixing. Different wind conditions resulted in different spatial distribution patterns and coverages. Among the nine environmental scenarios, the largest spatial coverage (area) was predicted for neap tides and calm wind conditions. The smallest coverage occurred for neap tides and northwesterly winds. This finding was consistent among three different release locations in the large PIN-CAD cell.

According to toxicity tests using sediments from the NBH-202 station sampled at CAD-CI, the combination of multiple pollutants was the cause of the observed acute toxicity effects. For example, half the toxicity to mysids was due to PCBs and the other half was due to a combination of copper and ammonia. From these results SAIC concluded a dilution to less than 2.2% of the elutriate concentration would be protective. The model results showed that for any environmental condition, area coverage for a concentration of 2.2% of the elutriate level was always smaller than the PIN-CAD area (1.67×10^5 m^2 [41 ac]). The largest area coverage (1.2×10^5 m^2 [30 ac]) of the 2.2% elutriate concentration occurred for a release during calm conditions while the smallest coverage (1.0×10^4 m^2 [2.5 ac]) occurred for a release during northwesterly winds. Other sediments with lower elutriate concentrations, and presumably lower toxicity, would affect smaller areas.

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1. Introduction

New Bedford Inner Harbor (Figure 1.1) is morphologically complex due to two contractions at the Coggeshall St. and I-95 bridges in the upper estuary and it is semi-enclosed by the Hurricane Barrier at its southern end, connecting to the Outer Harbor with a 46 m (150 ft) wide opening. The hydrodynamics are hence complicated, exhibiting circulation governed by both winds and tides. Winds in the area are distinct by season, northwesterly in winter and southwesterly in summer. The currents in the Inner Harbor are dominated by semi-diurnal tides, on the order of 10 cm/s (0.2 kt). A small tributary at the north end of the Inner Harbor is the Acushnet River. Its annual average flow is 0.54 m^3/s (19.1 ft^3/s) (Abdelrhman and Dettmann, 1995). This discharge is too small to play a role in flushing of disposed materials.

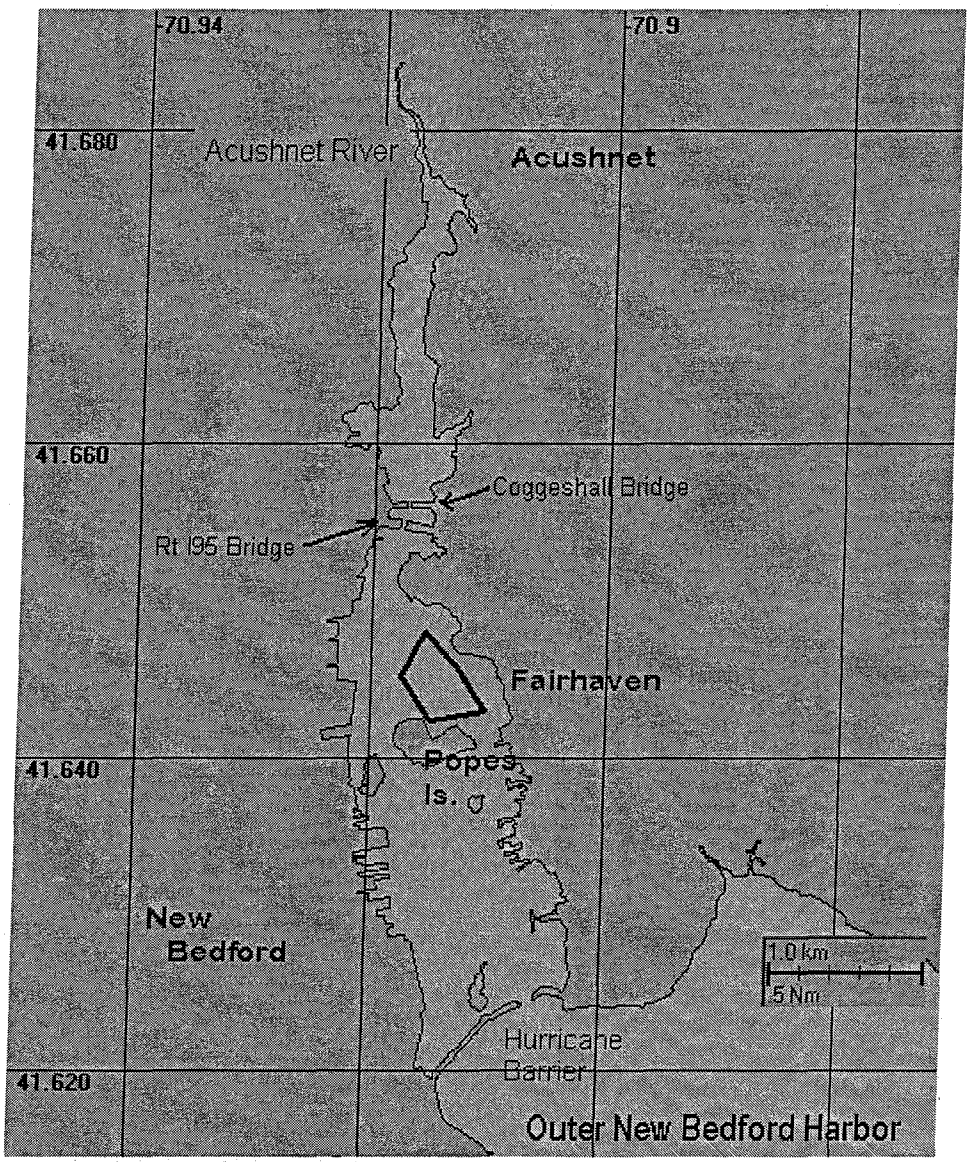


Figure 1-1. New Bedford Inner Harbor.

Applied Science Associates, Inc. (ASA)'s work reported here is part of the final draft environmental impact report for the navigation and operational dredging and disposal in Inner New Bedford Harbor, supported by Massachusetts Coastal Zone Management, and is an extension of the preliminary modeling conducted previously (ASA, 2001) to evaluate Confined Aquatic Disposal (CAD) sites at Popes Island and Channel Inner. This present work included modeling of dredging operations and the fate and transport of dredged material in the Inner Harbor. A two-phase approach was taken; first, a field program to determine present conditions and second, extension of the preliminary modeling to characterize transport and fate of the dredged sediment and associated pollutants during disposal operations.

The main purpose of field observations was to support the calibration of the hydrodynamic, sediment and pollutant transport models. Tide and current data were collected for use in the hydrodynamic calibration, sediment physical samples were obtained for use in the dredging modeling, and elutriate concentrations of sediment contaminants were collected to determine source strengths for the fate and transport modeling. Details of the field observations are presented in section 2.

The modeling phase was composed of three parts: 1. hydrodynamic modeling, 2. dredging operation modeling, and 3. fate and transport modeling of disposed material. Models employed for the individual tasks were ASA's BFHYDRO (Boundary Fitted Hydrodynamic model), SSFATE (Suspended Sediment Fate model), and BFMASS (Boundary Fitted Mass Transport Model). A 3-D BFHYDRO application was used to simulate the vertical structure of horizontal currents. SSFATE was employed to estimate the fate of material released during dredging operations. BFMASS was used to model dissolved fractions of pollutants (metals and PCBs) found in the sediments to be dredged so that comparison of predicted concentrations to water quality criteria could be made. Details of modeling work are documented in sections 3 through 5.

During the course of the study, the dredging modeling was focused on the construction of the Popes Island CAD site and disposal of dredged material into it. There are two types of dredging (and therefore disposal) projects planned in New Bedford Harbor that are classified by dredging volume: 1) small projects run by private, state or local government where dredging volume is on the order of 30,600 m^3 (40,000 yd^3) per project; and 2) a large project by the federal government to dredge substantially more than 30,600 m^3 (40,000 yd^3). Since the large scale dredging operations in the navigation channel are thus far not defined, the next largest dredging operation is the excavation of the CAD cells. The CAD site north of Popes Island is composed of one large and five small cells, with potential storage capacities of 1,408,000 m^3 (1,841,000 yd^3) and 36,800 m^3 (48,100 yd^3), respectively.

2. Field Program and Data

Data considered here derive from a field survey conducted by Science Applications International Corporation (SAIC) in New Bedford Harbor from 23 October through 22 November 2002. Current speed and direction, surface elevation and optical backscatter were measured continuously throughout the study period at two locations in New Bedford Harbor: the Popes Island and Channel Inner stations (Figure 2-1, Table 2-1). This was accomplished through the deployment of Acoustic Doppler Current Profilers (ADCPs) and Acoustic Doppler Current

Meters (ADCMs) at each of these two locations. Surface elevation and optical backscatter were also monitored at the Tide Gauge station, located outside of New Bedford Harbor, using a tide gauge and an Optical Backscatter Sensor (OBS). In addition to the long term instrument deployments, a series of water samples were taken at each of the three stations mentioned above to measure suspended sediment concentrations. A set of surface grab samples were obtained from eleven locations within the study area and analyzed to provide sediment grain size composition. Finally, elutriate analyses were performed on sediment samples from three locations at the proposed Channel Inner CAD site, two locations at the proposed Popes Island CAD site, and one location northwest of Fish Island in the Inner Harbor to determine levels for a number of pollutants.

Table 2-1. Location of stations from field survey.

Station Name	Latitude (°N)	Longitude (°W)	Data Types
Channel Inner	41.6315	70.9134	elevation, currents, OBS
Tide Gauge	41.6232	70.9037	elevation, OBS
Popes Island	41.6447	70.9138	elevation, currents, OBS
NBH-201 (CAD-CI)	41.6305	70.9114	elutriate
NBH-202 (CAD-CI)	41.6320	70.9152	elutriate
NBH-204 (CAD-CI)	41.6430	70.9106	elutriate
NBH-205 (CAD-PI)	41.6462	70.9146	elutriate
NBH-206 (CAD-PI)	41.6447	70.9151	elutriate
NBH-207 (Fish I)	41.6402	70.9210	elutriate

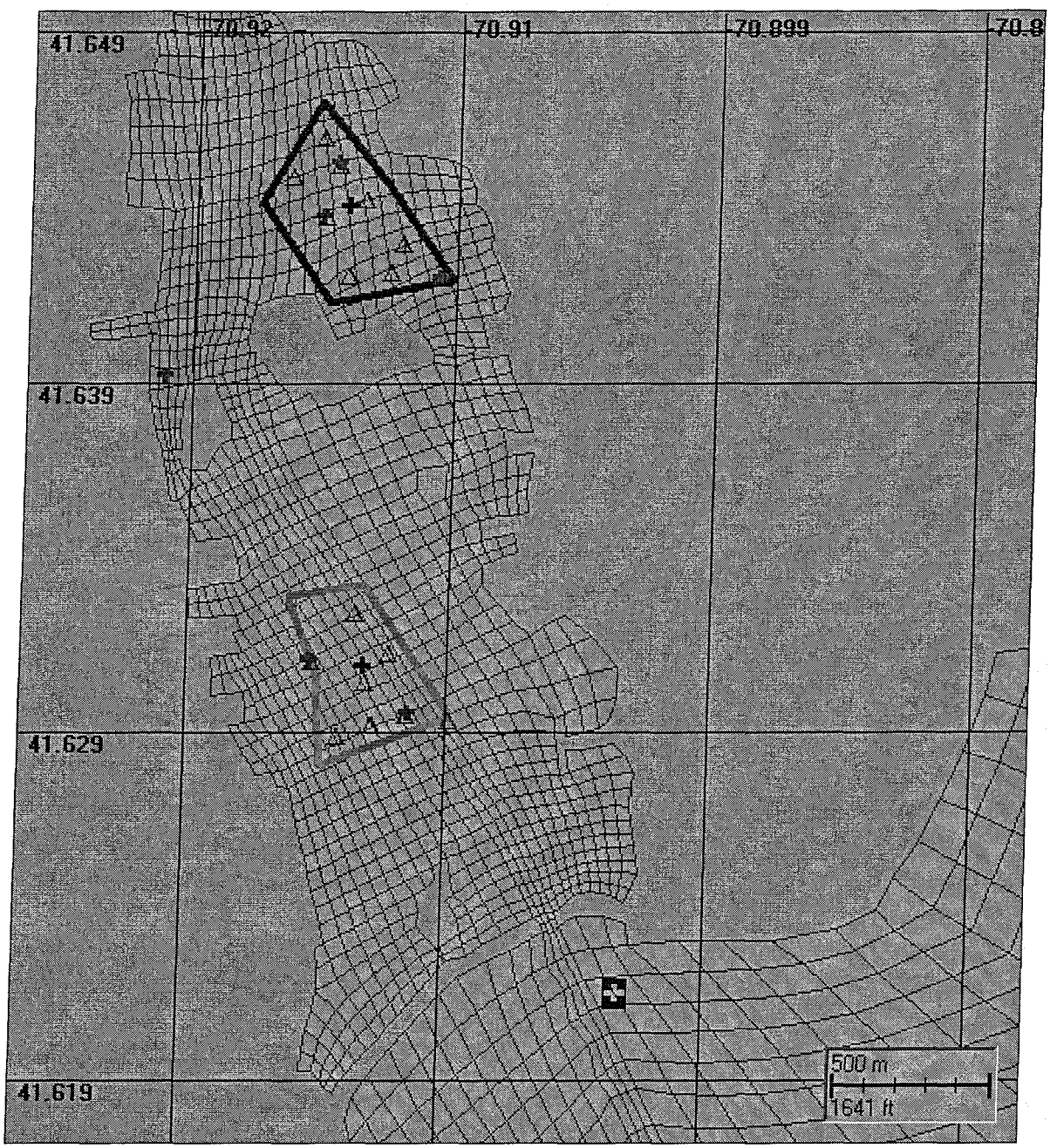


Figure 2-1. Distribution of two long term deployment stations (black crosses), eleven sediment sampling sites (blue triangles), and six elutriate analyses locations (red crosses). Popes Island (blue polygon) and Channel Inner (green polygon) CAD sites are also shown. Grid of model cells shown is explained in Section 3.

2.1 Tides

Variations in sea surface elevation were measured at three stations within the study area. For convenience, these time series are shown relative to mean sea level (Figure 2-2). Pressure gauges on the ADCMs deployed at the Popes Island and Channel Inner stations recorded total

pressure from the water column and atmosphere at 15 minute intervals. These data were corrected for atmospheric pressure and then demeaned to give variations relative to mean sea level shown in the figure. Sea surface elevation was measured outside of New Bedford Harbor at the Tide Gauge station. A tide gauge was used to record total pressure due to atmospheric pressure and water column height at 15 minute intervals. As with the ADCMs, these data were corrected for atmospheric pressure and demeaned to give variations relative to mean sea level.

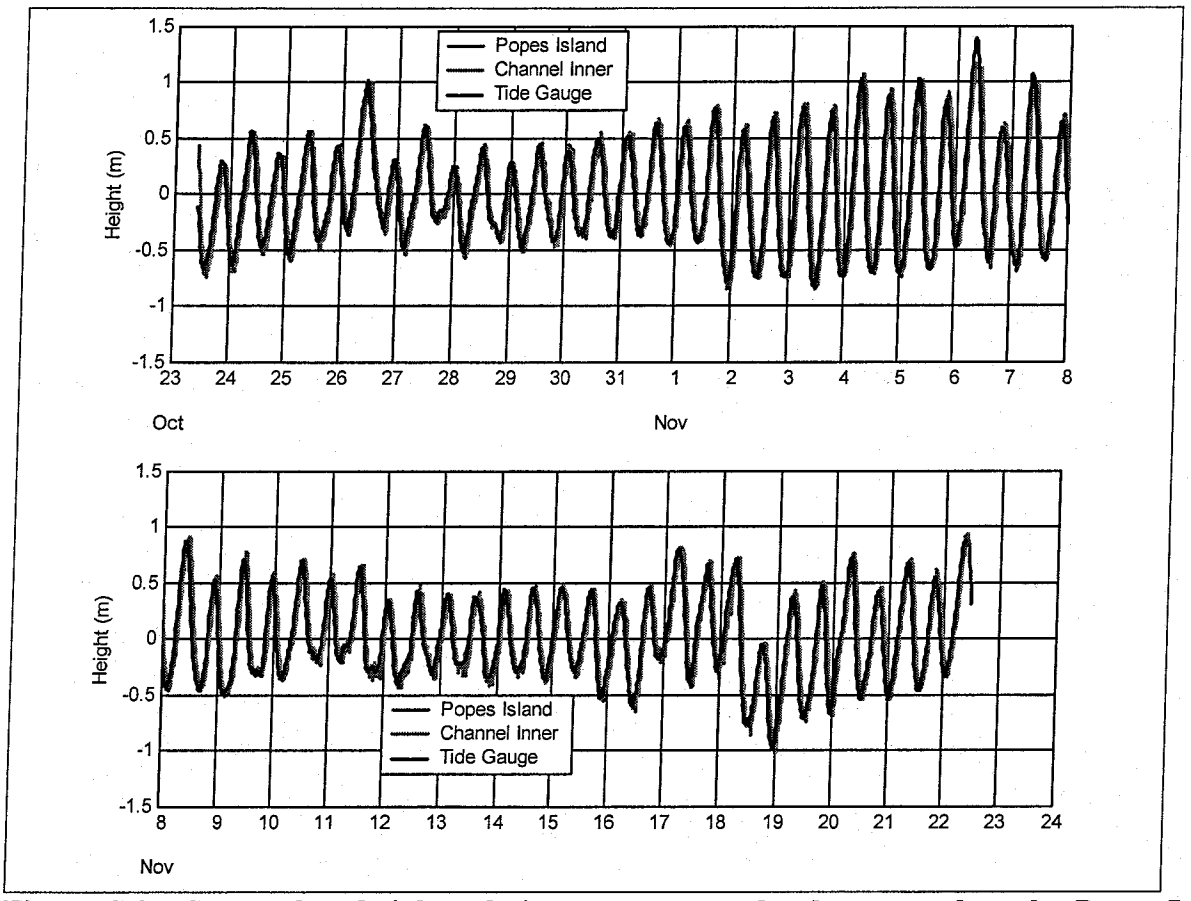


Figure 2-2. Sea surface height relative to mean sea level measured at the Popes Island (blue), Channel Inner (red) and Tide Gauge (black) stations during the study period.

The sea surface height record was dominated by the semi-diurnal tidal signal, which has a period of 12.42 hr and an amplitude of approximately 1 m (3.3 ft) at this location. Periodic low frequency deviations from a simple semi-diurnal signal are due to the spring–neap cycle, while brief excursions from this smooth envelope (e.g., 17-19 November) most likely reflect storm events. The records at all three stations are very strongly correlated, with the signal showing little lag or attenuation between stations.

2.2 Currents

Horizontal currents were measured throughout the water column at the Popes Island and Channel Inner stations using ADCPs from RD Instruments. A 1200 kHz instrument was used at the Popes Island site, with a bin size of 0.25 m (0.8 ft), while a 600 kHz instrument, with a bin size

of 0.50 m (1.6 ft), was used in the deeper waters at the Channel Inner site. The ADCPs recorded velocities at 15 minute intervals. The resulting data was subsequently low-pass filtered using a 5-hr window. To better resolve currents near the bottom, an Aquadopp ADCM was deployed in conjunction with each ADCP. Positioned approximately 0.6 m (2 ft) above the seafloor, or about one third of the distance to the first bin of ADCP data, the ADCMs recorded velocities at the bottom of the water column at 15 minute intervals. These data were low pass filtered with a 5-hr window.

The net flow of water at a given location can be estimated by considering the average current velocity over the entire depth of the water column. Depth-averaged currents at the Popes Island site were predominantly to the southeast during the study period, though periods of flow to the north did occur during flood tides (Figure 2-3). Depth-averaged currents had a mean speed of 2.3 cm/s (0.08 ft/s) to southeast, with a maximum value 15.0 cm/s (0.49 ft/s) during this period.

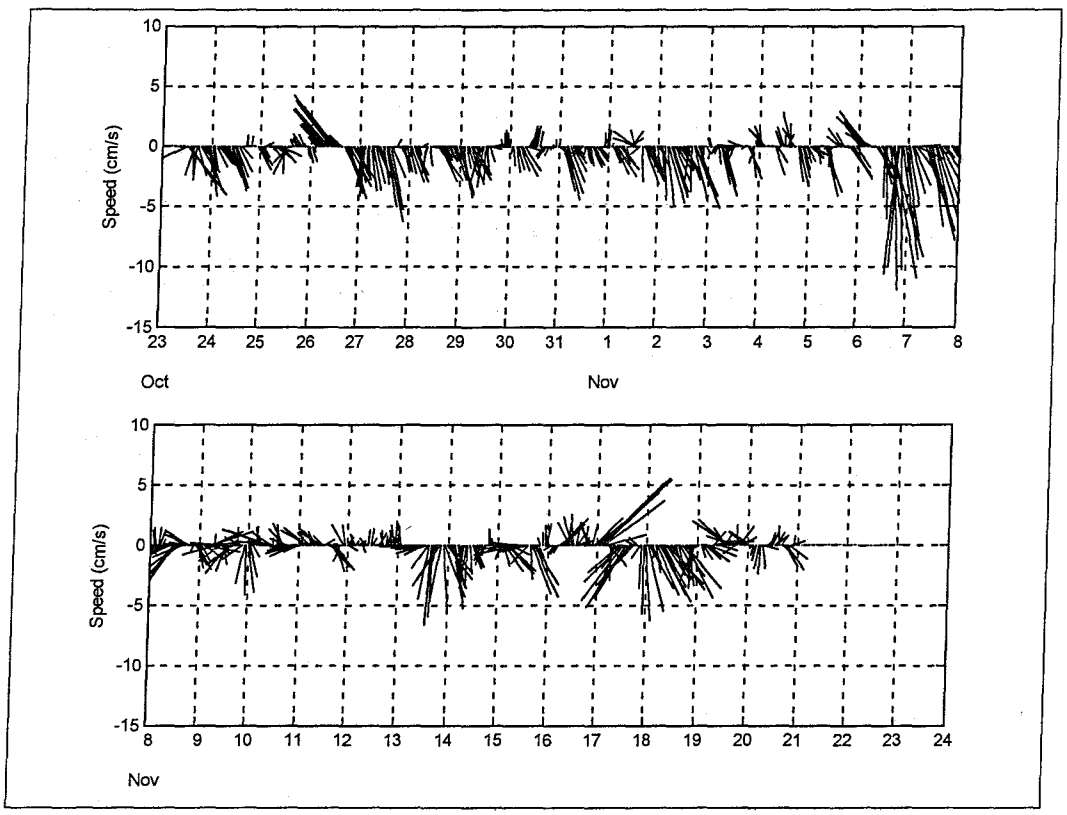


Figure 2-3. Depth averaged current velocities at the Popes Island station. Individual vectors point in the direction the current is moving to (e.g., a vertical line pointing upwards indicates flow from south to north). The length of each vector is proportional to the current speed. The data have been subsampled at hourly intervals for clarity.

Currents at the Popes Island site exhibited little vertical structure during the study period as shown by the vertical bands of color shown in Figures 2-4 and 2-5. The relatively shallow water precluded large variations in currents over the water column. Maximum velocities over the period reached approximately 5 cm/s (0.16 ft/s) to the east, 7 cm/s (0.23 ft/s) to the west, 5 cm/s (0.16 ft/s) to the north and 10 cm/s (0.33 ft/s) to the south.

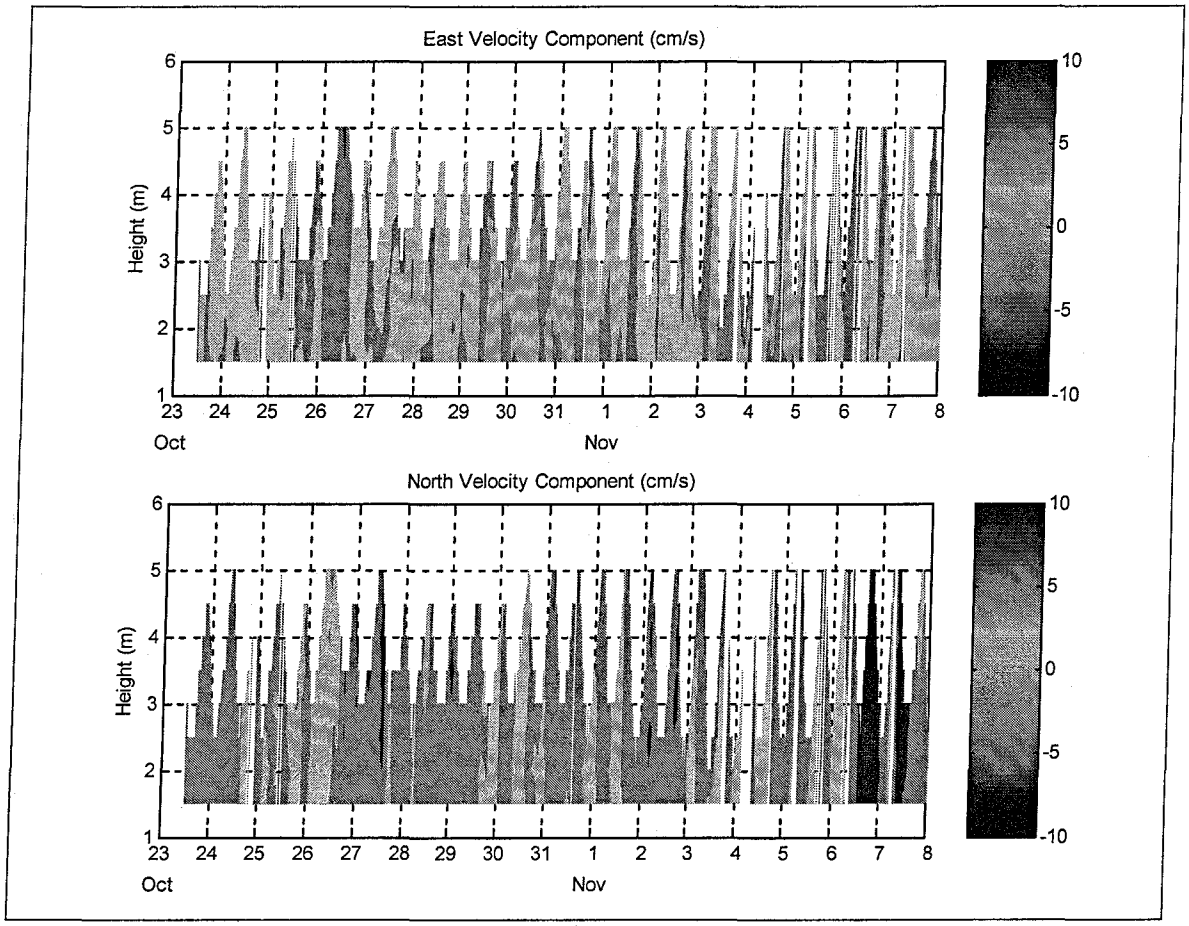


Figure 2-4. Vertical structure of east (top) and north (bottom) components of current velocity at the Popes Island station for the period from 23 October through 8 November 2002.

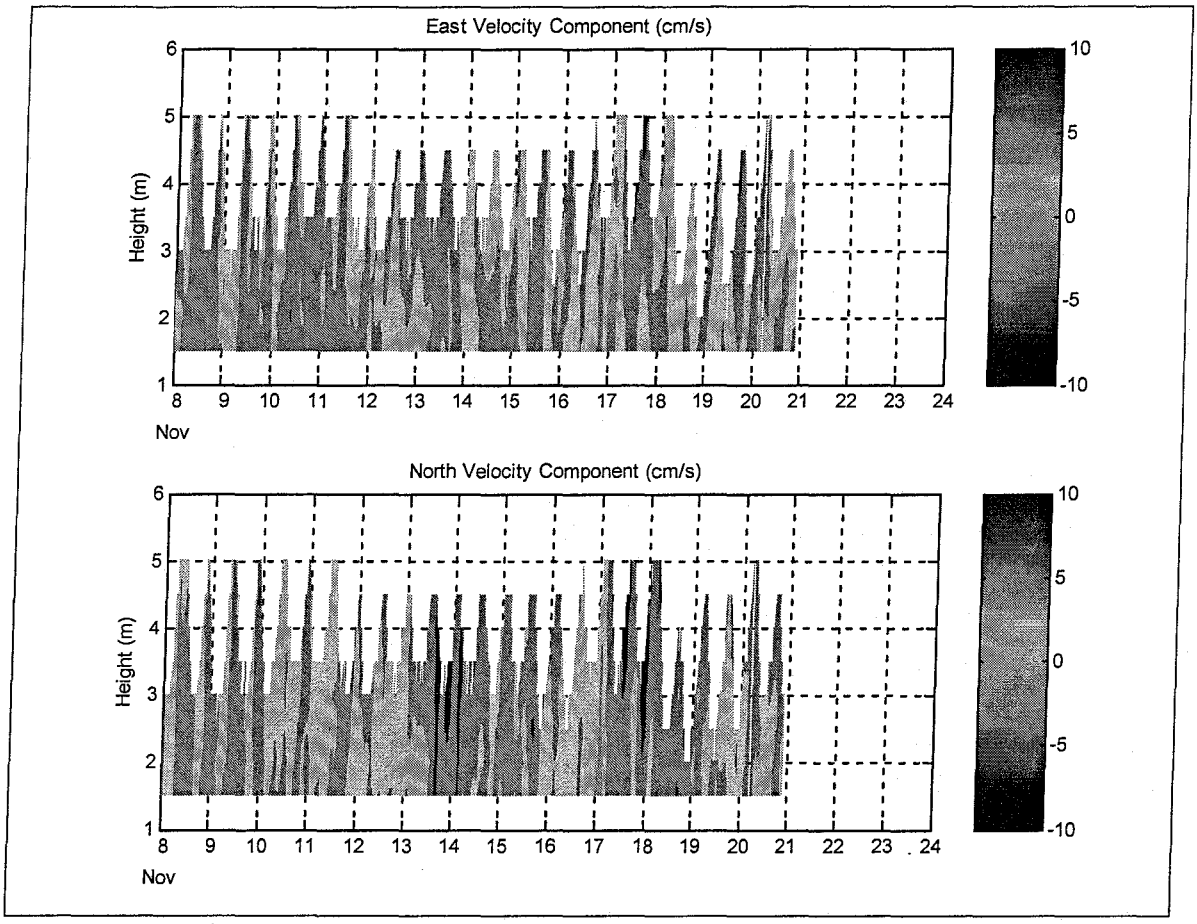


Figure 2-5. Vertical structure of east (top) and north (bottom) components of current velocity at the Popes Island station for the period from 8–24 November 2002.

Currents near the bottom of the water column at Popes Island differed little from those observed in the rest of the water column. A comparison of the currents observed by the ADCM to the deepest currents observed by the ADCP reveals only small differences (Figures 2-6 and 2-7). The average current speed recorded by the ADCM during this period was 2.2 cm/s (0.072 ft/s), with a maximum value of 8.3 cm/s (0.27 ft/s). The average speed for the deepest current measured by the ADCP was 2.3 cm/s (0.75 ft/s), while the maximum was 10.4 cm/s (0.34 ft/s).

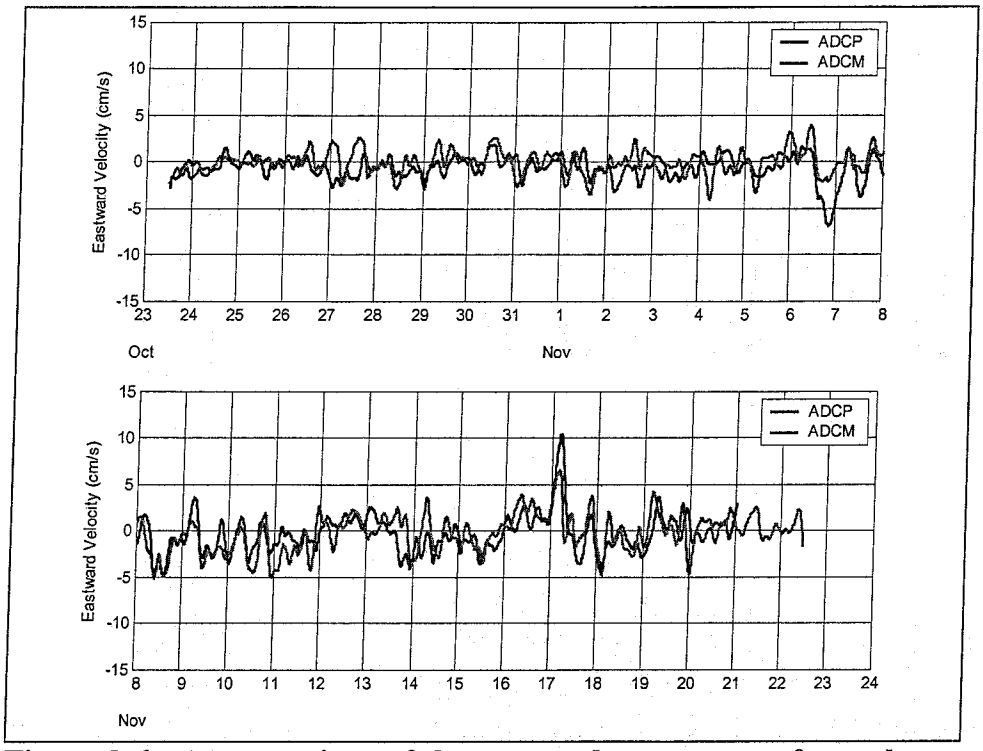


Figure 2-6. A comparison of the eastward component of near bottom current velocity as measured by the ADCP (blue) and the ADCM (red) at the Popes Island station.

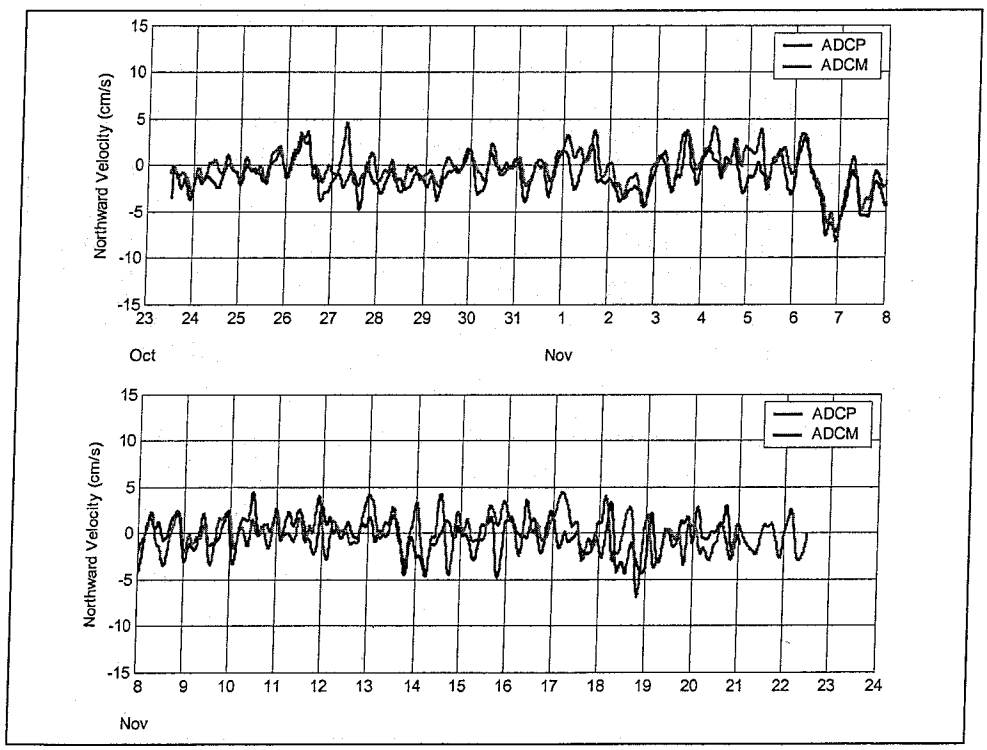


Figure 2-7. A comparison of the northward component of near bottom current velocity as measured by the ADCP (blue) and the ADCM (red) at the Popes Island station.

At the Channel Inner site, depth-averaged currents showed a regular variation in response to the tides (Figure 2-8). Flow to the south during ebb tide appeared slightly stronger and more sustained than the northward flow observed during flood tide. Depth-averaged currents averaged 4.0 cm/s (0.13 ft/s), with a maximum value 16.3 cm/s (0.53 ft/s) during the study period.

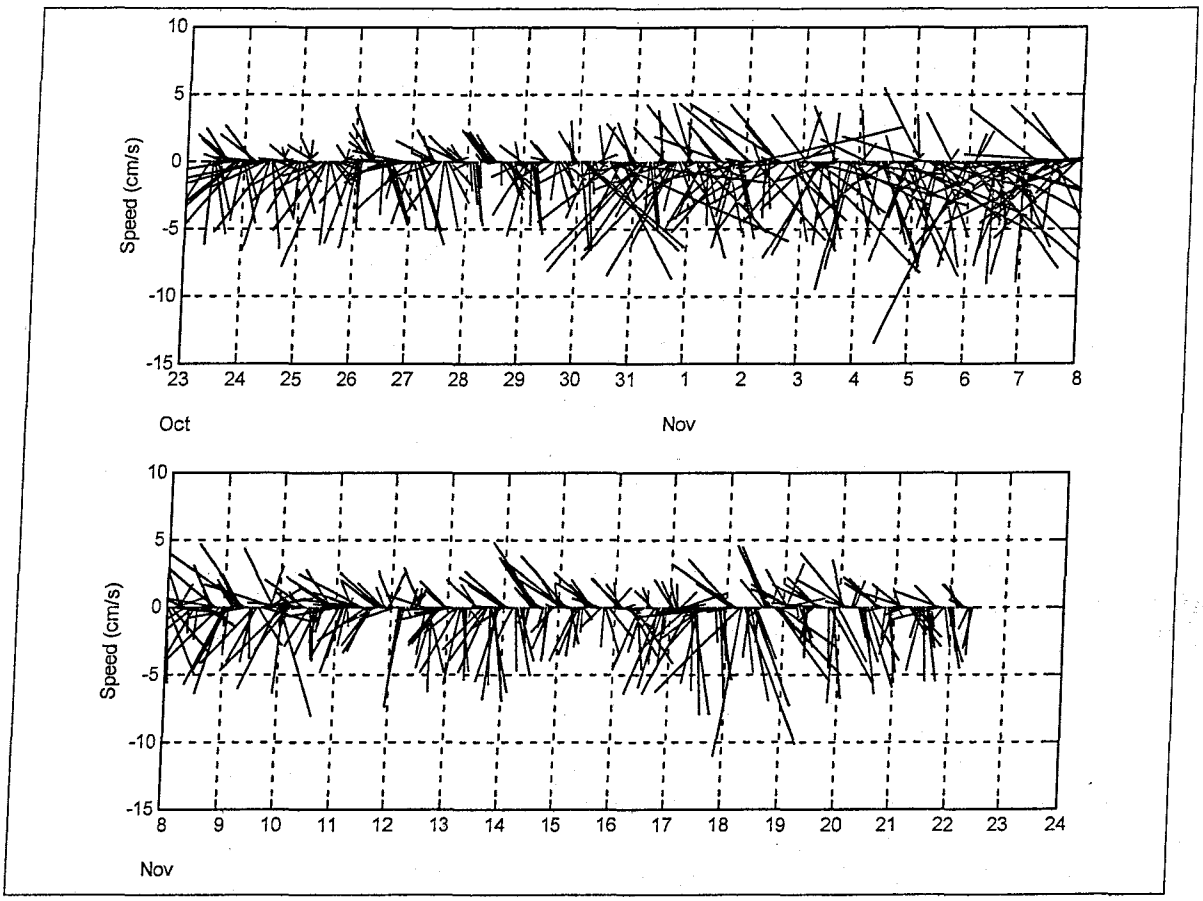


Figure 2-8. Depth averaged current velocities at the Channel Inner station. Individual vectors point in the direction the current is moving to (e.g., a vertical line pointing upwards indicates flow from south to north). The length of each vector is proportional to the current speed. The data have been subsampled at hourly intervals for clarity.

Horizontal currents at the Channel Inner site exhibited substantial vertical structure over the course of the study period (Figures 2-9 and 2-10). This is particularly evident in the north velocity component. At the surface, flow tends toward the south, particularly during ebb tide, while at the same time flow at depth is predominantly toward the north.

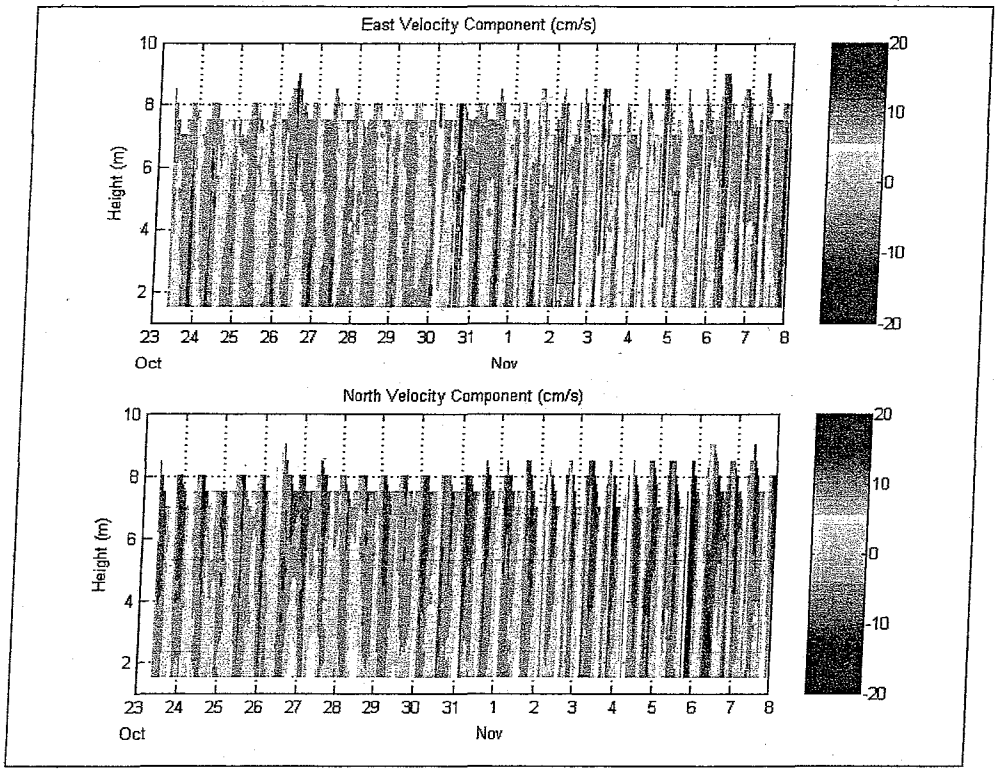


Figure 2-9. Vertical structure of east (top) and north (bottom) components of current velocity at the Channel Inner station for the period from 23 October through 8 November 2002

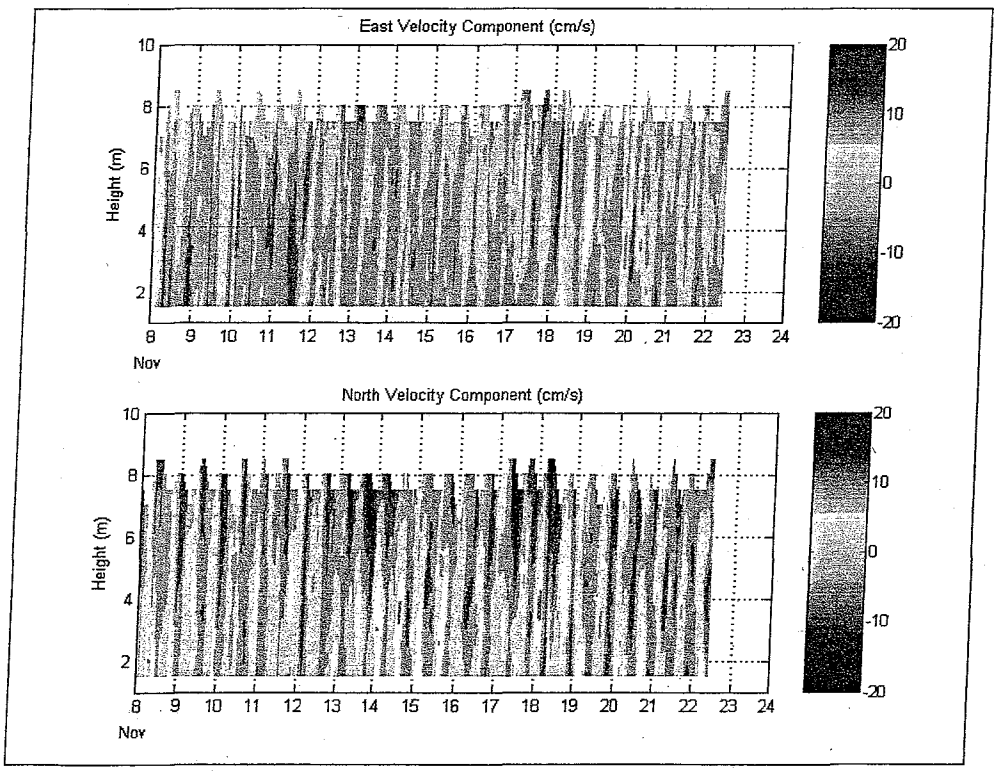


Figure 2-10. Vertical structure of east (top) and north (bottom) components of current velocity at the Channel Inner station for the period from 8–24 November 2002.

A comparison of the currents observed by the ADCM to the deepest currents observed by the ADCP shows the most significant difference to be a slight decrease in current speed near the bottom (Figures 2-11 and 2-12). The average current speed recorded by the ADCM during this period was 3.0 cm/s (0.098 ft/s), with a maximum value of 11.0 cm/s (0.36 ft/s). The average speed for the deepest current measured by the ADCP is 4.0 cm/s (0.13 ft/s), while the maximum was 15.2 cm/s (0.50 ft/s)

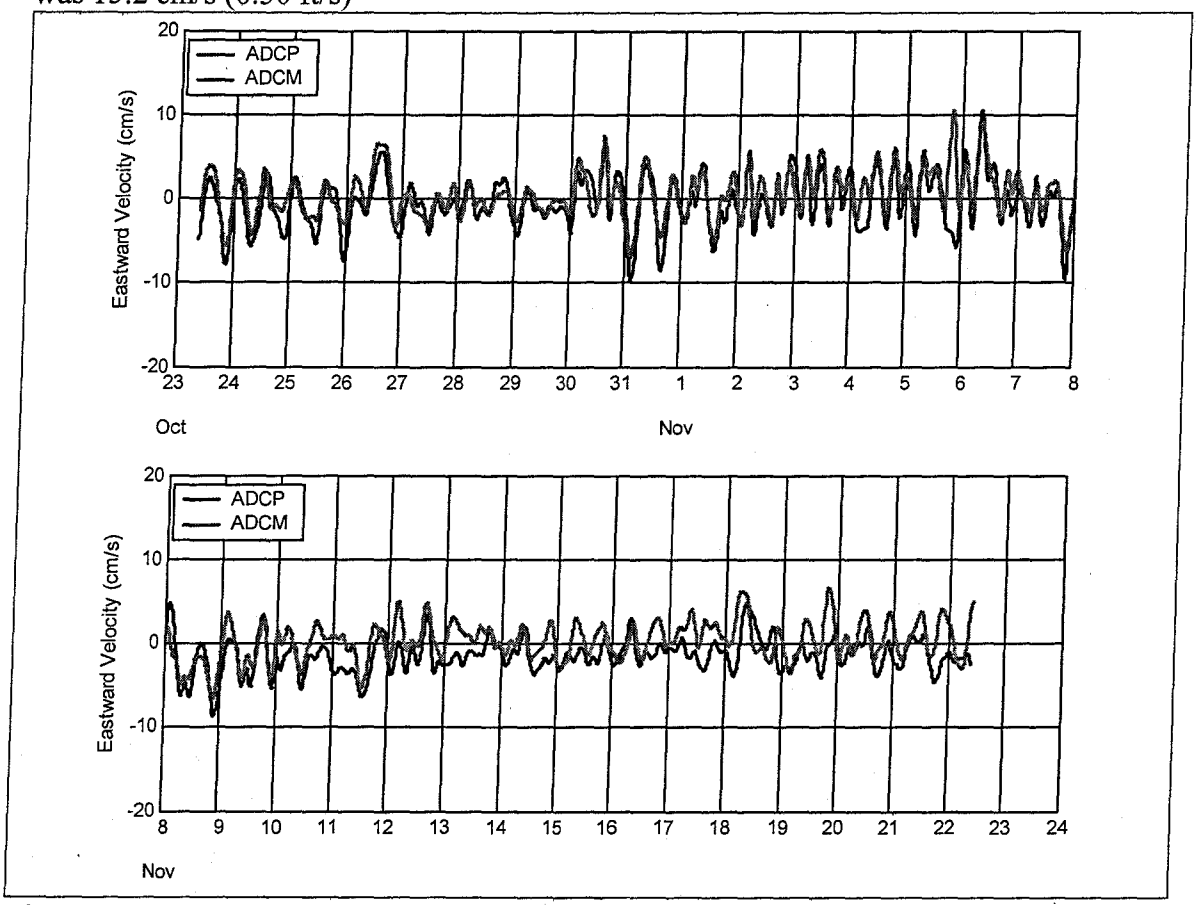


Figure 2-11. A comparison of the eastward component of near bottom current velocity as measured by the ADCP (blue) and the ADCM (red) at the Channel Inner station.

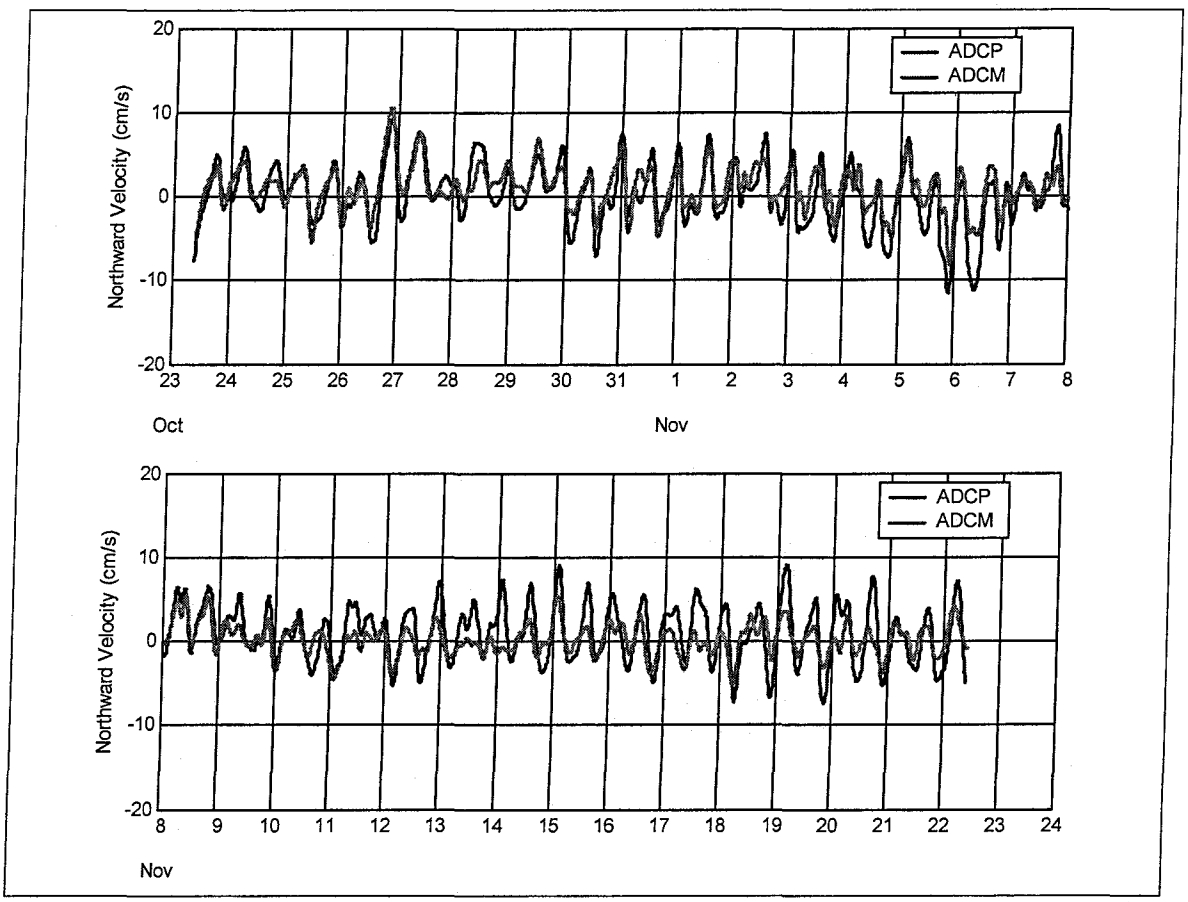


Figure 2-12. A comparison of the northward component of near bottom current velocity as measured by the ADCP (blue) and the ADCM (red) at the Channel Inner station.

2.3 Total Suspended Sediments

Optical backscatter was measured continuously at each of the three long-term deployment stations using D+A Optical Backscatter Sensors (OBSs). At the Popes Island and Channel Inner stations the OBSs were part of the ADCM instrument package, while at the Tide Gauge station it was a separate instrument. Optical backscatter was measured at 15 minute intervals at all three locations. Measurements of optical backscatter were generally low, averaging 2.7 (Nephelometric Turbidity Units (NTU) at Popes Island, 9.1 NTU at Channel Inner and 4.3 NTU at the Tide Gauge station. Deviations from these values were typically sudden spikes to extremely high values, with optical backscatter measurements reaching values of as much as 291.6 NTU (Popes Island), 448.0 (Channel Inner) and 210.0 (Tide Gauge). These excursions were short lived, lasting a few hours at most, except for one event lasting almost a day at Channel Inner. The Channel Inner station also experienced significantly larger and more frequent events than either the Popes Island or the Tide Gauge station.

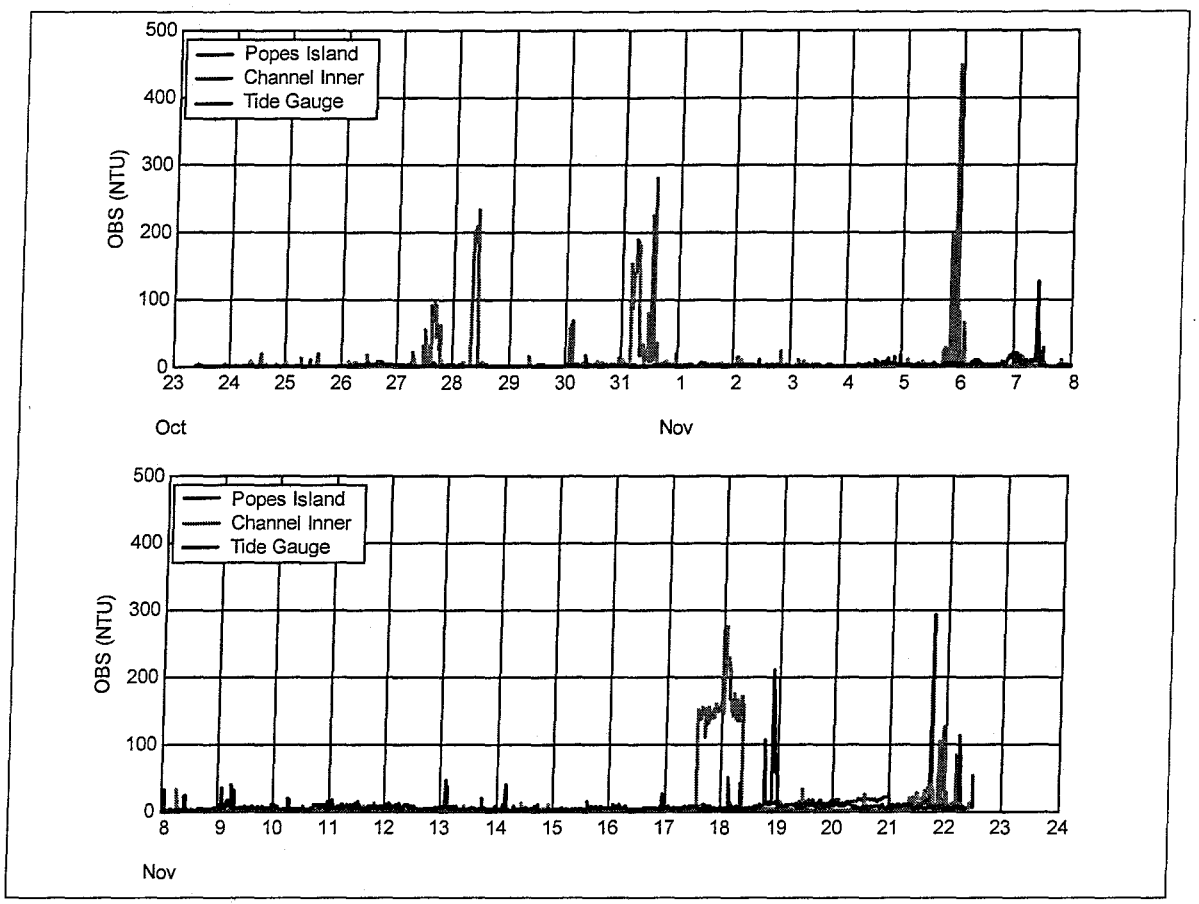


Figure 2-13. Optical backscatter measured at the Popes Island (blue), Channel Inner (red) and Tide Gauge (black) stations during the study period.

In order to relate optical backscatter to sediment levels in the water column, measurements of total suspended sediment (TSS) concentrations were made at the three station locations on five occasions during the study period (Table 2-2). Multiple samples were taken at a height of approximately 1 m (3.3 ft) above the seafloor on each occasion. Mean values of the three samples of TSS are compared to OBS measurements at the corresponding site at the same time in Figure 2-14.

Table 2-2. Total suspended sediment sampling schedule. Times are given as Local Standard Time (LST).

	Date				
Site	**23 Oct**	**1 Nov**	**7 Nov**	**14 Nov**	**22 Nov**
Popes Island	9:50	8:58	13:50	8:50	11:30
Channel Inner	11:50	9:15	13:00	9:10	9:38
Tide Gauge	11:00	9:30	15:00	9:30	8:50

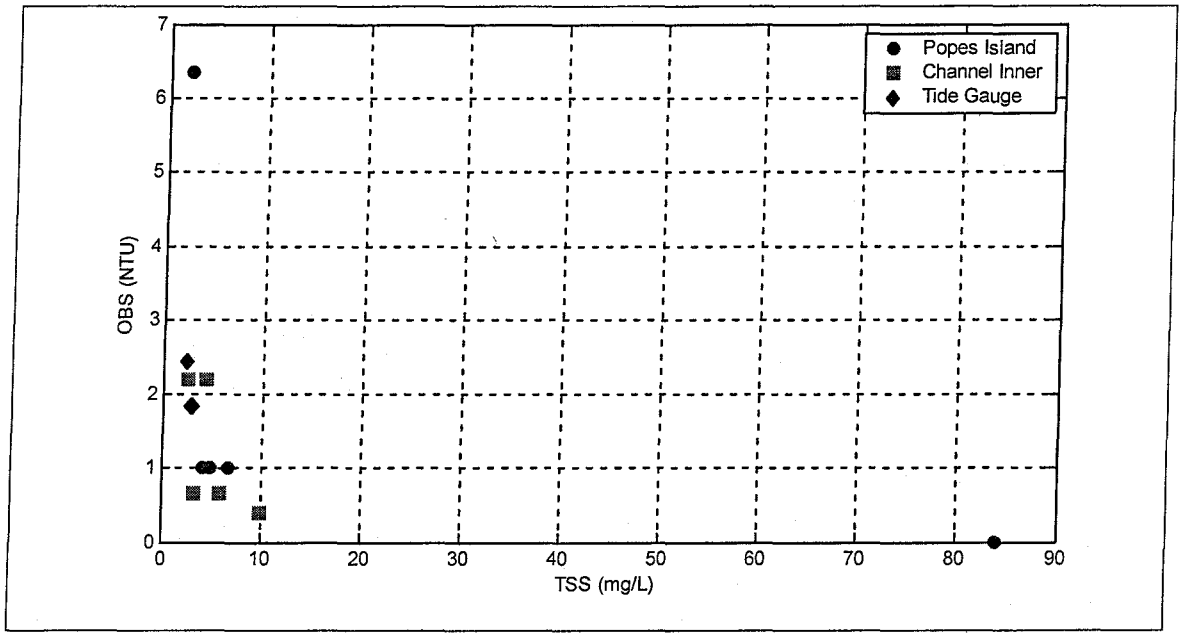


Figure 2-14. Optical backscatter plotted against total suspended sediment for the Popes Island (blue), Channel Inner (red) and Tide Gauge (black) stations.

2.4 Chemistry

Elutriate tests are performed to estimate the release of soluble contaminants during dredging operations. A combination of 20 sediment and 80% site water is mixed and allowed to settle. The liquid is then analyzed for contaminant concentrations. The protocol was designed to mimic the initial concentration levels when sediments are released in the water column (Averett, 1989). Elutriate analyses were performed on samples from six stations within Inner New Bedford Harbor to determine background pollutant levels (Table 2-3 and Figure 2-1) and reported in SAIC (2002). Aluminum, copper, nickel, silver and Total PCBs registered above the chronic exposure levels established by the United States Environmental Protection Agency (EPA) at all sites for which analyses were performed. Lead exceeded chronic exposure levels at the NBH-202 station, Benzo(b)fluoranthene exceeded chronic exposure levels at the NBH-202 and NBH-207 stations, and Benzo(k)fluoranthene exceeded chronic exposure levels at NBH-202, NBH-205, NBH-206 and NBH-207. In addition, acute exposure levels were exceeded for aluminum at NBH-202 and NBH-207, and for copper at NBH-201, NBH-202, NBH-205, NBH-206 and NBH-207. Stations NBH-202, a CAD Channel Inner site, and NBH-207, the Fish Island site, showed generally higher concentrations than the other sites.

Table 2-3. Results of elutriate analyses from the NBH Water Quality Study. Values given in bold red italics exceed chronic exposure levels as established by the EPA (chronic and acute values are listed to the right).

		Station (NBH-)						EPA Criteria	
Class	Analyte	201	202	204	205	206	207	Chronic	Acute
MET	Aluminum	***161*** B	***2320***	***577***	***346***	***216***	***853***	87	750
MET	Antimony	3.50 U	3.50 U	3.50 U	3.50 U	3.50 U	5.80 B		
MET	Arsenic	5.20 B	18	3.80 B	24	13	5.10 B	36	69
MET	Cadmium	0.30 U	0.45 B	0.30 U	0.30 U	0.30 U	0.30 U	9.3	43
MET	Chromium	4.60 U	35	4.60 U	4.60 U	4.60 U	10	50	1100
MET	Copper	***7.10*** B	***98***	***4.00*** B	***11*** B	***7.10*** B	***39***	3.1	4.8
MET	Iron	214	2630	587	218	212	995		
MET	Lead	1.10 U	***13***	1.10 U	1.10 U	1.10 U	1.10 U	8.1	220
MET	Manganese	2.50 U	2.50 U	27	2.50 U	2.50 U	2.50 U		
MET	Mercury								
MET	Nickel	***14*** U	***14*** U	***14*** U	***14*** U	***14*** U	***14*** U	8.2	74
MET	Silver	***1.40*** U	***1.40*** U	***1.40*** U	***1.40*** U	***1.40*** U	***1.40*** U	0.1	1.9
MET	Zinc	6.90 U	40	6.90 U	6.90 U	6.90 U	16 B	81	90
PAH	Benzo(b)fluoranthene	0.02 J	***0.14***	0.02 J	0.03	0.04	***0.11***	0.04	0.38
PAH	Benzo(k)fluoranthene	0.02 J	***0.14***	0.01 J	***0.03***	***0.03***	***0.07***	0.02	0.17
PCB	Total PCBs	***1.72***	***23***	***0.34***	***0.88***	***1.22***	***5.69***	0.03	10

Units: µg/L.
Data Qualifiers: "B" (metals) Contract Detection Limit but > Instrument Detection Limit; "J" = estimated (result is between 1/2 reporting limit (RL) and RL); "U"=not detected above reporting limit.
Total PCBs - Sum PCB congeners (8, 18, 28, 44, 52, 66, 101, 105, 118, 128, 138, 153, 170, 180, 187, 195, 206, 209) x 2; list of congeners analyzed by NOAA Status and Trends Program (listed in NOAA, 1993; revised NOAA, 1998).

3. Hydrodynamic Modeling

3.1 Water Circulation in New Bedford Harbor Estuary

The objective of hydrodynamic simulations was to provide characteristic circulation patterns in New Bedford Harbor for use in the subsequent pollutant and sediment transport modeling. This section documents the following tasks that were conducted:

- Examine the field elevation and velocity data to identify primary forces that drive the circulation in New Bedford Harbor (section 3.2).
- Perform hydrodynamic simulations for the period of the field program to verify model performance (section 3.3).
- Produce typical circulation patterns that reflect various tidal and wind conditions most likely encountered (section 3.4).

3.2 Driving Forces of Water Circulation in New Bedford Harbor

SAIC conducted an extensive hydrographic survey from 23 October to 22 November 2002, as part of the field program described in Section 2. Figure 3.1 shows energy spectrum distributions of the surface elevations collected at the three long-term deployment stations (See Figure 2-1). In general, an energy spectrum distribution reveals the relative significance of the basic driving forces. Each driving force is associated with a particular frequency band or period. There are

super tidal (less than 4 hrs), tidal (4 to 24 hrs), and sub-tidal (longer than 30 hrs) periods. Typically the magnitude increases steadily as frequency decreases and sharp spikes in tidal frequency band indicate a particular tidal constituent is present in the data.

Figure 3-1 shows that the semidiurnal tide (M_2) is the primary cause of elevation variation. Secondary components, which are of nearly equal magnitude, are M_4 (shallow tide), K_1 (diurnal tide), and sub-tidal forces. The sub-tidal forces are likely attributed to weather phenomenon (wind stress and atmospheric pressure). All stations (Hurricane Barrier [HB], Channel Inner [CI], and Popes Island [PI]) show almost identical profiles, except that station HB falls off more sharply at periods shorter than ~2 hours. Details of the relative significance among tidal constituents are exhibited in Figure 3-2. Very little difference exists among the three stations. The amplitude of the semidiurnal constituents (M_2, for example) increase by ~1% in the Harbor relative to outside the Hurricane Barrier and their phases lag by ~1 hour. Likewise, phases of diurnal constituents (K_1 for example) lag by ~45 minutes, however their amplitudes reduce by ~2%.

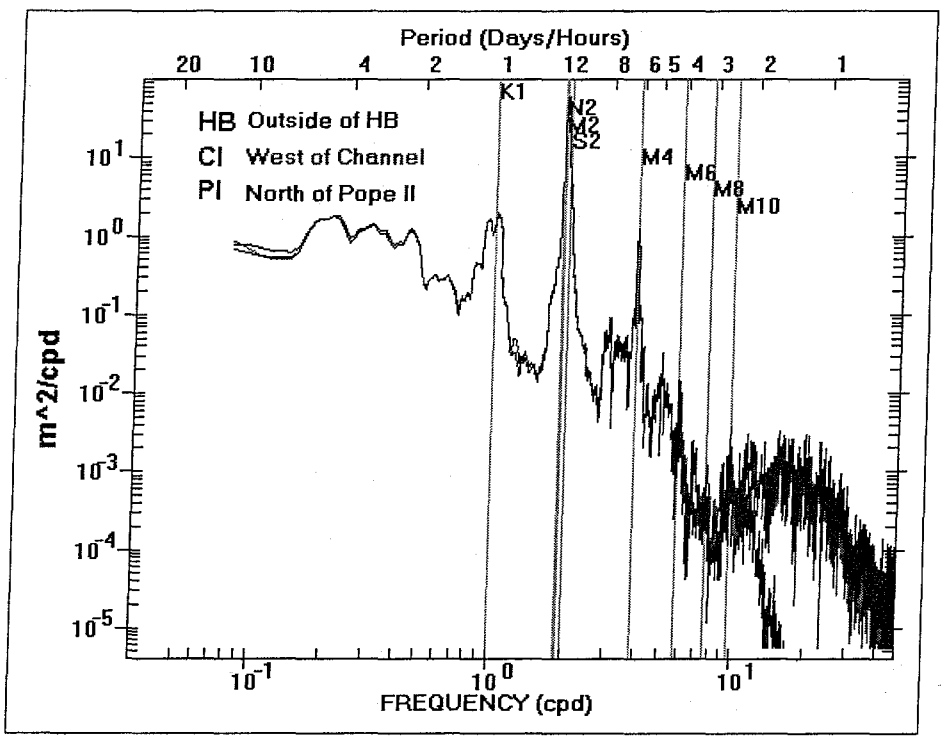


Figure 3-1. Energy spectrum distribution obtained from surface elevations at the long term deployment stations: HB(Hurricane Barrier), PI (Popes Island north), and CI (Channel Inner). Periods and frequencies of selected tidal constituents are shown.

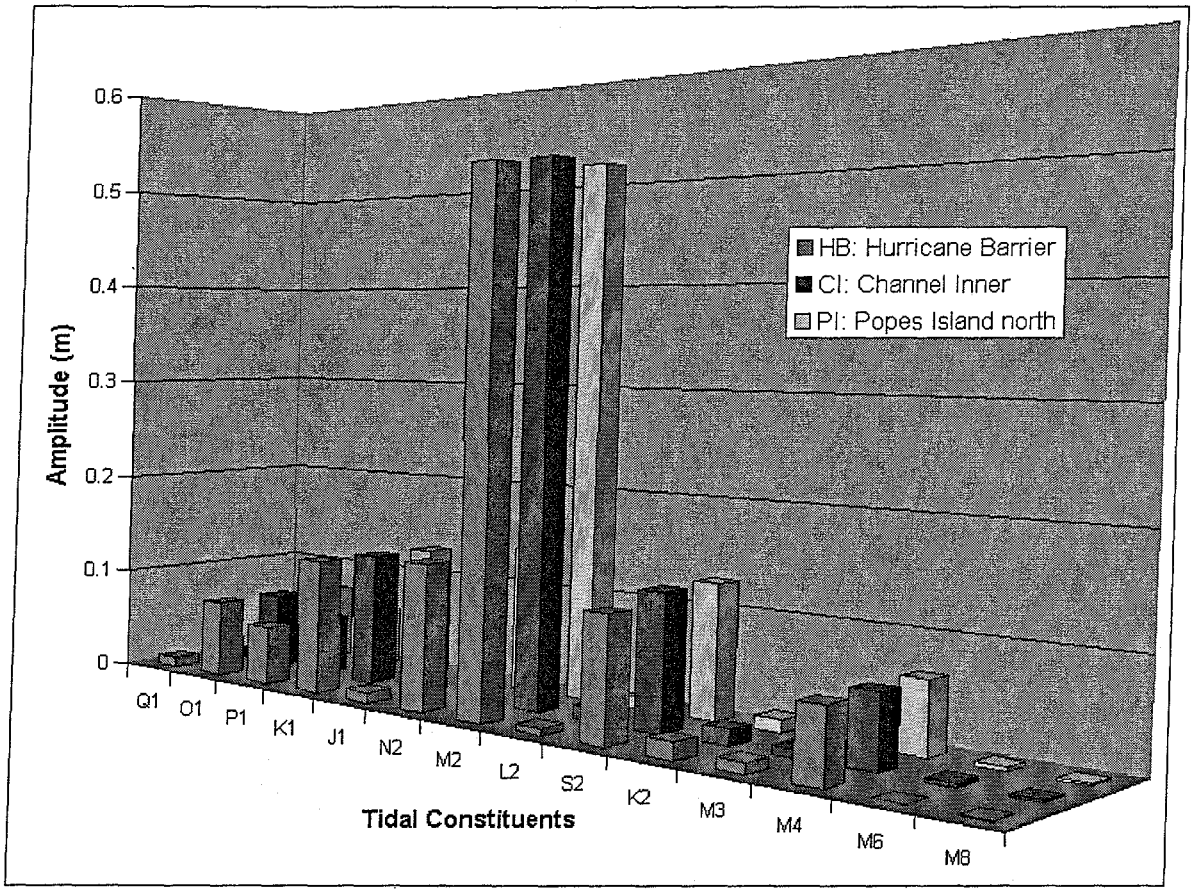


Figure 3-2. Tidal harmonic constituents obtained from surface elevations at the long term deployment stations (positioned in order from south (Hurricane Barrier) to north (Popes Island).

Similar observations can be made for the currents measured at the Channel Inner and Popes Island stations. No current meter was deployed at the Hurricane Barrier station. Figure 3-3 shows the energy spectrum distributions obtained from the vertically averaged velocities. The trend is similar to the one for elevations; with a falloff at higher frequencies and the existence of tidal frequency spikes. The energy in sub-tidal spectrums, however, becomes more prominent at the shallower station, Popes Island with a MLW depth of 2.6 m (8.5 ft) compared to 9.2 m (30 ft) at Channel Inner. Magnitudes of energy at the sub-tidal periods (~2 to 4 days) equal the tidal (M_2) components. Also noticeable is the difference at sub-tidal periods in the east/west versus south/north components. This difference indicates wind forces have significant influence on currents.

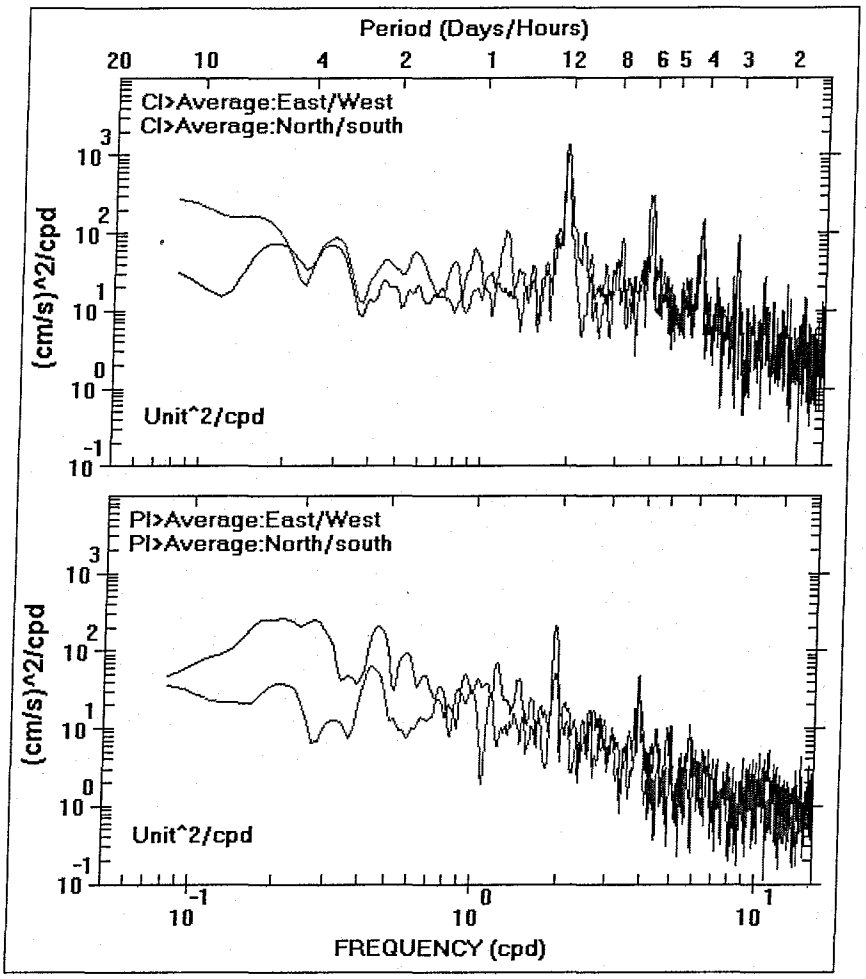


Figure 3-3. Energy spectrum distributions obtained from vertically averaged velocities at the long term deployment stations, Channel Inner (CI) and Popes Island (PI).

There are some differences in elevation versus velocity spectrum distributions, however, due to the inherent differences in these hydrodynamic quantities. Elevations are integrated quantities over the water depth and the region. Velocities are highly variable and dependent on depth of observation and immediate local morphology. This is why the elevation spectrum distributions look very similar for all stations while the velocity spectrum distributions look different.

The elevation and velocity spectrum distributions reveal that tides and winds are the primary causes that drive circulation in the region. This observation can also be inferred by examining the variations of elevation and velocity in time. Figure 3-4 shows observed winds (New Bedford municipal airport), elevation (outside of the Hurricane Barrier) and velocities (Channel Inner and Popes Island North) together on the same time axis. All forces drive the circulation with their own frequencies or random times: half daily tidal cycles, spring-neap fortnightly cycles and episodic wind events. Although the variation of velocities is very complex, the response to wind is particularly noticeable through time. Velocities in Figure 3-4 are shown for surface, vertically averaged, and bottom. At the Channel Inner station, with a 9.2 m (30 ft) water depth, the surface and bottom velocities are quite different. The surface velocities are larger, more variable, and generally flow to the south, while bottom velocities are smaller and show an oscillating north-

south direction. Velocities at Popes Island North, with a 2.6 m (8.5 ft) water depth, are more uniform vertically with somewhat higher speeds t the surface than at the bottom.

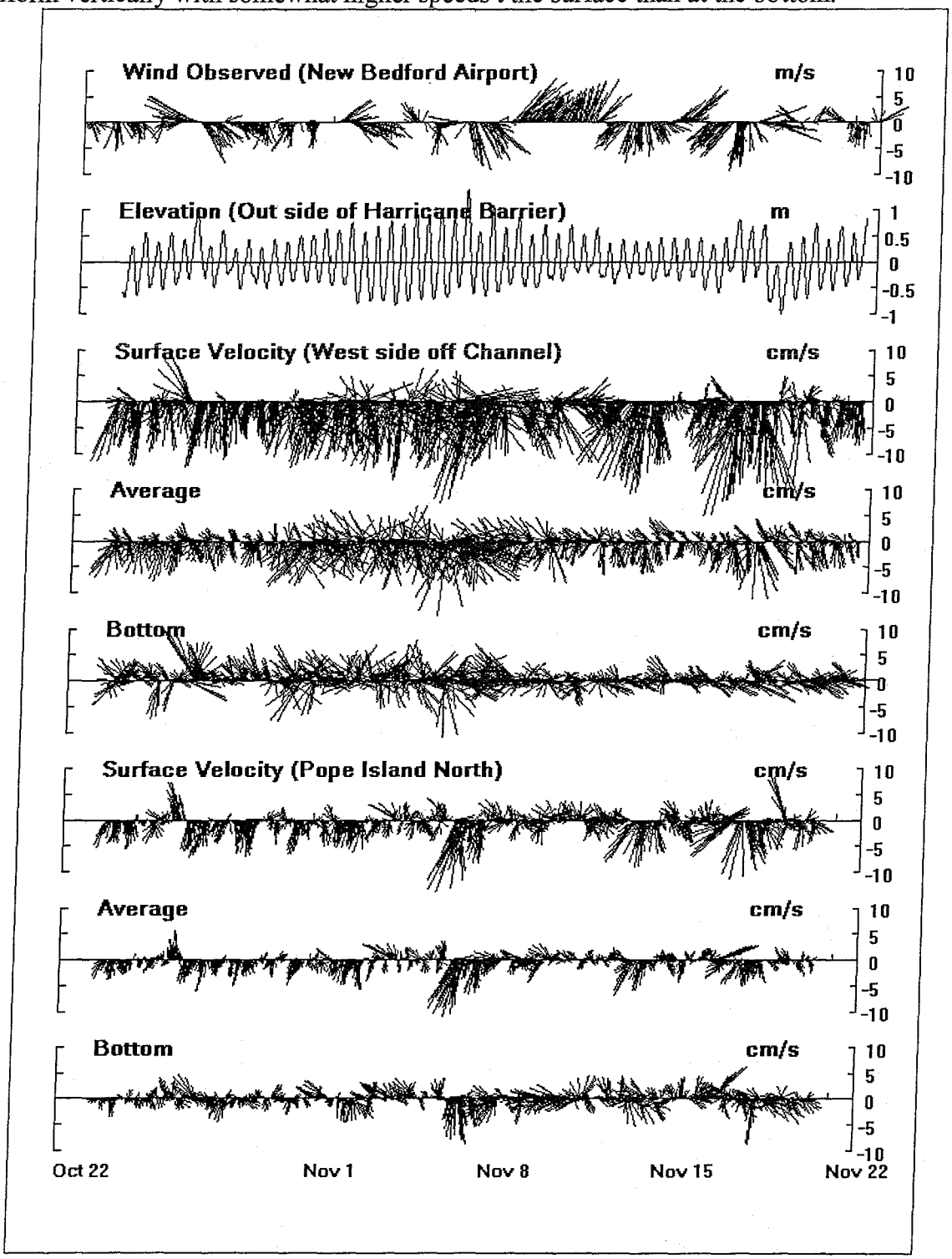


Figure 3-4. Time series stack plot of observed wind, elevation and velocity data.

In general, typical driving forces in normal estuarine circulation are tide, wind, and density gradient. Tide and wind influence are clearly seen in the observations. The significance of the density gradient is based on freshwater inflows. If the amount of freshwater inflow is small relative to the estuary size, the density gradient is not expected to play a significant role. The evidence of density gradients can be seen in the longitudinal salinity. No salinity observation were made for the period of field investigation but other studies concluded the density driven flow would be much less than 1 cm/s (see the discussion in Abdelrhman [2002]) south of Coggeshall St./I-95 Bridge, the lower portion of the Inner Harbor where the dredging and disposal operations are planned.

3.3 Hydrodynamic Model Application

3.3.1 Description of Hydrodynamic Model WQMAP/BFHYDRO

ASA has developed and applied evolving versions of sophisticated model systems (Swanson 1986, Spaulding et al., 1999) for use in studies of coastal waters for more than two decades. WQMAP, as the model system is known, uses a three dimensional boundary fitted finite difference hydrodynamic model (BFHYDRO) developed by Muin and Spaulding (1997a and b). The model has undergone extensive testing against analytical solutions and used for numerous water quality studies. Some applications particular to dredging studies in the northeastern United States are

- Water quality impacts of dredging and disposal operations in Boston Harbor (Swanson and Mendelsohn 1996)
- Dredged material plume for the Providence River and Harbor Maintenance Dredging Project (Swanson et al., 2000)
- Simulations of sediment deposition from jet plow operations in New Haven Harbor (Swanson et al., 2001)
- Simulations of sediment transport and deposition from jet plow and excavation operations in the Hudson River (Galagan et al., 2001)

The grid system used in the boundary-fitted coordinate model system is unique in that grid cells can be aligned to shorelines and bathymetric features (like dredged channels) to best characterize the study area. In addition, grid resolution can be refined to obtain more detail in areas of concern. This gridding flexibility is critical in representing the New Bedford Harbor waters where geometry is highly variable and complex.

3.3.2 New Bedford Harbor Grid

The domain of the hydrodynamic model for this application included the entire New Bedford Harbor, Inner and Outer, and a portion of Buzzards Bay. Figure 3-5 shows the large variation of cell size. The Buzzards Bay portion served as the open boundary condition where a cell size of ~700 m (2300 ft) was employed. The finest grid resolution of ~50 m (165 ft) was located in the

immediate study area of Inner New Bedford Harbor where bathymetric and shoreline variations were complex. Special attention was made to resolve the narrow channel that extends from the upper portion of the Inner Harbor to the Outer Harbor. The bathymetry data used in the model was taken from the hydrographic survey data CD-ROM Set (NGDC 1998) and from the Buzzards Bay project web-site http://www.buzzardsbay.org/gisdownload.htm.

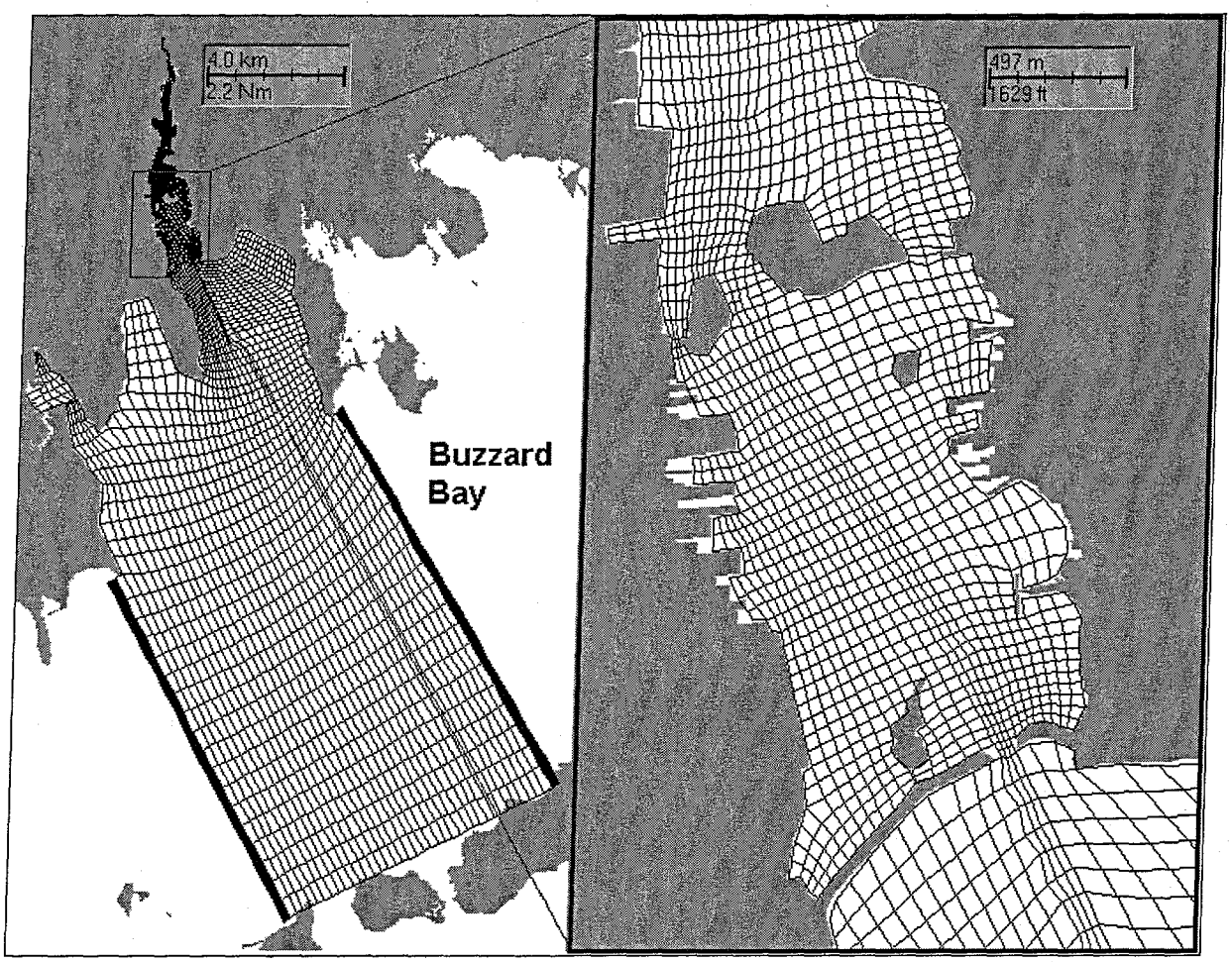


Figure 3-5. New Bedford harbor hydrodynamic model grid

3.3.3 Model Input

3.3.3.1 Open Boundary Condition

Elevation was prescribed at the open boundary. Two sets of boundary lines extend across Buzzards Bay as shown. Since no observations were available there, the elevation observed at Hurricane barrier is used by applying phase offsets of -20 minutes to the western boundary and +20 minutes to the eastern boundary, based on the gravity speed of long wave propagation.

3.3.3.2 Surface Wind Stress

Two wind data sets from New Bedford Municipal Airport (~5.3 km [3.3 mi] north-west of Popes Island) and Buzzards Bay NOAA Buoy (~29 km [18 mi] south-south-west of Popes Island) were considered. During the period of the field program, their directions were nearly identical but speeds at the buoy were substantially larger. Although the NOAA Buzzards Bay Buoy provided a better estimate of the unobstructed wind, the wind record from the airport was selected because of its proximity to the Inner Harbor.

3.3.3.3 Other Model Parameters

The computational time step defined how often the model calculated velocities and was chosen to be 300 sec, the largest allowed without causing model instabilities. The number of vertical layer was chosen as 7, sufficient to resolve the vertical structure of the horizontal currents. The bottom stress coefficient, based on Manning's equation was selected as 0.03, typical for estuaries. The wind stress coefficient was selected as 0.0014. The depth dependent vertical viscosity was chosen as 0.0005 + 0.0001 times the local depth (m) and expressed in m^2/sec.

3.3.4 Simulation Results

The hydrodynamic model simulated the circulation from 20 October to 20 November 2002, the period of the field program, with aforementioned model inputs and parameters. Figure 3.6 shows comparisons of observed versus simulated elevations at the three field stations. The station outside of Hurricane Barrier shows the best match. This is not surprising since the open boundaries were based on this elevation (+/- 20 min phase offset but the same amplitude). There was very little elevation gradient between Buzzards Bay and the Outer Harbor. Simulated elevations at Channel Inner and Popes Island are in good agreement in amplitude but their phases slightly lead the observations.

Figure 3-7 and 3-8 show comparisons of the observed versus simulated velocities at the Channel Inner and Popes Island North stations, respectively. Magnitudes of the velocities agreed well with the observations. The flow directions, however, differed in various degrees during the simulation period. The apparent complexity is due to wind stress. During some periods, the currents strongly correlated with the wind. For example, during the period (Oct 24 – Oct 30), wind blew steadily from the NNW direction. The observed surface currents flowed to the SSE, showing a strong positive wind/current correlation. On other occasions, i.e., from Nov 8 to Nov 12, strong winds blew from the SW~SSW direction but both observed surface currents appeared unaffected. The simulated current showed a contrary response during these periods: weak flow in the first period and strong flow to the later period, although the surface currents were always positively correlated with the wind. This suggests actual winds on the water may be different from the wind observed at the airport. However, simulations using rotated winds were tried but with no significant improvement.

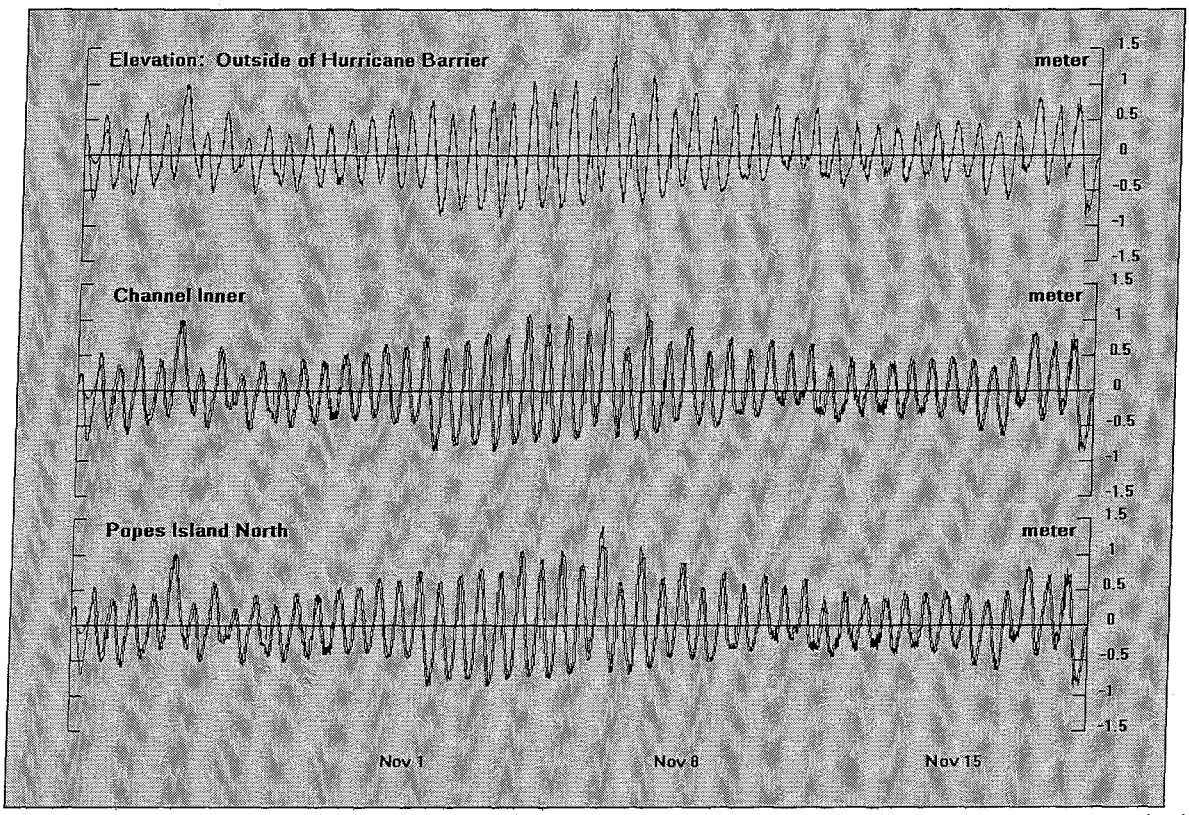


Figure 3-6. Comparisons of elevations: observed (thick blue line) versus simulated (thin red line).

In conclusion, the simulated elevations and velocity magnitudes agree very well with the observations. This assures overall hydrodynamics are consistent. The difference in the flow direction can be attributed to the uncertainty of the actual forcing wind magnitude.

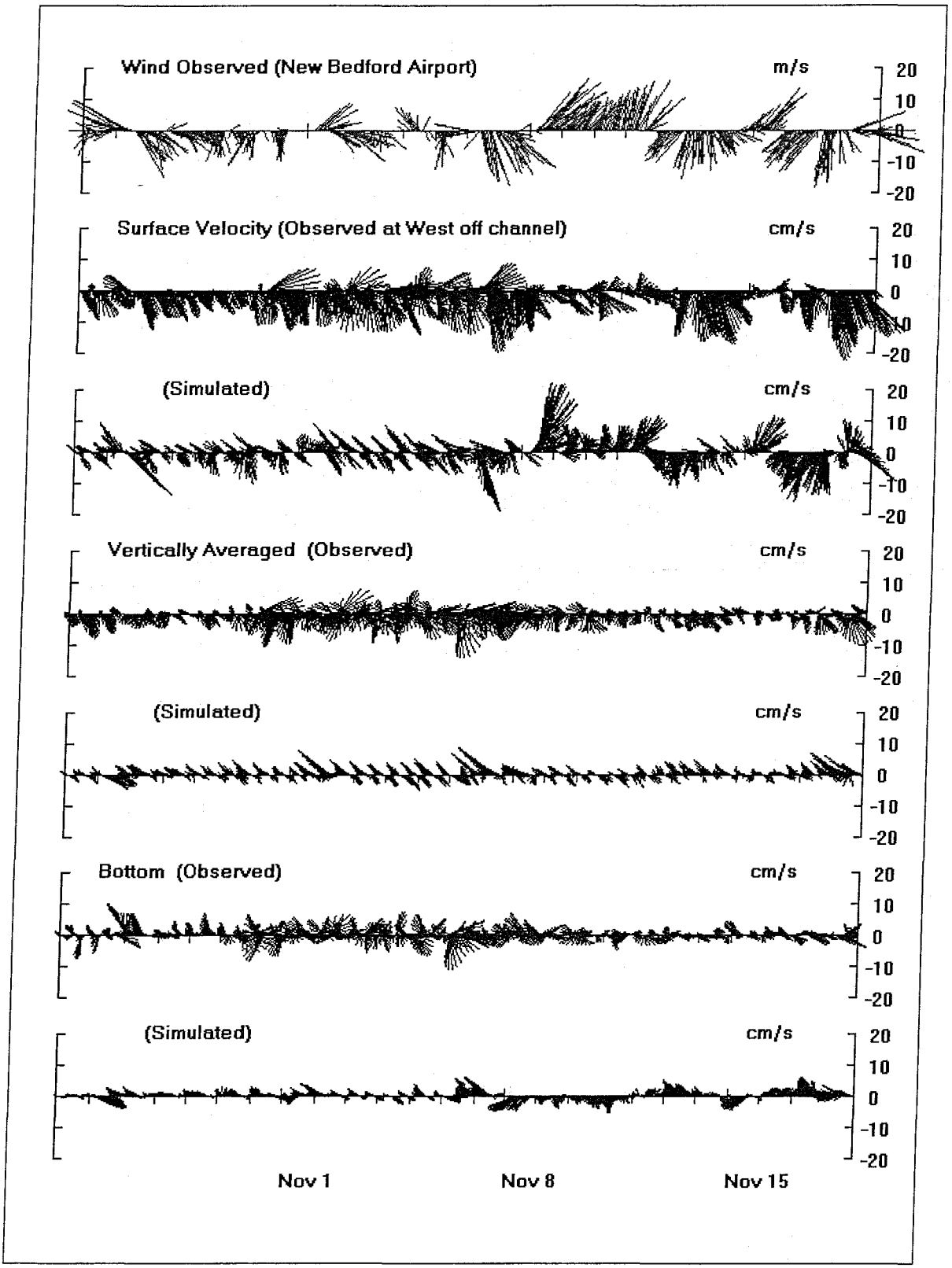


Figure 3-7. Comparison of observed versus simulated velocity at Channel Inner station.

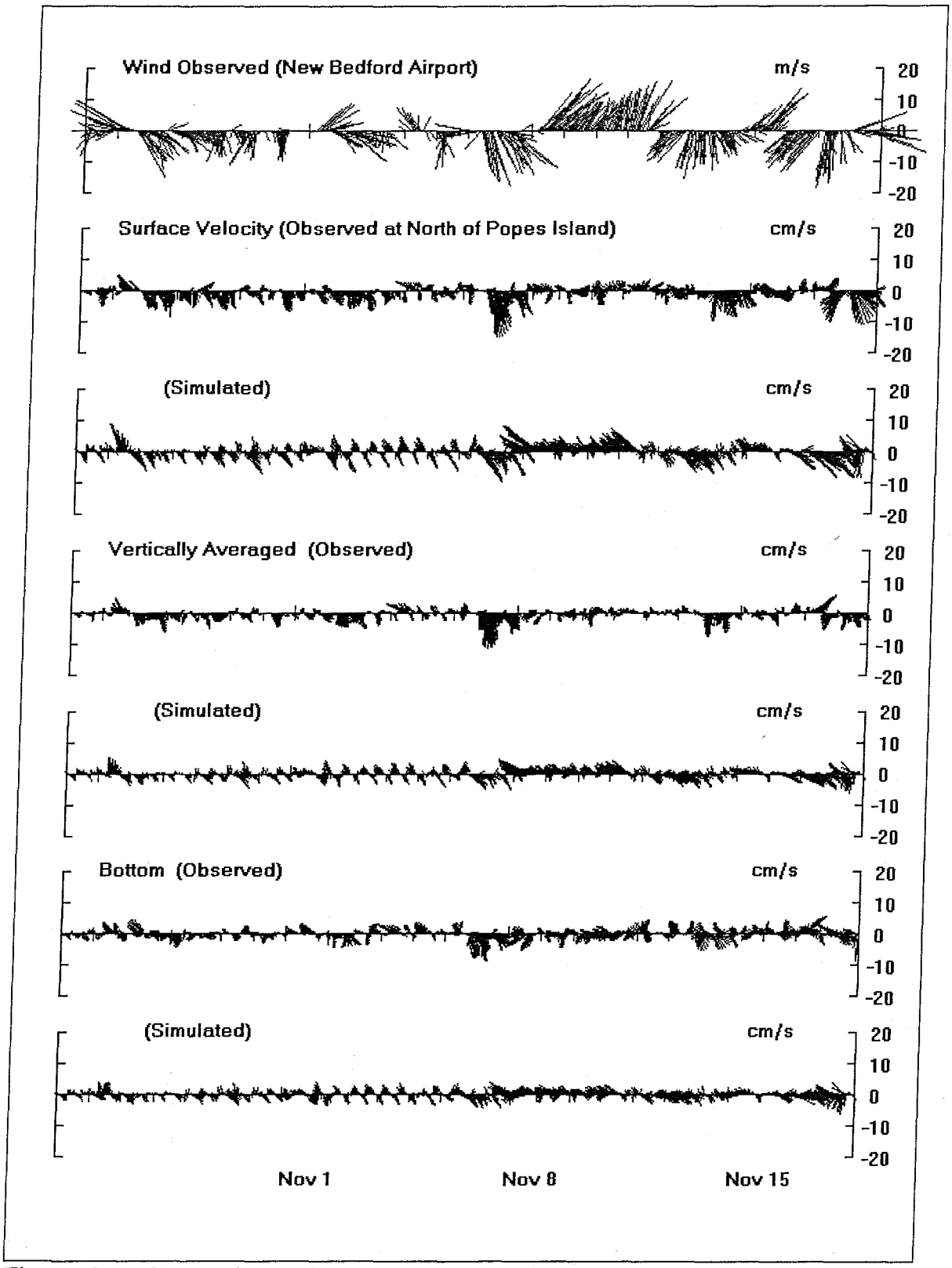


Figure 3-8. Comparison of observed versus simulated velocity at Popes Island north station.

3.4 Characteristic Circulation Scenarios

The analysis of the field observations and hydrodynamic simulations confirmed that the major forces driving the circulation in New Bedford Harbor are astronomic tides and winds. Since the purpose of the mass transport simulations was to predict the distribution of dredged pollutants and sediments under typical wind and tidal conditions, the particular periods (season or date) of such simulations were not determined *a priori*. The approach taken here was to develop a set of circulation scenarios that reflected most likely conditions. These scenarios were comprised of various tidal conditions and most probable wind conditions. Tidal variations considered were spring, mean and neap tides. Unlike the astronomic tide, which is predictable, wind is very episodic and must be approached in a statistical sense.

3.4.1 Wind Climate for Inner New Bedford Harbor

The variability of the wind at the New Bedford Municipal Airport was examined. Figure 3.9 and Table 3.1 shows the seasonal probability of wind direction in 30° increments. Two prominent wind directions found were south-west-south (SWS) and north-west-west (NWW). Nearly 50% of the time wind blew from the SWS direction in summer and the NWW direction in winter. This tendency remained to a lesser degree during spring and autumn. The probability that wind speed was less than 3.0 m/s (6.7 mph), considered as calm wind, is ~10.7% on average.

Table 3.1. Variations of winds at New Bedford Municipal Airport by season.

	Chance wind blows from either SWS or NWW	Calm wind (<3.0 m/s)
Winter	45.5%	8.4 %
Spring	35.4	11.1
Summer	50.9	13.8
Autumn	35.3	10.1

Wind speed was quite variable during the seasons. The average wind speed for both directions (excluding the calm wind period) was calculated to be 8.2 m/s (18.3 mph), equivalent to a wind stress of approximately 1 dyne/cm^2 (0.0021 lbs/ft^2).

3.4.2 Circulation Scenarios

Three tidal conditions (neap, mean, and spring) and three wind conditions (calm, SWS, NWW at 8.2 m/s speed) were combined to make the nine circulation scenarios summarized in Table 3.2.

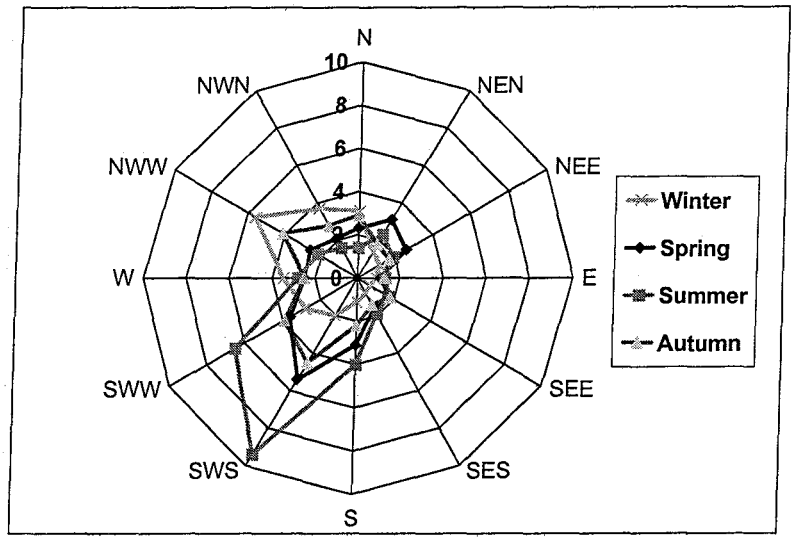


Figure 3-9. Probability of wind direction of the four seasons.

Table 3.2. Circulation scenarios based on tide and wind conditions.

Circulation Scenario	Tide Range	Wind
1	Neap (0.7 m [2.3 ft])	Calm
2	Mean (1.0 m [3.3 ft])	calm
3	Spring (1.4 m [4.6 ft])	calm
4	Neap (0.7 m [2.3 ft])	SWS 8.2 m/s
5	Mean (1.0 m [3.3 ft])	SWS 8.2 m/s
6	Spring (1.4 m [4.6 ft])	SWS 8.2 m/s
7	Neap (0.7 m [2.3 ft])	NWW 8.2 m/s
8	Mean (1.0 m [3.3 ft])	NWW 8.2 m/s
9	Spring (1.4 m [4.6 ft])	NWW 8.2 m/s

To assess the direct effect of tidal conditions and winds, hydrodynamic simulations were run separately for each component. Figures 3-10 and 3-11 show simulated surface flood speed contours and velocity vectors for neap, mean and spring tides under calm wind conditions, respectively. As the tide range doubles from neap to spring conditions, the velocity also approximately doubles throughout the region. Figures 3-12 and 3-13 show simulated surface and bottom flood speed contours and velocity vectors driven by the SWS wind and mean tide, respectively. There is a strong surface flow heading downwind but modulated by the Inner Harbor geometry. The bottom flow is much lower in magnitude. Figures 3-14 and 3-15 show simulation results driven by the NWW wind and mean tide. Here the surface flow is again downwind with a significant upwind flow along the bottom in the channel. In general, surface and shallow waters tend to move with the wind while flows in deeper areas adjust by compensating the flow to balance the direct wind-induced flows.

Nine hydrodynamic simulations using the combination of tide and wind conditions were then executed. Table 3.3 compares the simulated speed (vertically averaged) at the two field stations. The result indicates flows driven only by tides are very weak, varying from 1.4 to 4.3 cm/s (0.046 to 0.14 ft/s). Wind substantially increases flow velocities, the SWS wind generating a range of speeds between 5.1 and 9.6 cm/s (0.17 to 0.32 ft/s) and the NWW wind generating a range of speeds between 6.5 and 15.7 cm/s (0.21 to 0.52 ft/s).

Table 3.3 Vertically averaged simulated speed at two field station locations for the nine circulation scenarios.

Circulation Tide	Scenario Wind	Channel Inner Speed (cm/s)	Popes Island North Speed (cm/s)
Neap	Calm	2.1	1.4
Mean	Calm	3.0	1.9
Spring	Calm	4.3	2.6
Neap	SWS @ 8.2 m/s	5.1	9.6
Mean	SWS @ 8.2 m/s	6.0	9.3
Spring	SWS @ 8.2 m/s	7.1	9.4
Neap	NWW @ 8.2 m/s	13.6	6.5
Mean	NWW @ 8.2 m/s	14.6	7.0
Spring	NWW @ 8.2 m/s	15.7	7.5

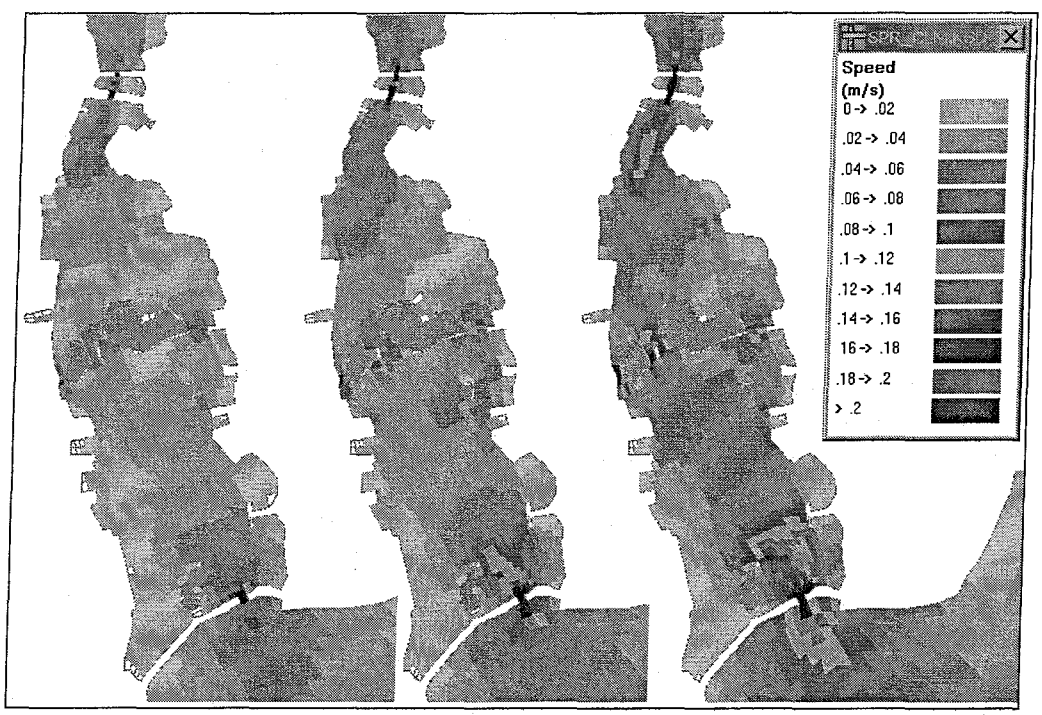


Figure 3-10. Surface flood speed contours for neap, mean and spring (from left to right) tide conditions under calm wind conditions.

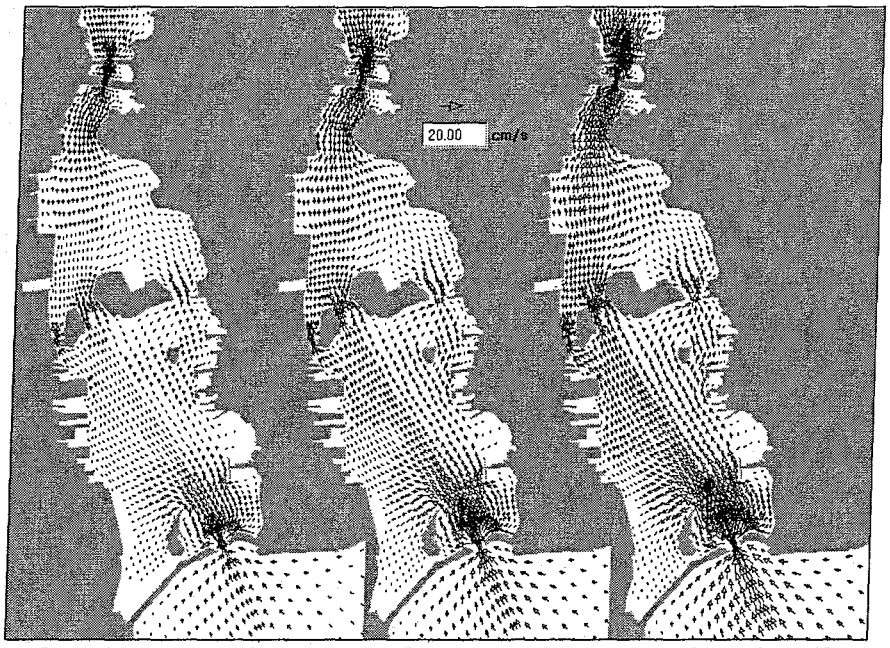


Figure 3-11. Surface flood velocity vectors for neap, normal, and spring (from left to right) tidal conditions under calm wind conditions.

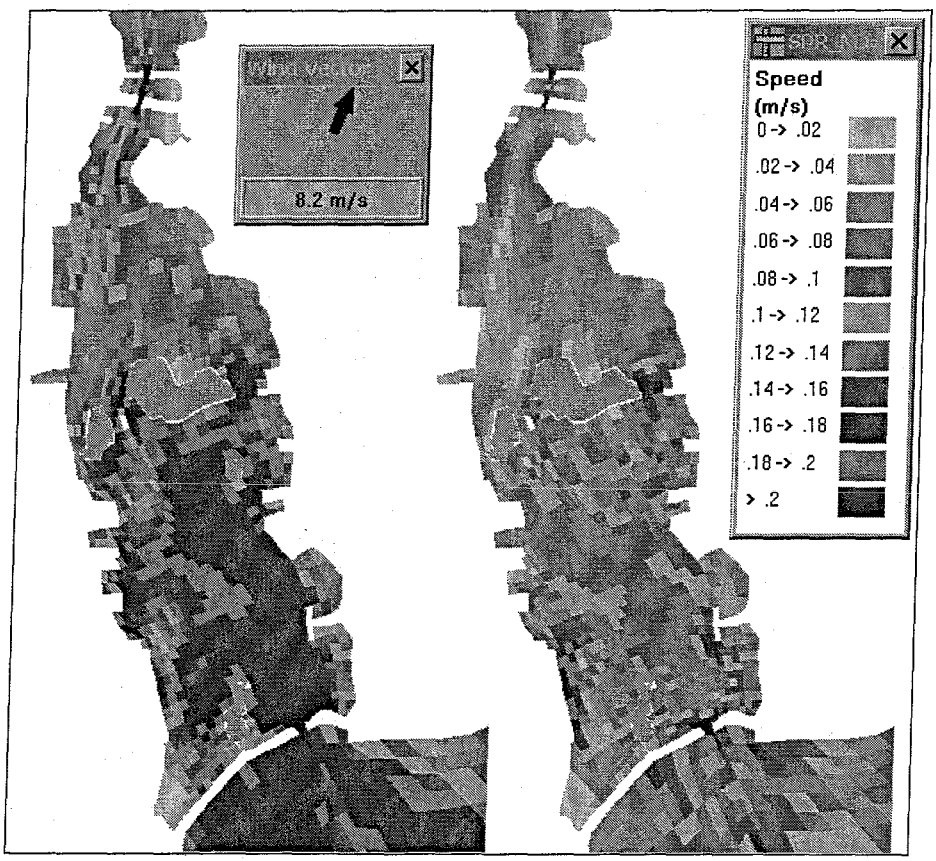


Figure 3-12. Surface (left) and bottom (right) speed contours for SWS wind.

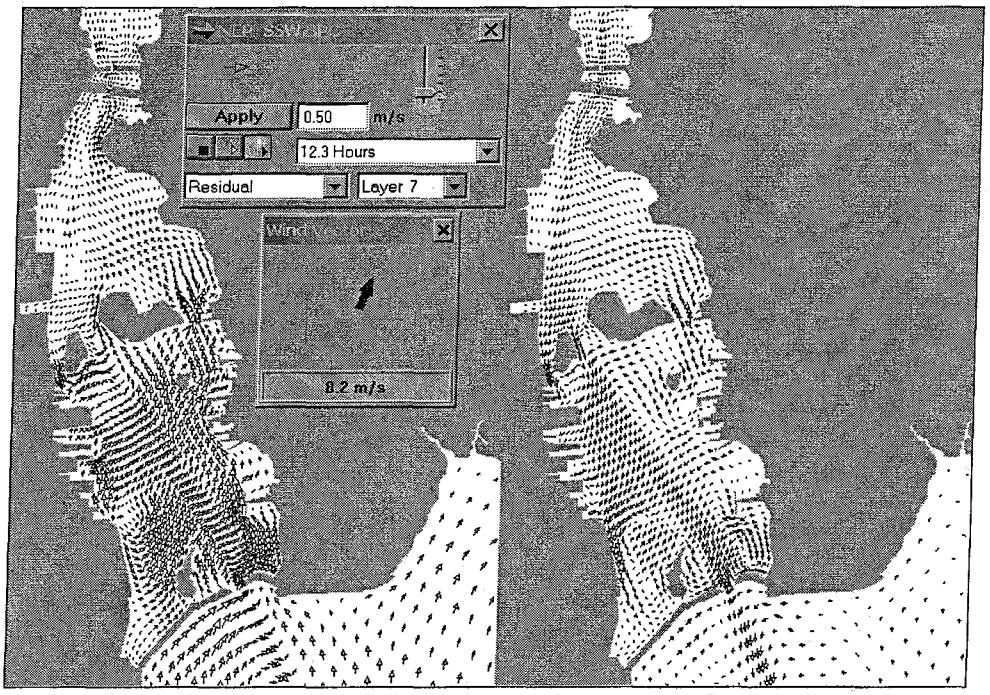


Figure 3-13. Surface (left) and bottom (right) velocity vectors for SWS wind.

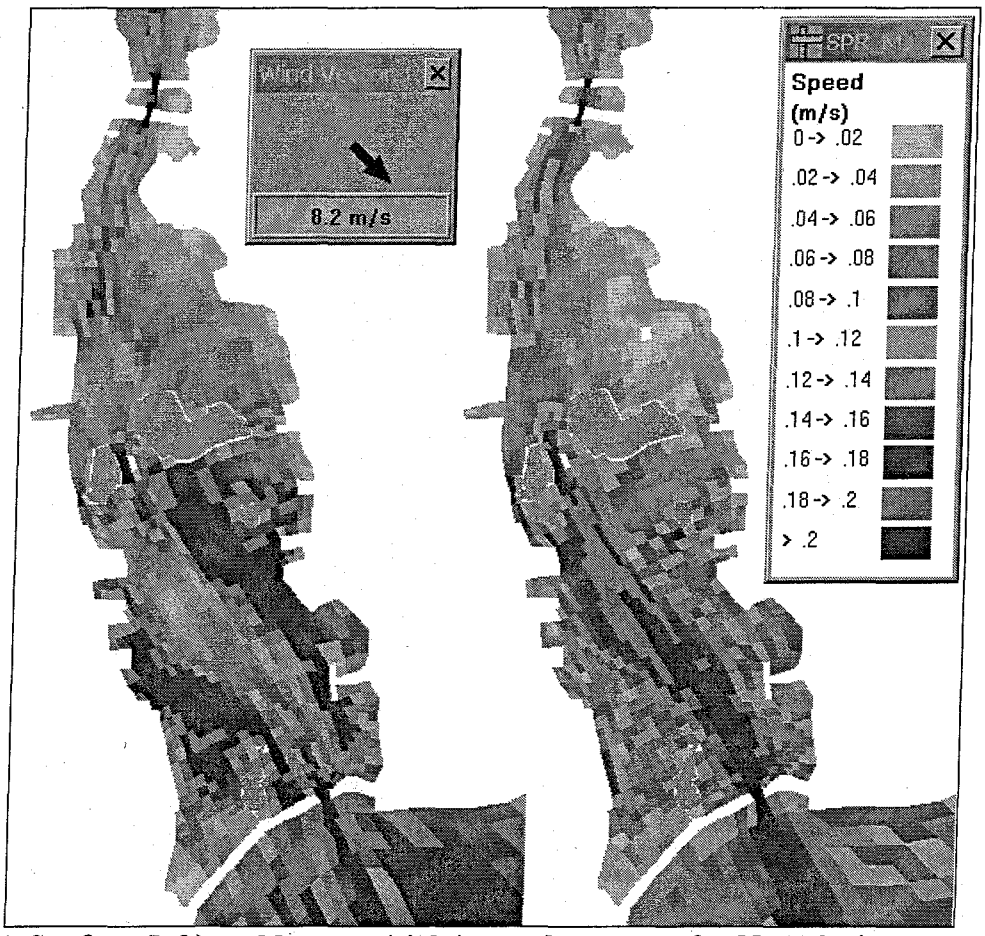


Figure 3-14. Surface (left) and bottom (right) speed contours for NWW wind.

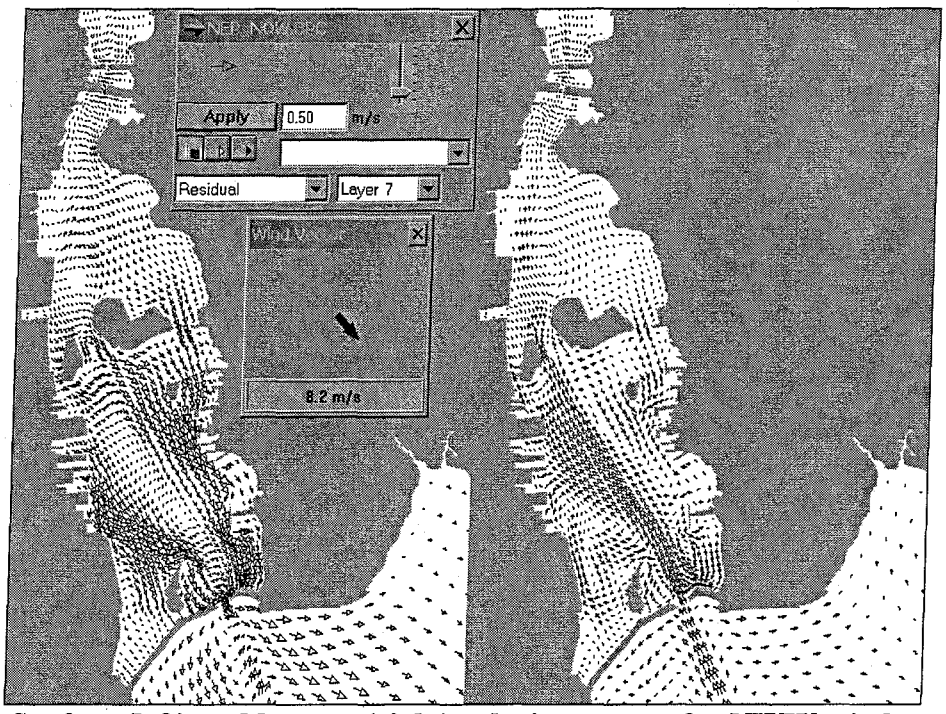


Figure 3-15. Surface (left) and bottom (right) velocity vectors for NWW wind.

The set of scenarios listed in Table 3.3 were rerun with bathymetry that reflects the proposed Popes Island CAD cell excavation, from 2.6 to 17 m (8.5 to 56 ft), to simulate the circulation for dredge material disposal simulations into the cells. The results of these additional hydrodynamic runs were very similar to the present bathymetry runs. Velocities for tide only cases simply showed a reduction in speed (Figure 3-16). The immediate vicinity of the CAD site, however, showed surface water moving in direct response to wind and a reverse flow developed at the bottom for wind driven cases (Figures 3-17 and 3-18).

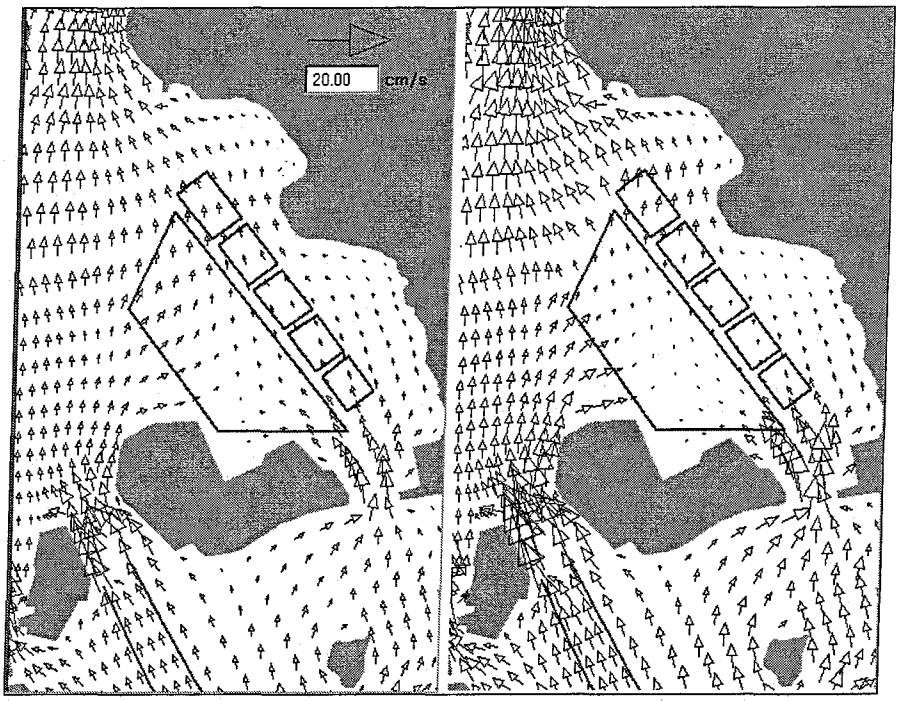


Figure 3-16 Comparison of flood surface velocity vectors for spring tide and calm winds: existing (left) versus excavated (right) bathymetry. Red polygons represent cells in the proposed CAD facility at north of Popes Island.

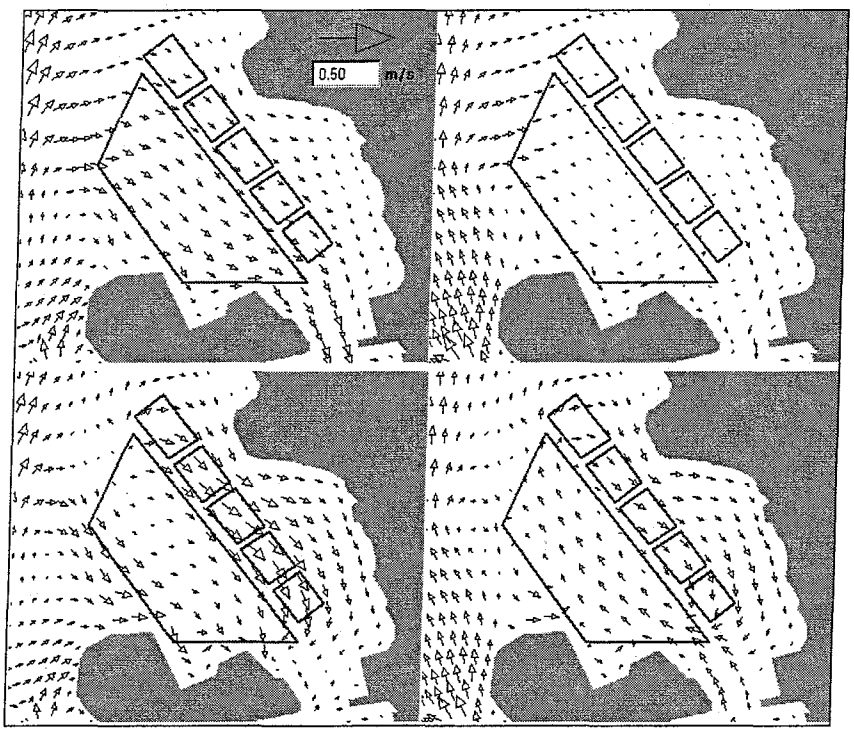


Figure 3-17 Comparison of velocity vectors at surface (left panels) and bottom (right panels) for the NWW wind case, existing (upper panels) versus excavated (lower panels) bathymetry. Red polygons represent cells in the CAD facility at north of Popes Island.

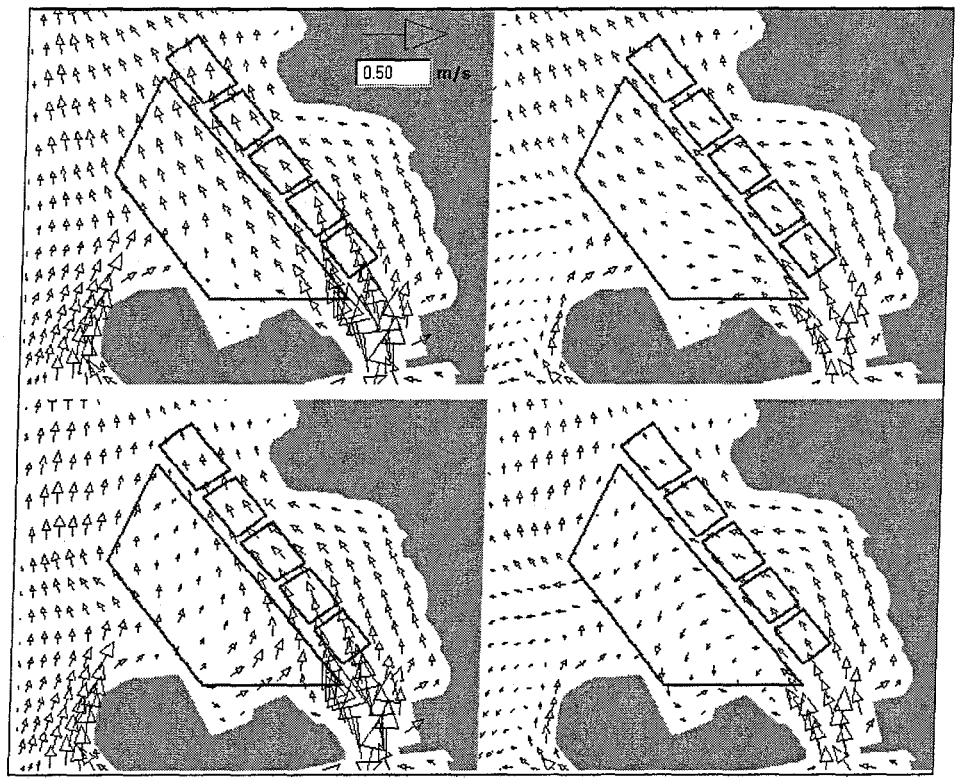


Figure 3-18 Comparison of velocity vectors at surface (left panels) and bottom (right panels) for the SWS wind case, existing (upper panels) versus excavated (lower panels) bathymetry. Red polygons represent cells in the CAD facility at north of Popes Island.

4. Dredged Material Modeling using SSFATE

4.1 Excavation of Popes Island CAD Cell

All of the dredged sediments from the waterways are to be disposed in the PIN-CAD facility. The capacity of the CAD site was designed to accommodate many dredging projects. Six cells are planned at the PIN-CAD site (shown in Figures 3-16 to 3-18). The largest cell volume is 1,739,362 m^3 (2,275,000 yd^3), and the volume for the small cells ranges from 62,980 m^3 (82,375 yd^3) to 65,331 m^3 (85,459 yd^3). Excavation of these CAD cells exceeds the volume from dredging operations from all the waterways projects..

This report section details the analysis of water column TSS concentration increases due to excavation of the PIN-CAD cells. The process of excavation is similar to maintenance dredging; a clamshell bucket (7 yd^3 [5.4 m^3]) is lowered to the bottom (~15 m [50 ft]), grabs the sediment, and the bucket is then raised to the surface, where the sediment is dropped into a barge. This cycle repeats every ~90 sec until the total volume is excavated (lasting up to several months). Water column TSS increases occur if some portions of the sediment become waterborne. Most of the sediment release takes place when the bucket contacts the seafloor. Additional sediment escapes from the bucket while the bucket travels up through water column, particularly if the bucket is not well sealed. Total sediment amount released (source strength of TSS) varies depending on the type of bucket (to be discussed in the next section).

This sediment loss during dredging serves as a TSS source to the water column for the entire period of dredging operation. The distribution of water column concentration of TSS away from the immediate site of operation is governed by how the sediment is transported, settled, and dispersed by ambient currents, in addition to the initial source strength. These processes were simulated by ASA's SSFATE (Suspended Sediment Fate) model.

SSFATE was jointly developed by ASA and the U.S. Army Corps of Engineers (USACE) Engineer Research and Development Center (ERDC). SSFATE is to be one of a family of USACE models that simulate various dredging related activities (e.g., STFATE, dredged material disposal; MDFATE, multiple dump disposals; and LTFATE, long-term mound stability). It has been documented in a series of USACE Dredging Operations and Environmental Research (DOER) Program technical notes (Johnson et al., 2000 and Swanson et al., 2000).

4.1.1 Source Strength Estimation

Dredging operations using a clamshell bucket inevitably disturb the bottom sediments and cause a portion to suspend above the bottom. Sediment losses from the bucket occur during travel through the water column and as the bucket breaks the water surface. There can be additional losses if the excess liquid in the scow is allowed to flow overboard. Typical loss rate ranges 1.5 to 4% for various bucket types shown in Table 4.1.

Table 4.1. Typical loss rates for different bucket types.

Type of bucket	Loss (%)
Conventional bucket with over flow	4
Conventional bucket without over flow	2
Environmental bucket	1.5

From *DOER Technical Notes Collection* (ERDC TN-DOER-E12)

Newer buckets (environmental buckets) are designed to minimize resuspension and loss by using various measures, for example, better venting, rubber sealed bucket and level cut capability which reduces side collapsing. The use of such buckets is planned for this project so a loss rate of 1.5% was assumed.

Total suspended solids (TSS) source strength used in the model is the defined as the mass rate of sediment injected into the water column. It can be determined using the following parameters,

- Production rate = 214 m^3/hr (280 yd^3/hr equivalent to a bucket capacity of 7 yd^3 and a cycle time of 90 s)
- Solid fraction = 60% (average of 65.7% for NHB-202-3 and 53.4% for NHB-202-6)
- Sediment density = 2,600 kg/m^3 (162 lb/ft^3)

The mean release rate of sediment is then the quadruple product,

(loss rate) × (production rate) × (solid fraction) × (density) = 1.8 kg/s.

4.1.2 Sediment Characteristics Near the CAD Cell Site

One of the major factors that controls TSS concentration is how fast the sediment settles from the water column back to the bottom. In general, coarser materials have higher settling velocities while the finer materials stay in the water column much longer. By examining size fractions of sediment for the site, basic settling characteristics can be determined. The SSFATE model treats sediments as having five distinct size classes (Johnson, et. Al., 2000),

Table 4.2 SSFATE sediment size classes.

Class	Size (micron)	Description
1	0 – 7 micron	Clay
2	8-35	fine silt
3	36-74	medium fine silt
4	75-130	fine sand
5	>130	coarse sand

Figure 4-1 shows the distribution of sediment size classes obtained from samples from the proposed PIN-CAD cell site (see Figure 4-2 for locations of the sediment samples). Values of the all sampling stations were averaged (Table 4.3) and used in the SSFATE model.

Table 4.3 Average sediment size composition of samples from the PIN-CAD site.

Class	Description	Distribution (%)
1	Clay	25.1
2	find silt	19.0
3	medium fine silt	19.0
4	fine sand	16.5
5	coarse sand	20.5

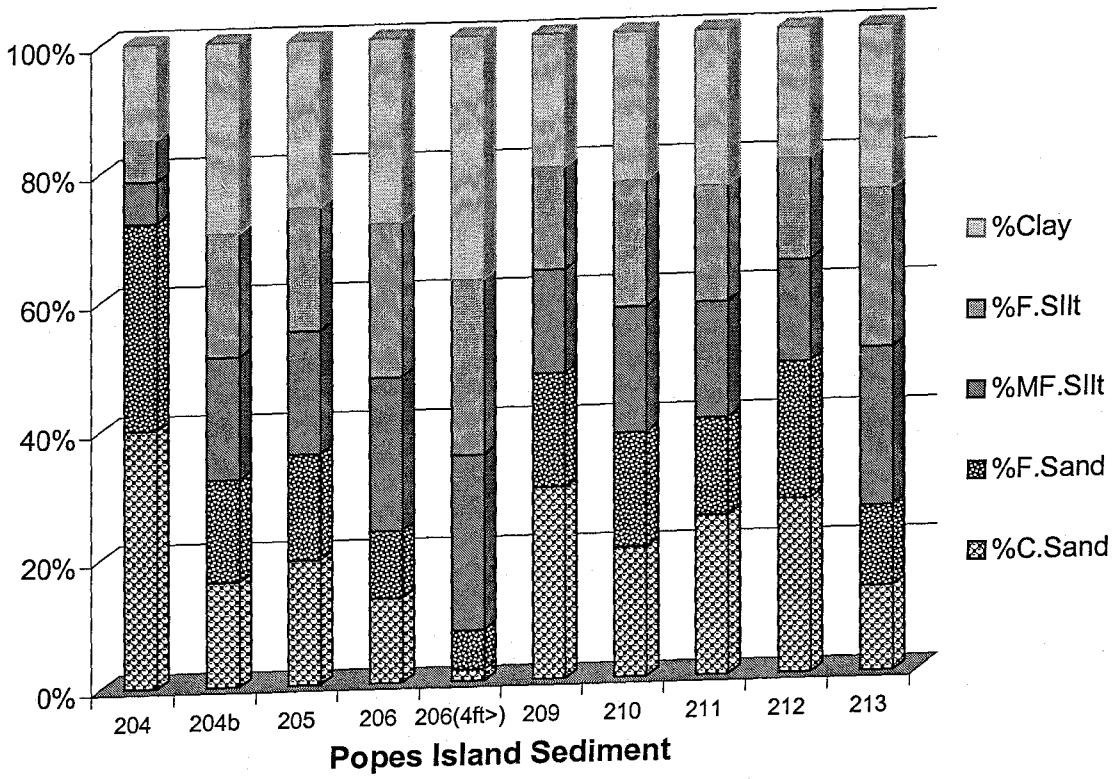


Figure 4-1 Sediment type distributions near the PIN-CAD cell site.

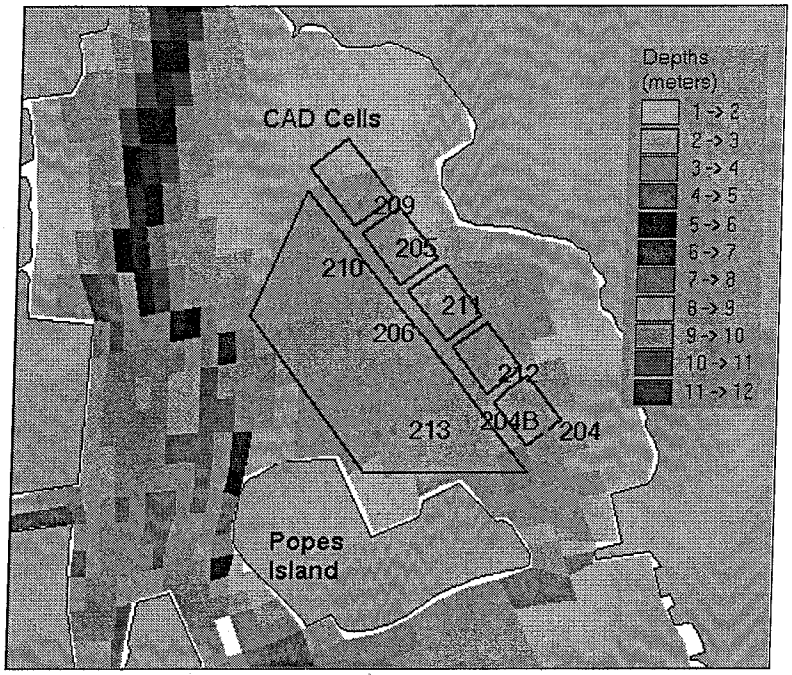


Figure 4-2 Map showing the PIN-CAD cells and sediment sampling stations.

4.1.3 Predicted TSS Concentrations

SSFATE simulations that represent CAD cell excavations using clamshell bucket dredging were performed for the nine typical hydrodynamic conditions described above. The center coordinate of the largest CAD cell was designated as a representative dredging operation location, which was fixed for the duration of the simulation. TSS concentration distributions due to the clamshell dredging reached a quasi-steady state within two tidal cycles (~1 day). All simulations were run for 3 days.

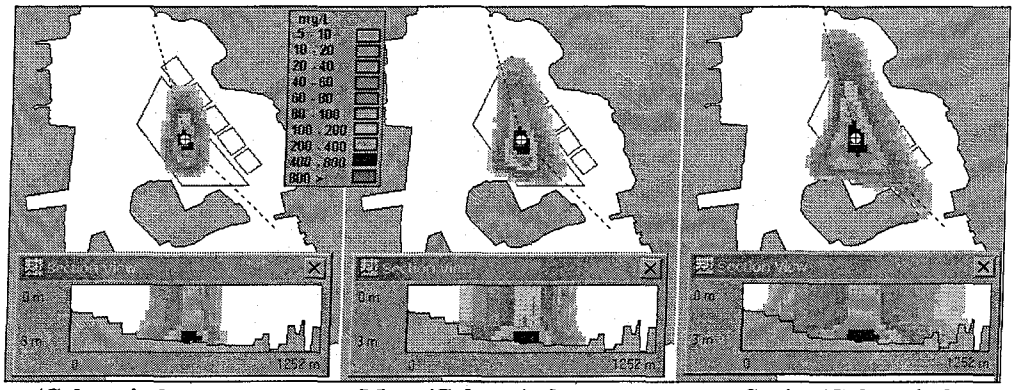
Presentation of simulation results are shown by:

- Horizontal and vertical views of TSS concentration distribution
- Acreage of the area exceeding various concentration levels
- Sediment mass balance

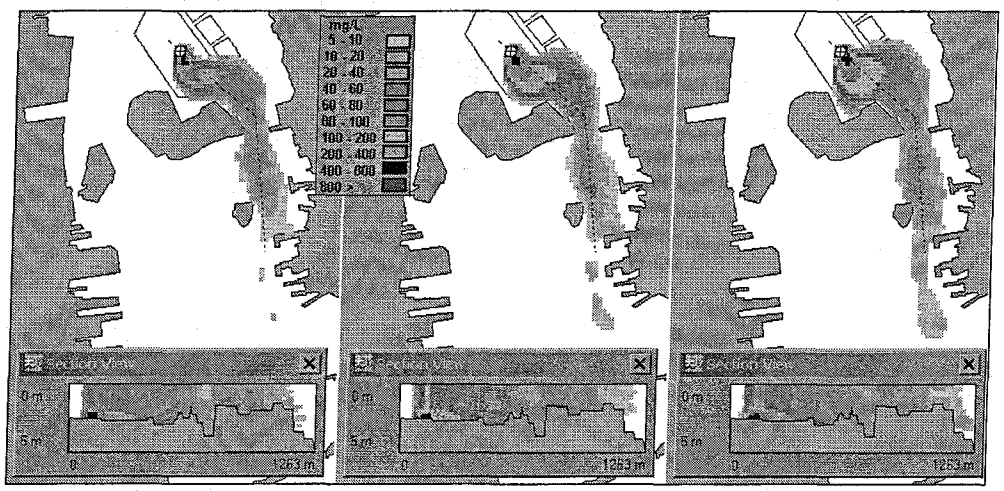
Figure 4-3 shows contours of the maximum TSS concentrations throughout the water column over the 3-day simulation period. A vertical section of the concentration distribution was inserted at the base of each plan view. Frames in the figure are organized such that rows display simulations for the three wind conditions and columns for the three different tides.

For the neap only condition (1st row), all TSS distributions appeared to be centered in the dredge site. Overall sediment plume sizes correspond to the tide strength. For the NWW wind cases, all sediment plumes trail to the lee side of the wind direction, whereas the opposite is found for the SWS wind cases. Similar results are obtained for mean and spring tidal conditions, except the size of plume increases with increasing tide range.

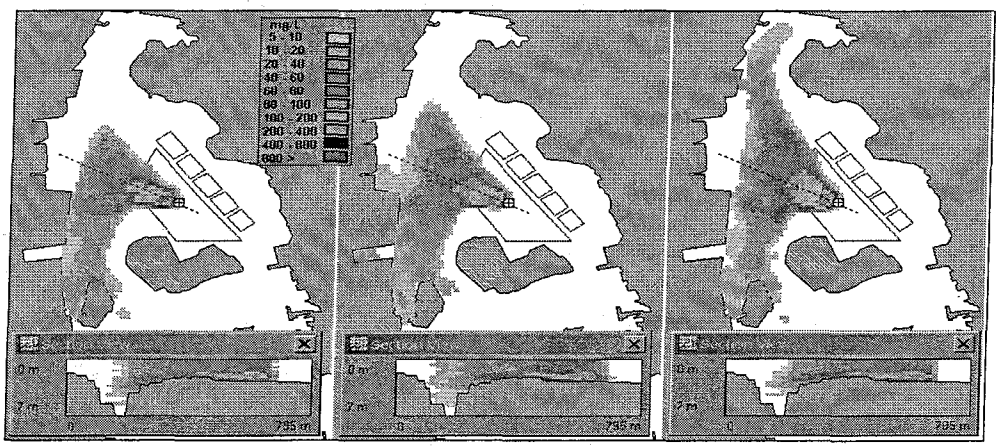
It is important to note that the instantaneous concentrations, which vary widely in time, are significantly smaller than the maximum TSS concentrations presented here.



Neap/Calm wind **Mean/Calm wind** **Spring/Calm wind**



Neap/NWW wind **Mean/NWW wind** **Spring/NWW wind**



Neap/SWS wind **Mean/SWS wind** **Spring/SWS wind**

Figure 4.3 Maximum TSS concentrations for the nine circulation scenarios. Inserted in each plan view is a vertical section view along the dashed line.

Figures 4-4 through 4-6 shows the area coverage (acres) exceeding fixed TSS concentration levels in the same order as Figure 4-3. This is essentially the same information as contained in Figure 4-3, except it more direct area comparisons in a quantitative manner. Neap tide also results in smaller areas and spring tide results in larger areas than the mean tide. The analysis presented here did not include the ambient or background TSS concentrations which were sampled during the field program and typically ranged from 3 to 10 mg/L.

Figure 4-7 presents the mass of the fine fractions of sediment remaining in the water column after all settling has occurred. When the system reaches a quasi-steady state, the sediment mass introduced by dredging balances the mass that settles out, so the fraction of sediment that remains waterborne becomes constant. This water column sediment fraction is uniquely distributed by overall size and concentration among the hydrodynamic conditions.

For example, the water column sediment fractions in the NWW case and SWS case are ~2% and ~3%, respectively. This number indicates that the SWS case produces a larger sediment plume and a higher sediment fraction remaining in the water column, compared to the NWW case. This is caused by advection carrying sediments to the deeper waters, in contrast to the NWW case, in which sediments are transported to shallow water where more settling take place. In the case of calm wind conditions, the higher tide conditions have the higher water column sediment fraction. The reason is not obvious. However, there are two possible explanations: 1) the smaller tide range tends to form higher sediment concentrations, which in turn enhance the aggregative settling, 2) the lower tide (lower velocity) provides higher deposition probability (sediments can not be deposited if bottom velocity exceeds a certain threshold).

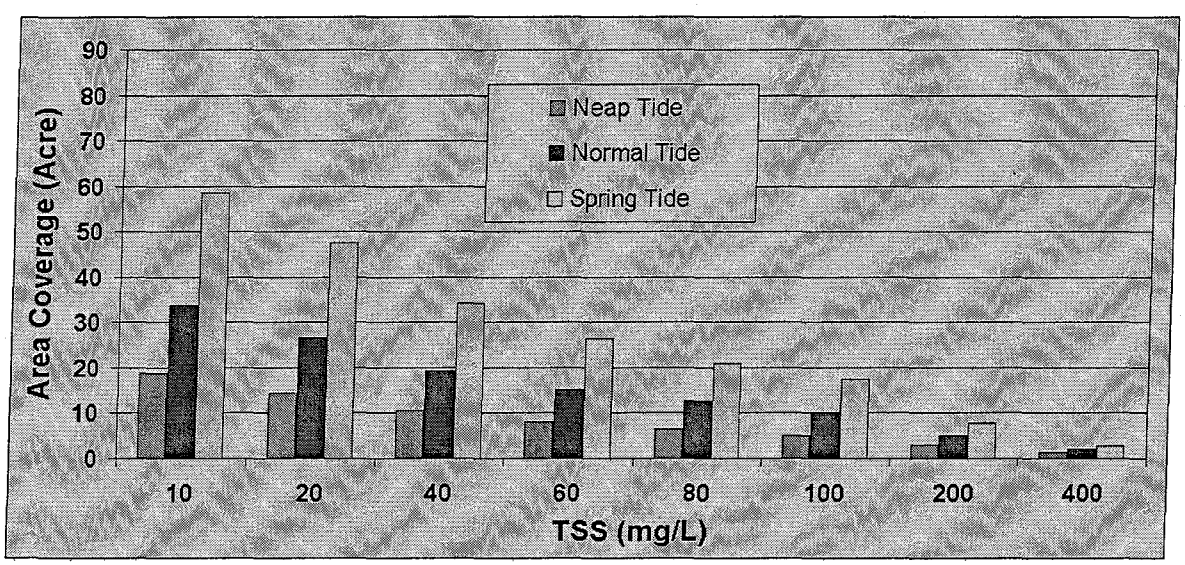


Figure 4-4 Area coverage (acres) of exceeding specified TSS concentration levels for the calm wind (tide only) condition.

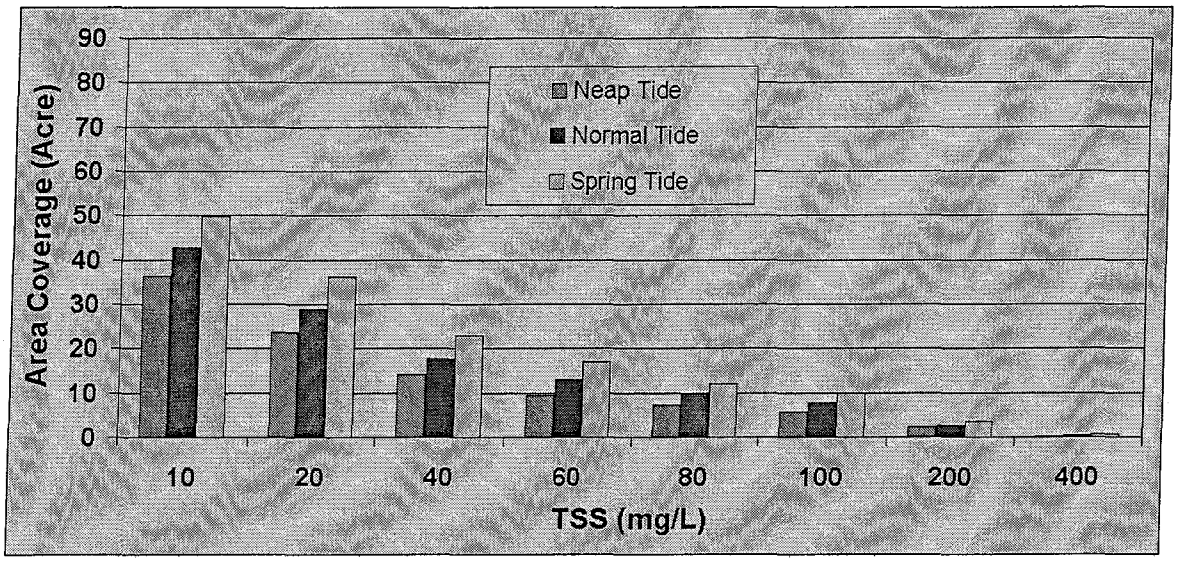


Figure 4-5 Area coverage (acres) of exceeding specified TSS concentration levels for the NWW wind case.

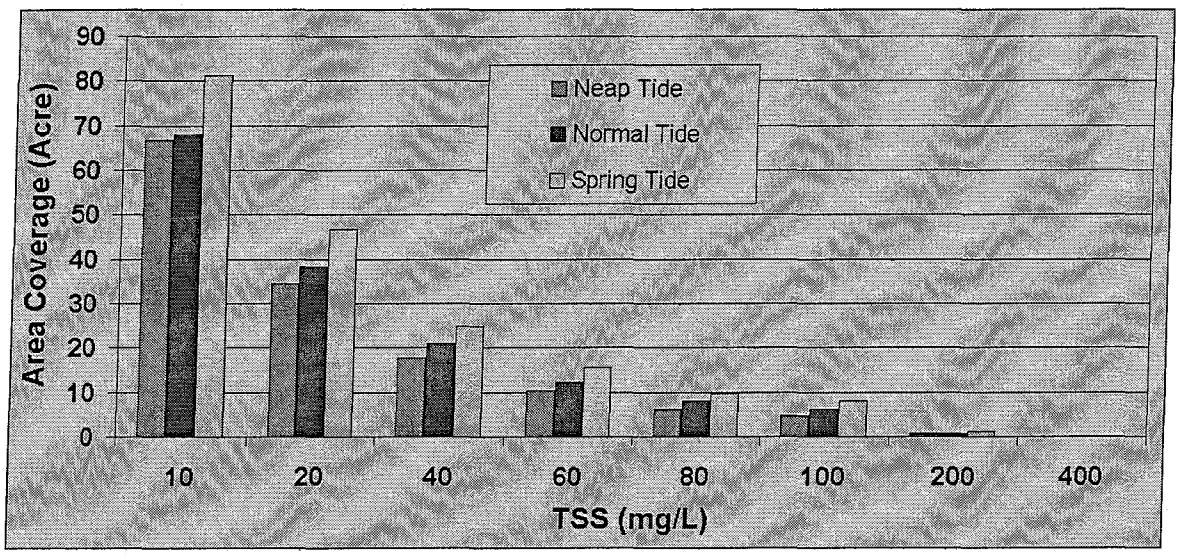


Figure 4-6 Area coverage (acres) of exceeding specified TSS concentration levels for the SWS wind case.

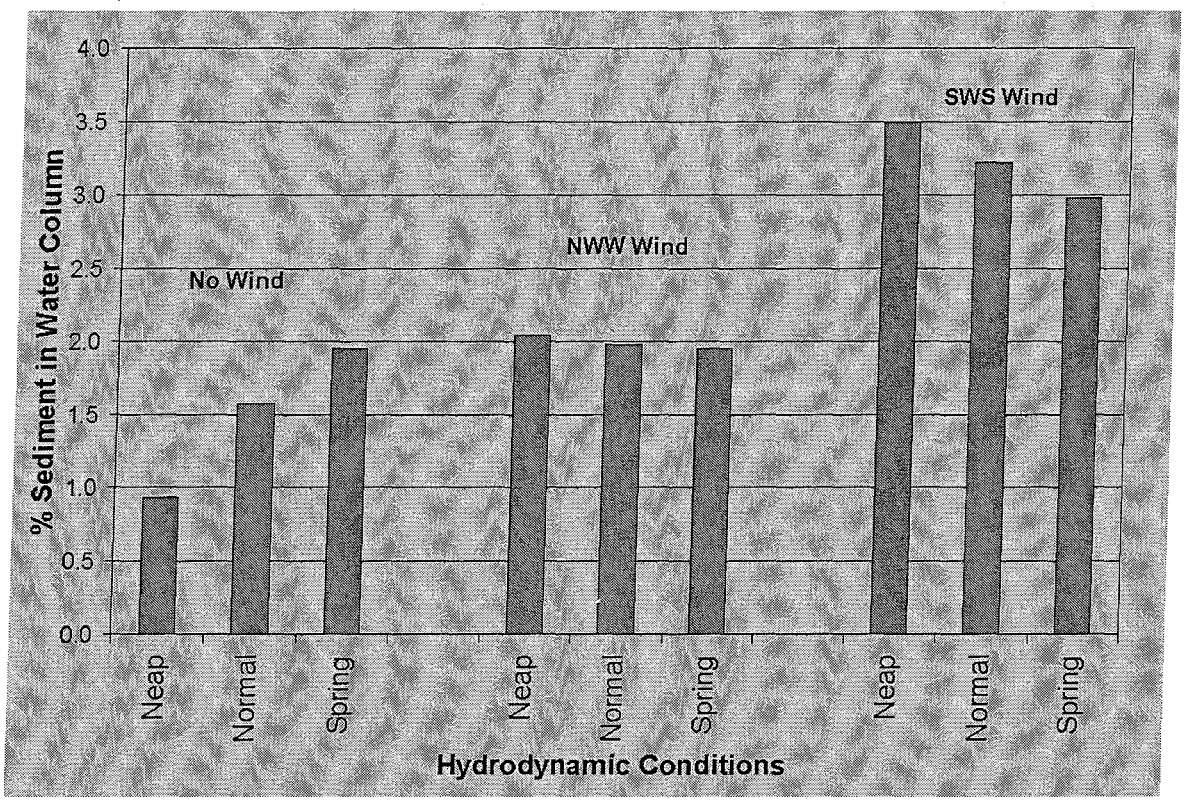


Figure 4-7 Sediment fractions in water column for various hydrodynamic conditions.

4.2 Single Event Disposal into Popes Island CAD Cell

In the previous section, simulations of the TSS increases in the water column due to CAD cell excavation were presented, in which a clamshell bucket operation continuously releases sediments. In this section, TSS concentration increases due to sediment disposal from a scow into the CAD cell is presented. Sediments dredged for channel maintenance and improvement are planned to be stored in a scow as the clamshell bucket removes sediments from the seafloor. When the scow becomes full, it will be moved from the dredging site to a location above the designated CAD cell. Then the scow bottom is opened and the entire contents released. As the sediment descends to the CAD cell floor, some portion of sediment is stripped and remains in the water column. The occurrence of those disposal events is controlled by the clamshell dredging speed of 214 m^3/hr (280 yd^3/hr) and the scow capacity of 1,530 m^3 (2,000 yd^3). At this rate, a disposal event will occur every ~12 hours. The approach to simulate TSS concentrations caused by a single scow disposal follows the same procedure employed in the previous section.

4.2.1 Source Strength Estimation due to Scow Disposal Events

Although excavated CAD cells have much deeper water depths (~17 m [56 ft]) than the original undisturbed depth (~2.6 m), the time for most of the sediment to reach the bottom is still very short (< 120 sec). This short time span cannot be directly simulated by SSFATE. Instead, the USACE model STFATE (Short-Term Fate dredged material disposal model) was used with

equivalent input and environmental conditions. STFATE has various operational modes. One option is to simulate convective descent and sediment cloud collapse phase. This output was used to estimate initial source strengths and vertical distribution of waterborne sediment mass.

The estimated portion of the sediment that is stripped during descent has been estimated to be 1% of total sediment in the bucket (ENSR, 2002). Clamshell-dredged, cohesive material has a high proportion of clump content that tends to reach the bottom intact. This stripped loss estimate is comparable to those used in similar projects in Providence and Boston. The vertical distribution of waterborne sediment mass predicted from the STFATE model is given in Table 4.4. Most (85%) of the material immediately falls to the bottom and only 1% remains in the surface less immediately following disposal.

Table 4.4 The vertical distribution of waterborne sediment mass.

Percent of water column	Percent of sediment mass
90 (near surface)	1
70	2
50	4
30	8
10 (near bottom)	85

4.2.2 Sediment Characteristics of Dredged Materials

Figure 4-8 shows the distribution of sediment classes obtained from the Channel Inner CAD cell site (see Figure 4-9 for locations of the sediment samples). Some of the dredging is expected to take place at this location.. Averaged values of size distributions from these sampling stations were considered to be representative (Table 4.5). The distribution is very similar to the Popes Island one (Table 4.3).

Table 4.5. Representative sediment size class distribution.

Class	Description	Distribution %
1	Clay	20.1
2	Fine silt	17.7
3	Medium fine silt	17.7
4	Fine sand	20.1
5	Coarse sand	24.5

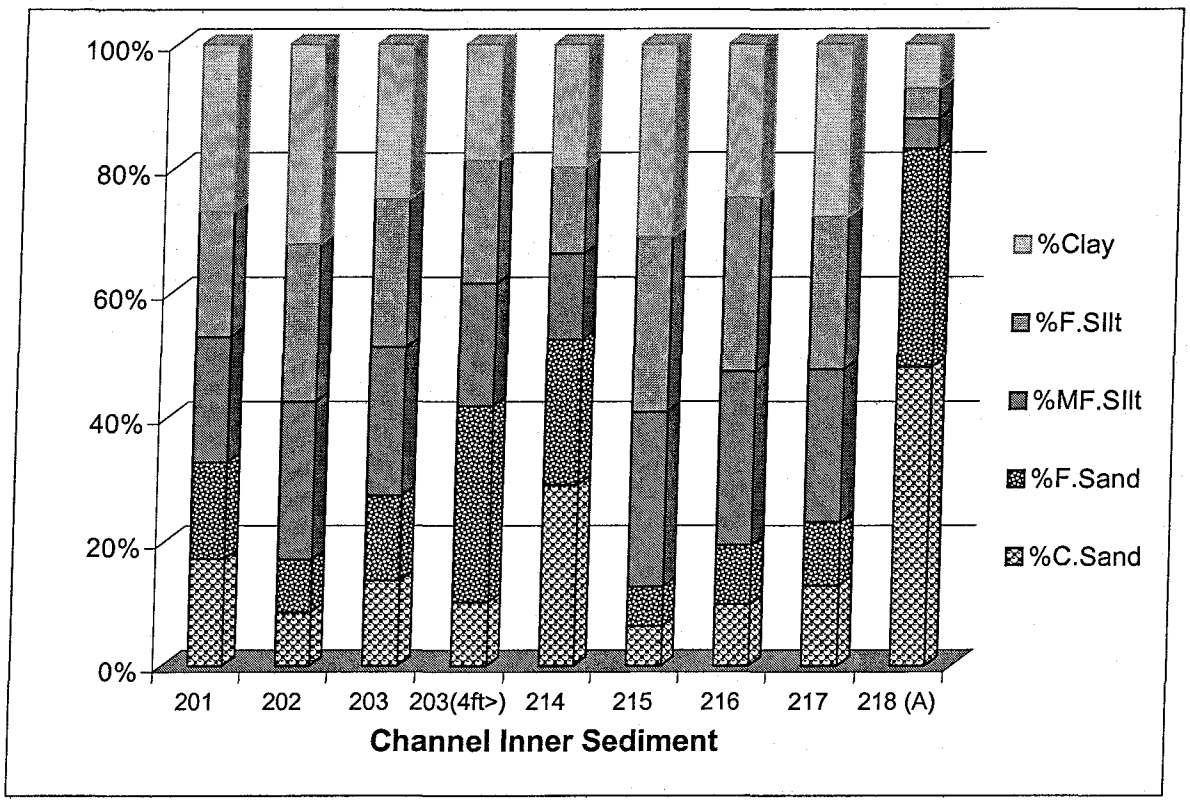


Figure 4-8 Sediment type distributions near Channel Inner dredging site.

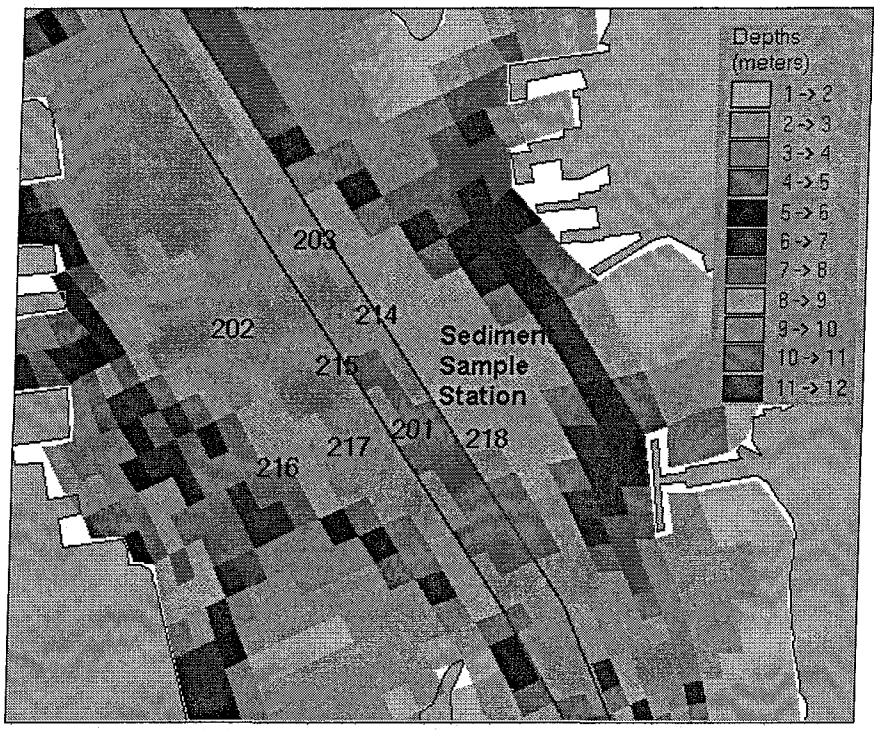


Figure 4-9. Map showing sediment sampling stations near Channel Inner dredge site.

4.2.3 Model Results for Dredged Material Disposal Operation

SSFATE simulations that represented the fate of the dredged material from disposal operations were performed for the nine hydrodynamic conditions. The bathymetry in which the circulation field was created is substantially deeper (~17 m [50 ft]) at the disposal site than the one used (~2.6 m [8.5 ft]) in the previous PIN-CAD cell excavation simulation. The center coordinate of the largest CAD cell was used as the representative disposal site. Unlike dredging operations, sediment disposal is much quicker. The simulation period was 12 hours.

The simulation results presented in this section include:

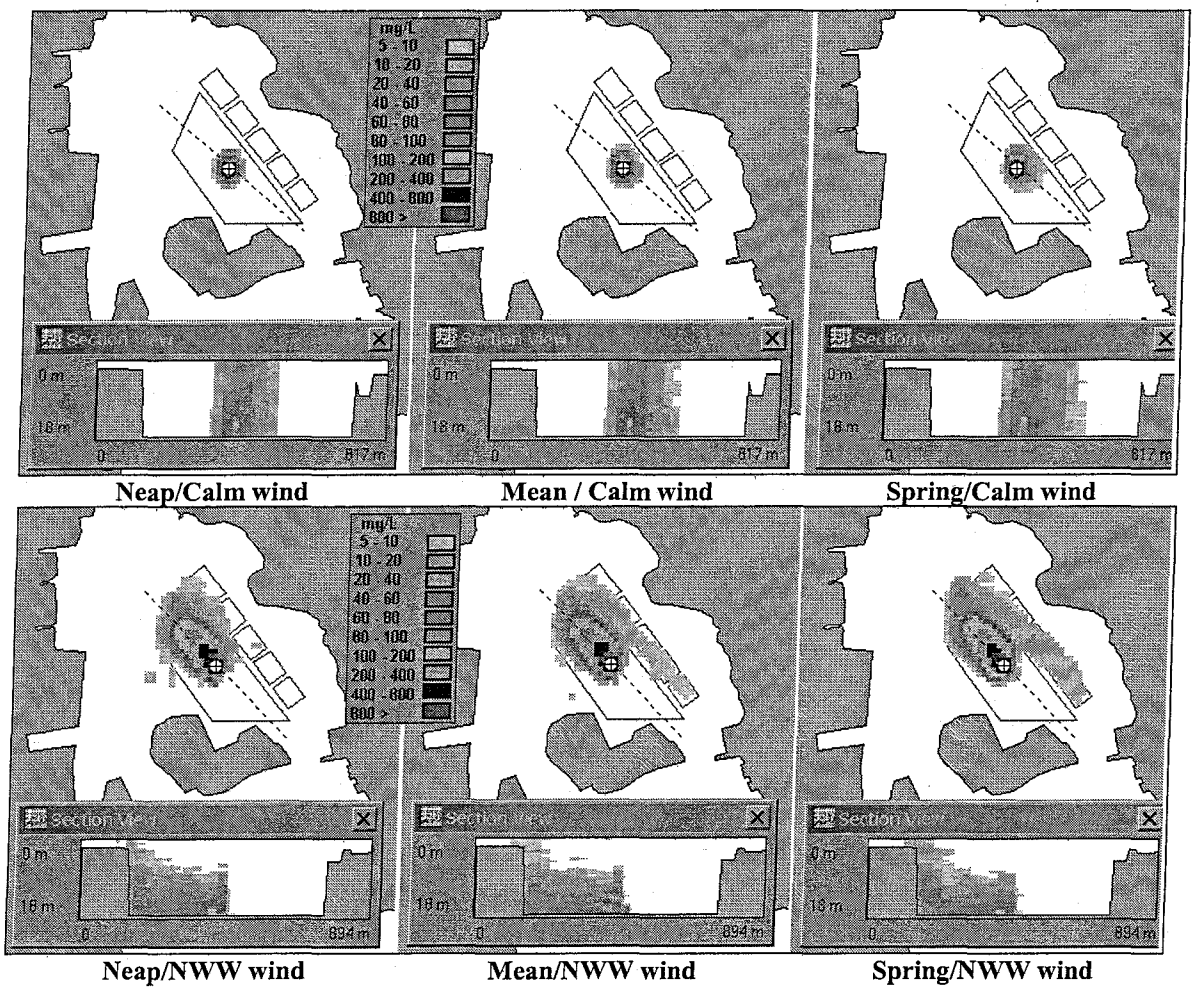
- Horizontal and vertical view of TSS distribution
- Time series of acreage of exceeding 10 mg/L concentration levels

Figure 4-10 shows a plan view of the maximum predicted TSS concentrations throughout the water column during the 12-hour simulation period. Inserted is a vertical section view of the concentration. The frames in the figure are organized by row (wind conditions) and columns (tide conditions). The rows correspond to calm wind, NWW wind and SWS wind from top to bottom, and the columns correspond to neap, mean, and spring tide from left to right.

All TSS concentration distributions for the tide only scenarios were confined within the PIN-CAD cell since the circulation is too weak (see Figure 3-16) to transport material very far. For the NWW and SWW wind cases, sediment clouds reach the edge of the CAD cells, although most of the sediment remained in the cell. The direction of sediment drift corresponded to the flow guided by a combination of the surface wind stress and the bathymetry of the CAD cell.

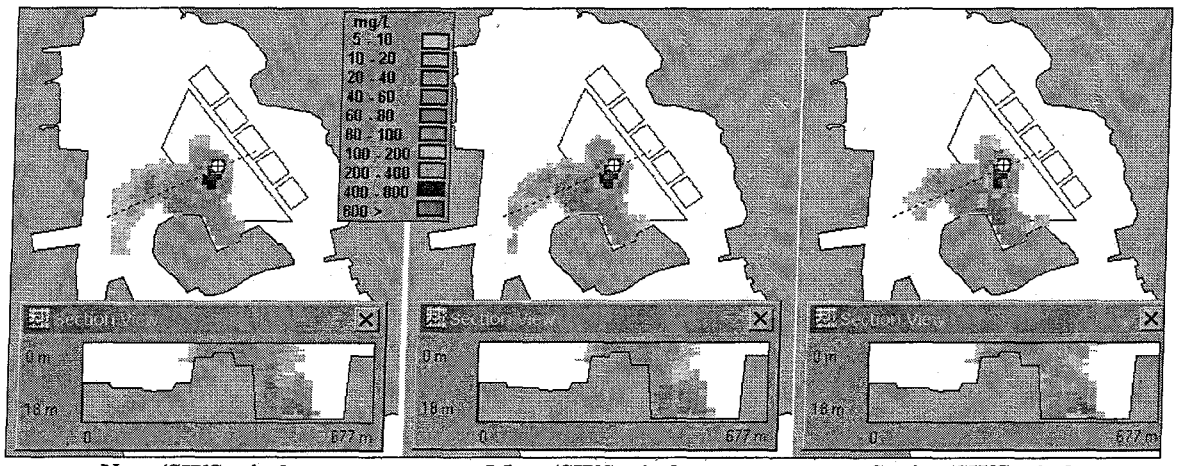
The NWW wind case transported the bottom sediment to the northwest and the SWS wind case transported the sediment to the southwest. It is important to note that the instantaneous concentrations, which varied widely in time, was significantly smaller than the maximum TSS concentrations presented here.

Figure 4-11 shows the area coverage that exceeds a TSS concentration of 10 mg/L (approximately the background threshold) in time. For the case of wind driven circulation, the sediment cloud dissipates within ~ 3 hours. The calm wind tide cases take much longer to settle as most sediment stays in the deep area (~17 m) and so the vertical travel time is increased.



Neap/Calm wind **Mean / Calm wind** **Spring/Calm wind**

Neap/NWW wind **Mean/NWW wind** **Spring/NWW wind**



Neap/SWS wind Mean/SWS wind Spring/SWS wind

Figure 4-10 Maximum TSS concentrations throughout water column and duration of simulation for the nine hydrodynamic scenarios.

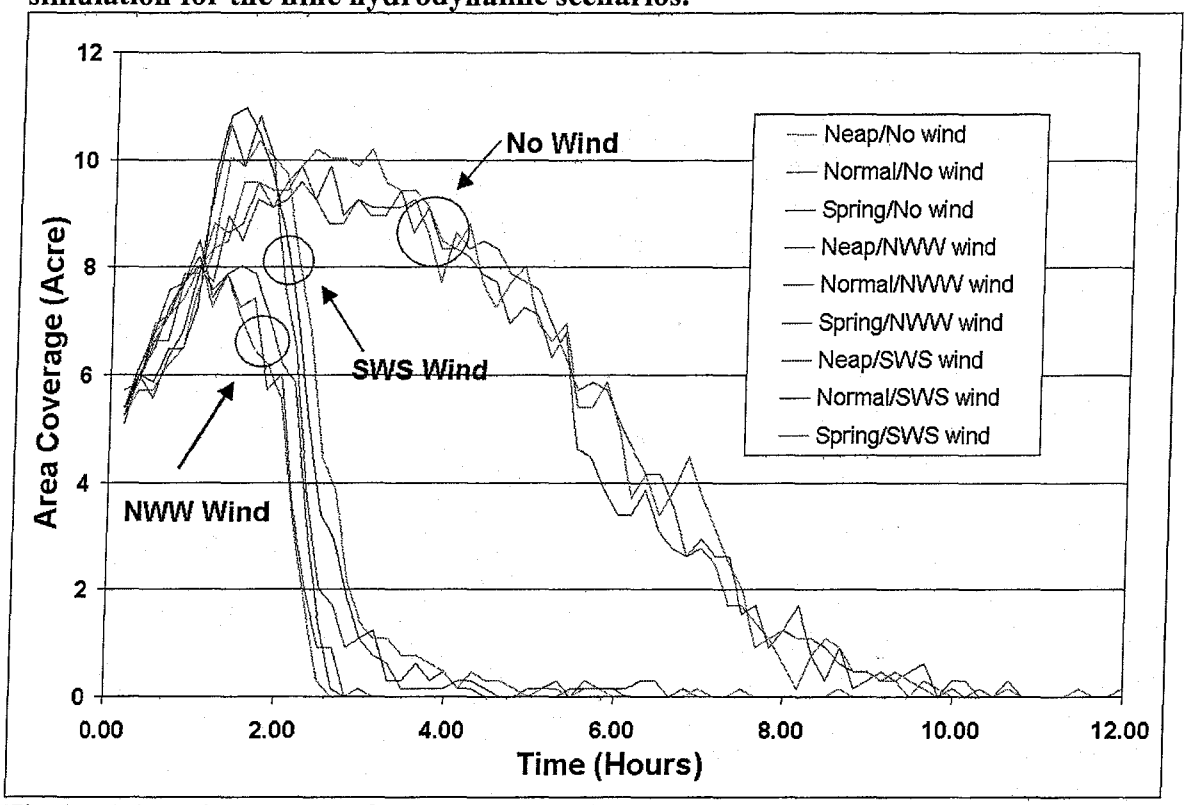


Figure 4-11. Time series of area coverage (acre) that exceeds TSS concentration of 10mg/L for the nine hydrodynamic scenarios.

5. Pollutant Transport Modeling

5.1 BFMASS Model

The BFMASS model, a component of the WQMAP pollutant transport model system, is a single constituent transport model, which includes first order reaction terms. This model is suitable for

a single constituent contaminant that is conservative, settles, decays, or grows. This model was used in this application to predict the temporally and spatially varying concentrations associated with transport of equilibrated sediment contaminants (e.g. hydrocarbons and metals) in dissolved phase (i.e. a conservative constituent).

In BFMASS the two- or three-dimensional advection-diffusion equation is solved on the same boundary conforming grid as the hydrodynamic model, BFHYDRO. The model obtains the face-centered, contra-variant velocity vector components from the hydrodynamic model. This procedure eliminates the need for aggregation or spatial interpolation of the flows from the hydrodynamic model and assures mass conservation. The transport model is solved using a simple explicit finite difference technique on the boundary conforming grid (ASA, 1997). The vertical diffusion, however, is represented implicitly to ease the time step restriction caused by the normally small vertical length scale that characterizes many coastal applications. The horizontal diffusion term is solved by a centered-in-space, explicit technique. The solution to the advection-diffusion equation has been validated by comparison to one- and two-dimensional analytic solutions for constant plane and line source loads in a uniform flow field and for a constant step function at the upstream boundary. The model has also been tested for salinity intrusion in a channel (Muin, 1993).

5.2 Model Application

5.2.1 Disposal Operations

Contaminated dredged material will be buried in the confined aquatic disposal (CAD) facility that is proposed north of Popes Island (PIN). There are two types of dredging operations that will use the facility that are classified large and small volume projects. Since the extent or likelihood of large projects are uncertain at this time, pollutant transport and fate simulations were focused on disposal activity for a small project whose volume is on the order of 30,600 m^3 (40,000 yd^3). Table 5-1 lists the details of a likely disposal activity in addition to the associated dredging operation. These details were developed jointly with Maguire personnel. The use of two split-hull scows were assumed, alternating to carry and dispose dredged material during two 12-hr shifts per day. Dimensions of each barge were 3 m (10 ft) wide by 76 m (250 ft) long with a holding capacity of 1,530 m^3 (2,000 yd^3).

Table 5-1. Assumed details for dredging and disposal operations in New Bedford Harbor.

Operation	Parameter		Detail
Dredging	Dredging Sites		Maneuvering channel, berth, wharf, inner federal navigation channel
	Dredging Project Volume		30,600 m (40,000 yd^3)
	Composition of dredged material (%)	Contaminated material	90
	Types of dredging operation for	Contaminated material	Continuous
	Dredging equipment used for	Contaminated material	Environmental bucket

	Bucket capacity	Environmental bucket	5.4 m^3 (7 yd^3)
	Dredging rate (min/grab)		1.5
	Duration of dredging operation (day)		6
	Number of concurrent dredging operations		One
	Time of dredge operations		1 June 2003 ~ 1 January 2004
	Loss rate during dredging operation		1.5%
Disposal	Disposal Site Location		Popes Island North
	Number of scows		2
	Scow Capacity (yd^3)		1,530 m^3 (2,000 yd^3)
	Dimension of scow		3 m (10 ft) wide × 76 m (250 ft) long
	Type of scow		Split-hull
	Duration of disposal operation (sec)		5
	Typical cycle from barge loading to disposal (hour)		12

5.2.2 Source Strength

The source strength is the mass of pollutant entering the system on a rate basis. Three types of source strengths can be specified in BFMASS: 1), an instantaneous release; 2), a constant release over time; and 3), variable release over time. An instantaneous source release is the mass of material released to the water column from an entire split-hull barge load in a second. A constant source is defined as the mean loading to the water column from multiple barge releases over time. A variable source is the time varying loading to the water column as individual barge releases occur according to a time schedule.

The disposal operation of dredged material in New Bedford Harbor is assumed to take place twice a day over a 6-day period for a typical small project (Table 5-1). To simulate the operation, a series of 12 instantaneous releases of a volume of 1,529 m^3 (2,000 yd^3) occurred once every 12 hours.

A conservative estimate of the mass of pollutant released from the disposal of dredged material can be determined from the elutriate analysis data (EPA, 1991). Elutriate pollutant concentration data are reported on a mass of pollutant to volume of water basis (i.e. mg/L) based on an initial 200 g of wet sediment mixed with 800 g of site water. (SAIC, 2003). Since the elutriate test is designed to measure the dissolved fraction of pollutant in liquid portion, the mass of pollutant can be approximated as the product of the elutriate concentration E and the volume of water V. Assuming the wet sediment is composed of 50% water and 50% sediment particles the total volume of water is its mass, 900 g, divided by its approximate density, 1000 g/L, to give V = 0.9 L. Thus a pollutant mass, m, is

$$
\begin{aligned}
m\ (\mu g) &= EV \\
&= E\ (\mu g/L) \times 0.9\ (L) \\
&= 0.9\ E\ (\mu g)
\end{aligned}
\qquad (1)
$$

is generated from every 200 g of wet sediment. The total amount of pollutant released from the total sediment volume released from a 1,530 m^3 (2,000 yd^3) barge, M (g), is

$$M\ (g) = m\ (\mu g) / 200\ (g) \times D\ (m^3) \times C\ (gL/10^3 m^3 \mu g), \qquad (2)$$

where D is the total sediment volume released in m^3, and C is a unit conversion factor, (10^3 L/m^3) × ($g/10^6 \mu g$).

5.2.3 Settling Velocity

The settling velocity acts as a mechanism to remove suspended sediment from the water column. It varies with the type (cohesive or non-cohesive) of material and particle size. Since we are considering dissolved phase contaminants in these disposal simulations, no settling velocity was applied.

5.2.4 Release Location

The PIN-CAD facility is excavated to an average depth between 11.6 m (38 ft) and 17.4 m (57 ft), to accommodate 734,000 m^3 (960,000 yd^3) of dredged material in a total of 6 cells generated from projects over the next 10 years. Except for cell 1 that is the largest, potentially storing 1,408,000 m^3 (1,841,000 yd^3) of sediment, cells 2 through 6 are similar in size and each can hold approximately 39,000 m^3 (51,000 yd^3) volume (Figure 5-1). Since the estimated size of a small cell (86 m long by 65 m wide) is slightly larger than a typical model grid cell at the PIN-CAD facility, the cell size is too small to accurately simulate. Therefore, simulations of disposal operations will focus on the much larger cell 1.

Since cell 1 will be filled in progressively, we simulated disposal operations as three separate operations as representative of the continuous activity, having release locations at the center, the northwest and southeast corners of the CAD-site (Figure 5-1).

Figure 5-1. Modeled mass load locations (white crosses) used to simulate disposal operations in PIN-CAD site (black polygon), superimposed on bathymetry.

5.2.5 Toxic Pollutants

Simulations of the fate and transport of pollutants were performed on constituents whose elutriate concentrations exceeded U. S. EPA water quality chronic levels. Analysis of elutriate samples in New Bedford Harbor (SAIC, 2003) showed that most of the stations located at dredging and disposal sites contained elevated concentrations of Aluminum (Al), Copper (Cu),

Nickel (Ni), Silver (Ag) and Polychlorinated Biphenyls (PCB). Benzo(a)fluoranthene and Benzo(k)fluoranthene, part of high molecular weight (HMW) (Petroleum Aromatic Hydrocarbon), also exceeded the USEPA chronic levels at some stations.

As part of modeling input, the mass of the pollutant source is required for each contaminant. Table 5-2 lists the source strengths calculated from equations (1) and (2). Also shown are U. S. EPA water quality chronic criteria and the dilution required to lower elutriate concentrations to meet the criteria.

None of pollutants exceed the U. S. EPA water quality acute level except copper (4.8 ug/L) at NBH-202 and NBH-207 stations. Only Al, Cu, Ag and PCB exceed the chronic levels. The dilution of elutriate concentration for PCB to meet the chronic level ranges between 11 and 67. Copper has the next highest required dilutions (1 to 32) followed by silver (14). Station NBH-202, located at the Channel Inner CAD site, has the highest concentrations for all constituents shown in the table. The next highest concentrations are from station NBH-207, located at Fish Island.

5.2.6 Other Model Parameters

Primary physical processes governing the fate and transport of disposed material are advection and diffusion. The former is due to the currents that are predicted from the hydrodynamic modeling. The latter includes horizontal and vertical diffusion which are specified as model inputs. The vertical diffusion coefficient used was 50 cm^2/sec (0.05 ft^2/s), typical of estuary systems (Officer, 1976), and the horizontal diffusion was 1000 cm^2/sec (1.09 ft^2/s), determined from a dye study in the lower Acushnet estuary (ASA, 2003).

Table 5-2. Pollutant constituents, elutriate concentrations, source strengths and dilutions for disposal operations at the PIN-CAD site. Dilution is the ratio of elutriate concentration and chronic criteria concentration.

Station	Pollutant	Elutriate Conc* (µg/L)	Source Strength (g)	WQ Chronic (µg/L)	Dilution
NBH-201	Al	161	2021.7	87	2
	Cu	7.1	89.2	3.1	2
	Ni	13.5	169.5	8.2	2
	Ag	1.4	17.6	0.1	14
	PCB	1.72	21.6	0.03	57
NBH-202	Al	2320	29132.0	87	27
	Cu	97.8	1228.1	3.1	32
	Pb	13.4	168.3	8.1	2
	Ni	13.5	169.5	8.2	2
	Ag	1.4	17.6	0.1	14
	PCB	23	288.8	0.03	767
NBH-204	Al	577	7245.3	87	7
	Cu	4	50.2	3.1	1
	Ni	13.5	169.5	8.2	2
	Ag	1.4	17.6	0.1	14
	PCB	0.34	4.3	0.03	11
NBH-205	Al	346	4344.7	87	4
	Cu	10.8	135.6	3.1	4
	Ni	13.5	169.5	8.2	2
	Ag	1.4	17.6	0.1	14
	PCB	0.88	11.1	0.03	29
NBH-206	Al	216	2712.3	87	3
	Cu	7.1	89.2	3.1	2
	Ni	13.5	169.5	8.2	2
	Ag	1.4	17.6	0.1	14
	PCB	1.22	15.3	0.03	41
NBH-207	Al	853	10711.0	87	10
	Cu	39	489.7	3.1	13
	Ni	13.5	169.5	8.2	2
	Ag	1.4	17.6	0.1	14
	PCB	5.69	71.4	0.03	190

5.3 BFMASS Modeling Results

This section documents the results of the fate and transport simulations of contaminants disposed at the PIN-CAD site in Inner New Bedford Harbor. Simulations were performed using a three-dimensional (7-layer) application of BFMASS. Three different tides (spring, neap and mean tides), and three wind conditions (calm, northwesterly and southwesterly winds) were chosen as representative of the range of likely environmental conditions.

All modeled constituents were released at the end of flood portion of the M_2 tidal cycle, so that the subsequent ebb currents transported the constituents in the water column south toward the Hurricane Barrier.

Elutriate concentration data (Table 5-2) shows that dredged material from station NBH-202 (located at the proposed CAD-CI) was more highly contaminated compared to the other stations. For example, the PCB elutriate concentration was 767 times the U.S. EPA chronic level (U. S. EPA, 2002). This is four times higher than the next highest PCB concentration found at station NBH-207 (located at Fish Island) and 70 times higher than the lowest at station NBH-204 (also located at CAD-CI). This section documents model results in detail for the worst contaminant case, NBH-202 PCBs, and then presents the results in more generalized format for the rest of contaminants and stations.

The BFMASS simulation results indicated that the contaminant distribution patterns in the horizontal and vertical were similar for the three tide ranges. Concentration levels, however, were higher in the near field for neap tides than for spring tides because more energetic currents during the spring tides promote more dispersion and mixing. Different wind conditions resulted in different spatial distribution patterns and coverages. For example, Figure 5-2 PCB shows concentration levels 1 hour after the final disposal event for calm, southwesterly and northwesterly winds. Background hydrodynamics were driven by neap tides. During calm conditions (Figure 5-2a), the simulated plume is more concentric, exhibiting the highest concentration at the release site, whereas the plume is oriented in the down-wind direction forming an elliptic shape (Figures 5-2b and 5-2c). The vertical distribution of contaminant confirms the plume pattern, exhibiting a larger shift toward the down-wind direction at the surface layer than in the lower layers.

Among the three wind conditions, spatial coverage (area exceeding a specified concentration) for the PCB WQ chronic concentration (0.03 ug/L) is the largest for calm wind and the smallest for northwesterly winds. Area coverages appear to have a distinct pattern for different ranges of concentration. Comparing between calm and southwesterly winds, the coverages without wind are larger for concentrations greater than 0.03 μg/L but smaller for lower concentrations. However, for calm conditions, the coverage is larger than for northwesterly winds. Although the same wind speed is applied to Figures 5-5b and 5-5c, smaller area coverages for concentrations larger than 0.05 μg/L and larger coverages for low concentrations ($\leq$ 0.05 μg/L) are predicted for southwesterly winds (Figure 5-2b). This is due to both tides and southwesterly winds, of which the latter advects contaminants to relatively open and deep areas where the former is also strong.

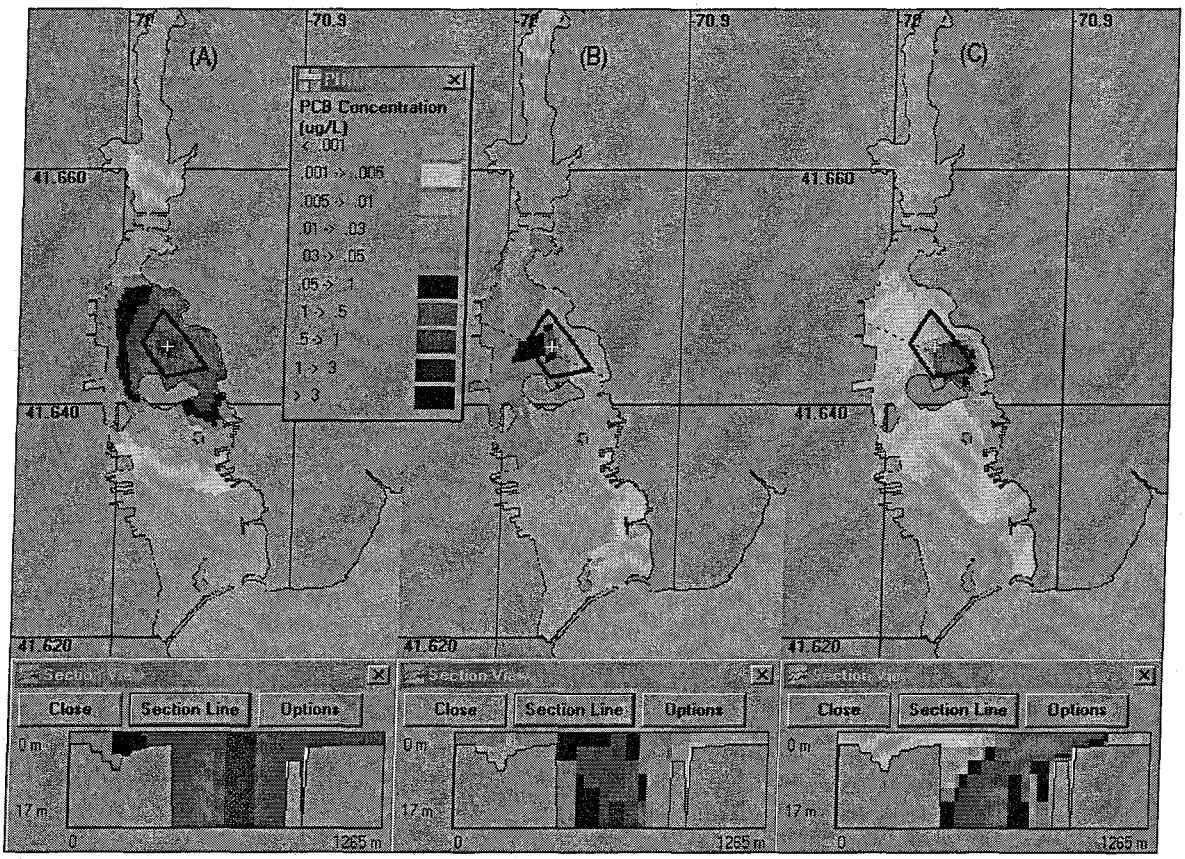


Figure 5-2. Simulated PCB distributions for calm wind (a), southwesterly (b) and northwesterly winds (c). Distributions are shown 1 hour after the final disposal event.

Among the nine environmental scenarios, the largest spatial coverage was predicted for neap tides and calm wind conditions. On the other hand, the smallest coverage occurred for neap tides and northwesterly winds. This finding was consistent among the three different release locations in the PIN-Cad cell. Figures 5-3 and 5-4 show the maximum area affected (coverage) due to released NBH-202 PCB as a function of concentration for the neap tide and no wind condition and the neap tide and northwesterly wind condition, respectively. The area of the PIN-CAD is shown for reference as is the U. S. EPA chronic water quality (WQ) concentration for PCB.

Under calm winds (Figure 5-3), the area coverage is always larger than the CAD area for concentrations less than 0.4 μg/L. The coverages at the PCB chronic level (0.03 μg/L) are 1×10^6 m^2 (southeast corner release) and 1.2×10^6 m^2 (center and northwest corner releases), which are between 6 and 7 times larger than the CAD cell area, respectively. The concentrations for an area the same as the CAD site area are 0.42 μg/L, 0.44 μg/L and 0.35 μg/L for a center, northwest and southeast release, respectively. While the calm wind condition simulates very similar coverages for the three release locations (Figure 5-3), a northwest release with northwesterly winds generates the largest coverage and a southeast release yields the smallest coverage (Figure 5-4). Spatial coverage for the 0.03

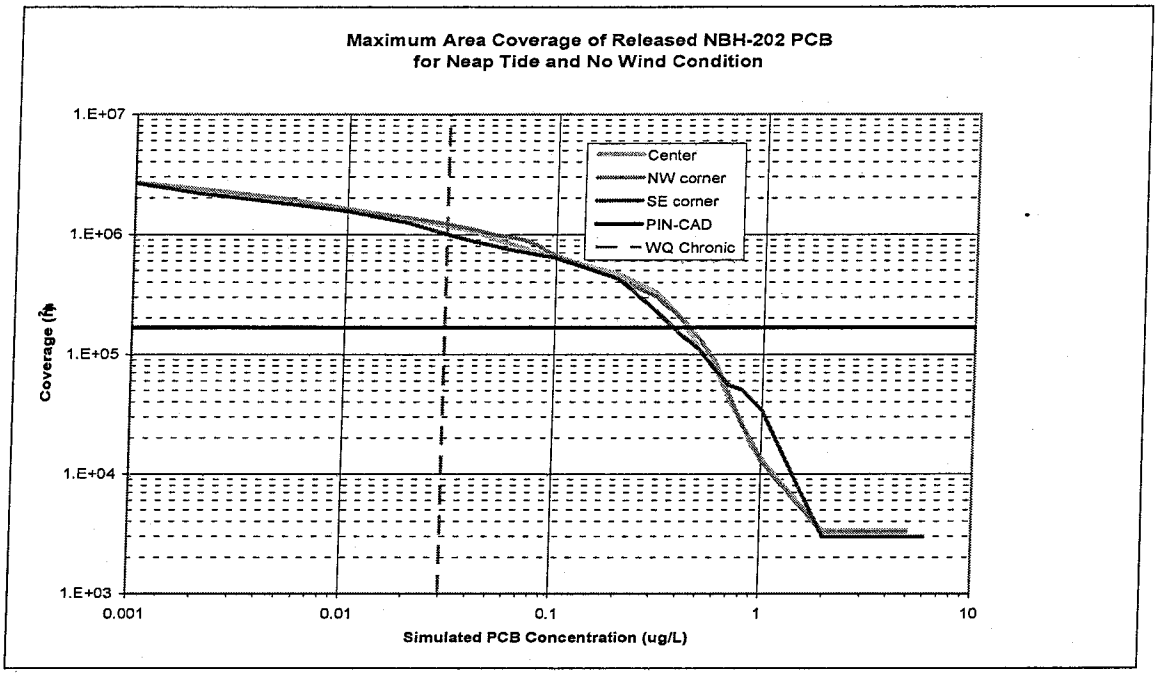


Figure 5-3. Maximum area coverages (y-axis) of PCBs vs. concentrations for neap tides and calm winds for three release sites using the NBH-202 station source strength. Both x- and y-axes are logarithmic scales. The PIN-CAD cell area (1.67×10^5 m^2) is shown with a black horizontal line and the U. S. EPA WQ chronic value for PCB (0.03 µg/L) is shown with a dashed vertical line.

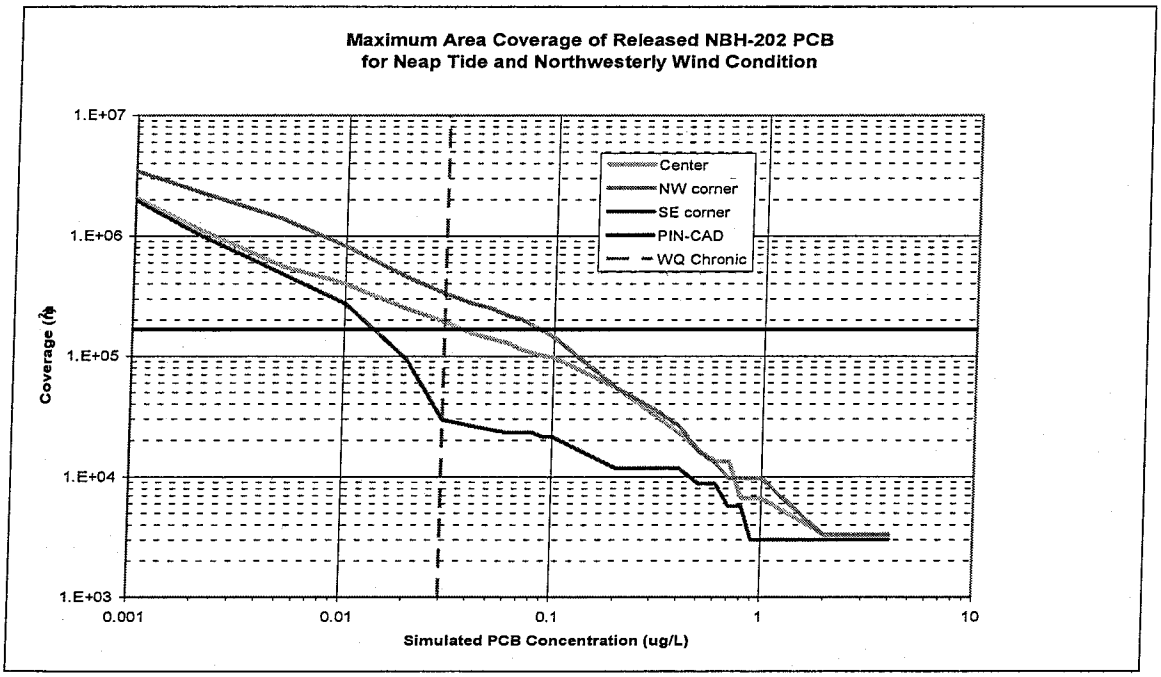


Figure 5-4. Maximum area coverages (y-axis) of PCBs vs. concentrations for neap tides and northwesterly winds for three release sites using the NBH-202 station source strength. Both x- and y-axis are logarithmic scale. The PIN-CAD cell area (1.67×10^5 m^2) is shown with a black horizontal line and the U. S. EPA WQ chronic value for PCB (0.03 µg/L) is shown with a dashed vertical line.

μg/L chronic concentration with wind is 0.3×10^6 m^2, 1.9×10^5 m^2, and 3.3×10^6 m^2 with southeast, center and northwest releases, respectively. The concentrations for areas equivalent to the CAD site area are 0.015 μg/L for a southeast release, 0.035 μg/L for a center release and 0.08 μg/L for a northwest release.

Figure 5-5a presents the same area coverages as Figure 5-3, except concentrations are shown relative to a unit input mass (g). In other words, Figure 5-3 can be obtained by multiplying the concentrations in Figure 5-5a by 288.8 (PCB source strength for NBH-202). The advantage of presenting the results in this way is that the simulated coverage is not pollutant- or site-specific. Hence, the results can be applied to any pollutant and any station by multiplying by the corresponding source strength listed in Table 5-2. Ni and Pb chronic criteria are almost identical so the Pb is not presented in the figure.

For example, using aluminum (Al) originating from station NBH-201, the concentration having the same size as the CAD cell is 3 μg/L (0.00158 μg/L × 2021.7) with the southeast corner release (red curve in Figure 5-5a). Areas for concentrations greater than 3 μg/L are smaller than the CAD cell. The coverage for the Al WQ chronic concentration (87 μg/L) is 5.5×10^4 m^2. Similarly for the center (blue in Figure 5-5a) and northwest releases (green in Figure 5-5a), the concentration covering the same size as the CAD cell is 2.5 μg/L (0.00126 μg/L × 2021.7) and spatial coverage for the chronic concentration is 2.2×10^4 m^2.

Overall, for neap tide and calm wind conditions both Al and Cu exhibit smaller area coverages than the CAD cell. Area coverage for Ag is either the same as or slightly larger than the area of the release cell (shown as the horizontal tail end of each curve). For Pb and Ni, predicted concentrations in the release cell are below the chronic level.

Figures 5-b and 5-c are the same as Figure 5-a, except for different wind directions, southwesterly and northwesterly, respectively. The difference between the two wind conditions is that the area coverage for southwesterly winds is almost constant for low concentrations and gradually decreases for high concentrations, whereas the coverage for northwesterly winds linearly decreases with concentrations. The coverages for Al, Cu and Ag chronic concentrations are smaller than the CAD cell size for both wind conditions. Predicted concentrations of Pb and Ni are always smaller than their chronic concentrations while PCB concentrations are larger.

During neap tides and calm winds (Figure 5-5a), the coverage is almost same regardless of release site. With winds (Figures 5-5b and 5-5c), the southeast corner release exhibits the largest coverage for southwesterly winds and the smallest coverage for northwesterly winds. The opposite exists for a northwest corner release, with a large coverage for southwesterly winds and small coverage for northwesterly winds.

Figure 5-6 shows maximum area coverages for spring tides and the three different wind conditions. Individual spatial coverage curves for spring tides appear very similar to those for neap tides (Figure 5-5). However, a comparison between Figures 5-5b and 5-6b for southwesterly winds shows that smaller coverages for spring tides are found with a southeast release, and relatively larger coverages for spring tides are predicted with a

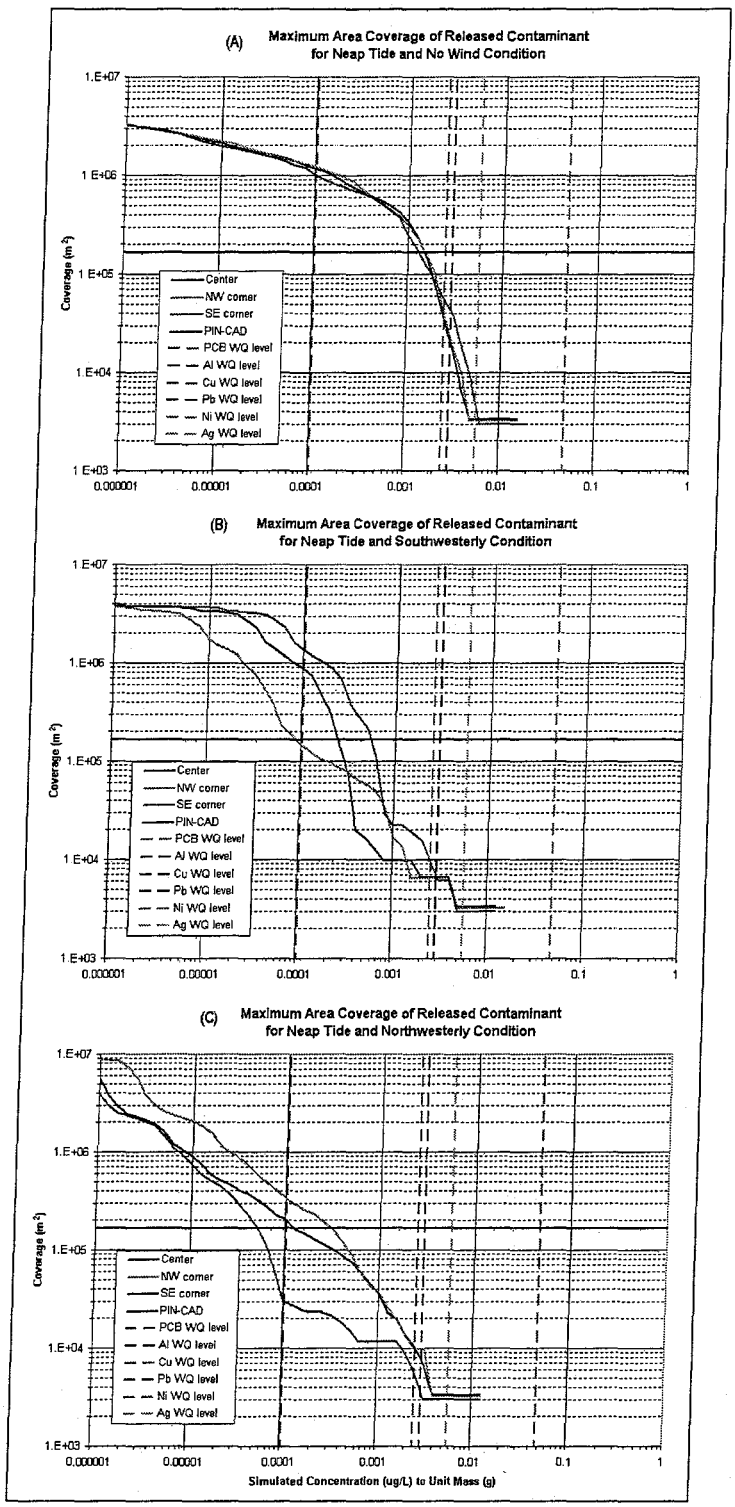


Figure 5-5. Maximum area coverages (solid lines) for neap tides and calm (a), southwesterly (b) and northwesterly winds (c). Dashed lines denote U. S. EPA WQ chronic concentrations normalized to input mass.

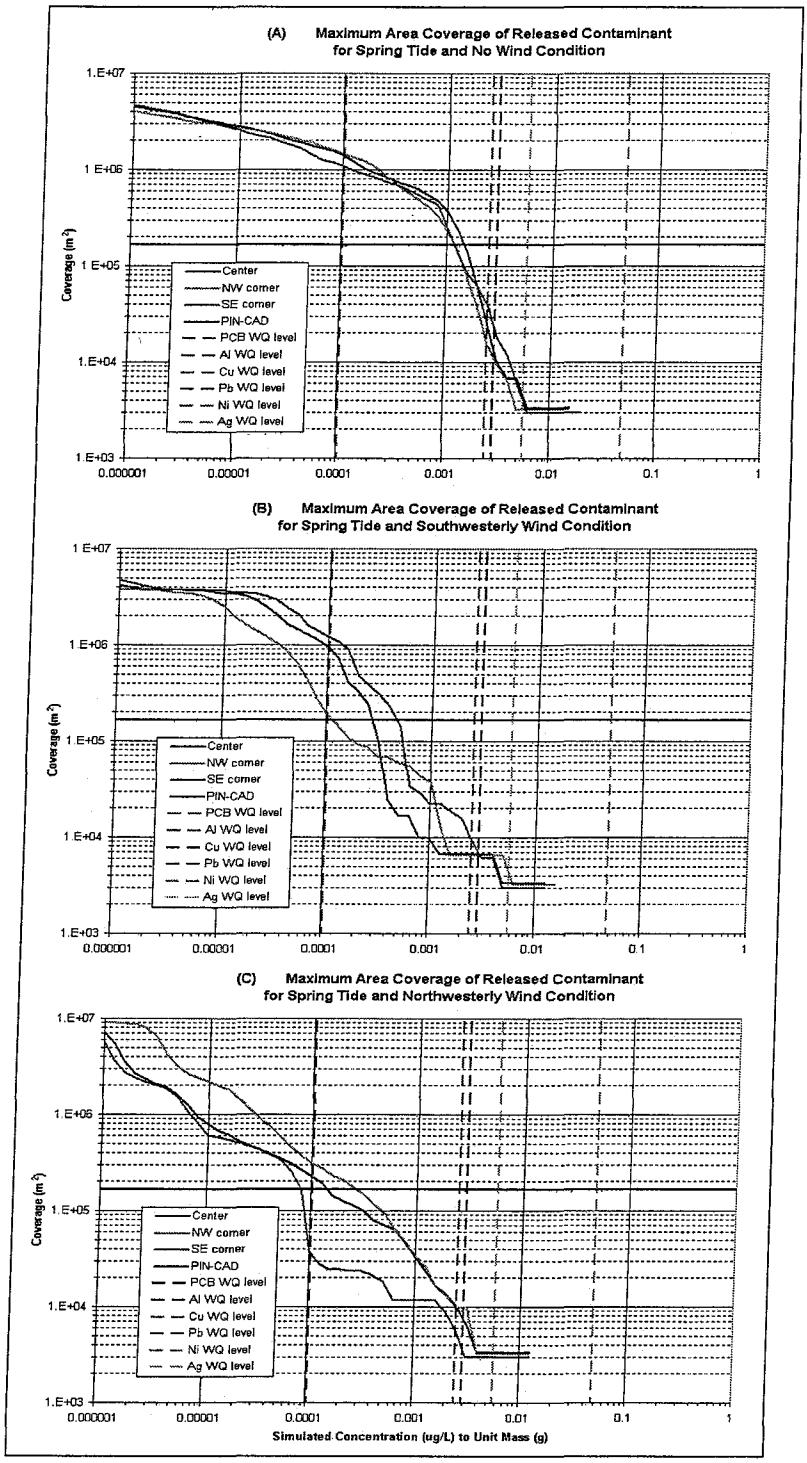


Figure 5-6. Maximum area coverages (solid lines) for spring tides and calm (a), southwesterly (b) and northwesterly winds (c). Dashed lines denote U. S. EPA WQ chronic concentrations normalized to input mass.

northwest release. For northwesterly winds between neap (Figure 5-5c) and spring (Figure 5-6c) tides, the coverage with a northwest release was the same for both tides but relatively larger coverage occurs for spring tides than neap tides with a southeast release.

Figure 5-7 shows maximum spatial coverages for mean tides and the three wind conditions. Variations in area coverage consistently lie between neap and spring tides, as expected.

According to toxicity tests using sediments from the stations listed in Table 5-2 with mysids and sea urchins reported by SAIC (2003), the cause of acute toxicity was the combination of multiple pollutants. For example, half the toxicity to mysids was due to PCBs and the other half was due to a combination of copper and ammonia. From these results, SAIC suggested that a dilution to at least 2.2% of the elutriate concentration would be protective.

Figure 5-8 shows maximum area coverages for a release of 1g of a combination of toxic pollutants. Presented are the coverages for the worst conditions (neap tide and calm wind) and the most favorable conditions (neap tide and northwesterly wind). For both conditions, area coverage for a concentration of 2.2% of the elutriate level was always smaller than the PIN-CAD area. The largest area coverage for the 2.2% elutriate concentration occurred for a northwest release during calm winds, 1.2×10^5 m^2. The smallest coverage for the protective dilution level occurred for a southeast release during northwesterly winds, 1.0×10^4 m^2.

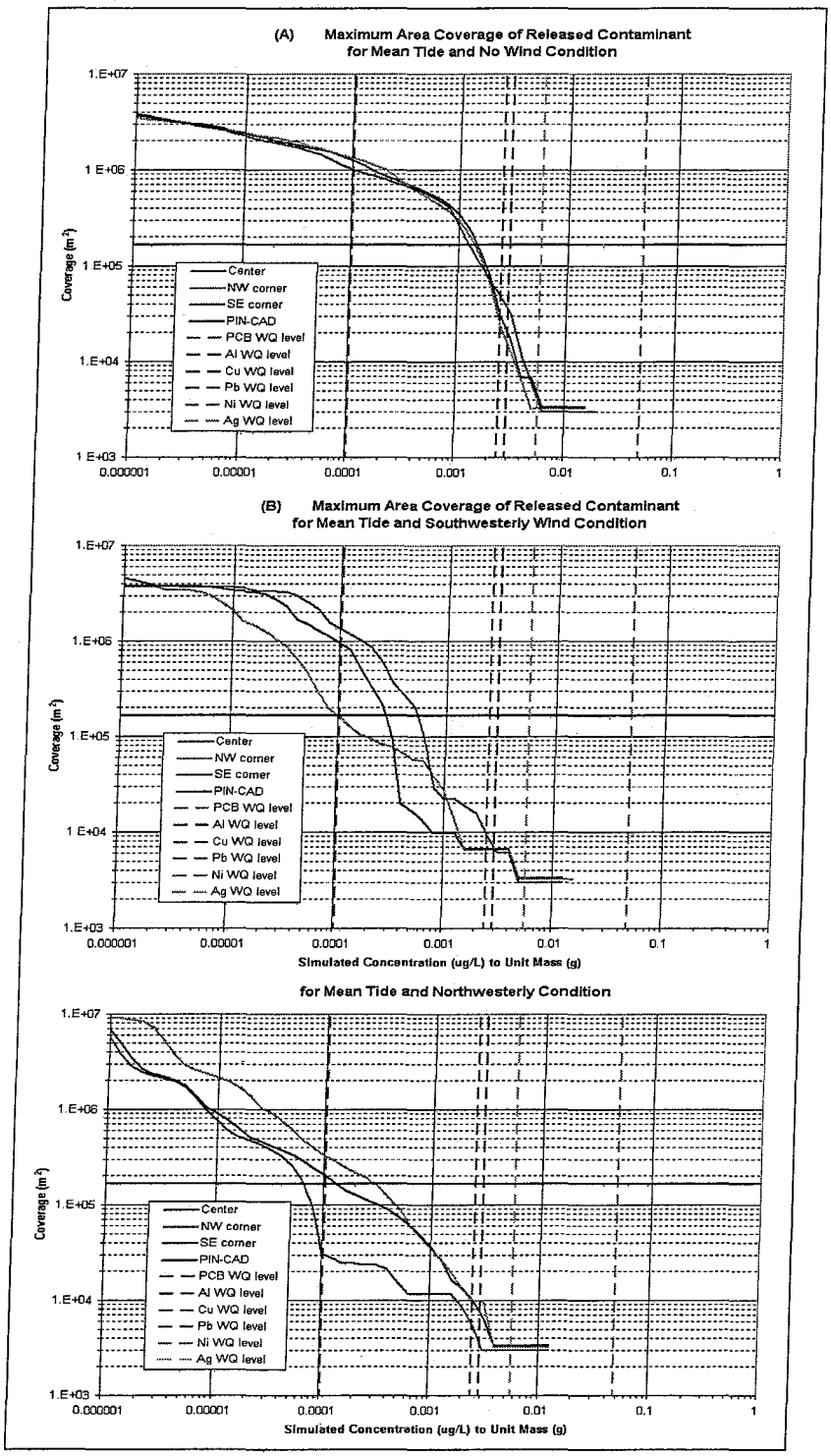


Figure 5-7. Maximum area coverages (solid lines) for mean tides and calm (a), southwesterly (b) and northwesterly winds (c). Dashed lines denote U. S. EPA WQ chronic concentrations normalized to input mass.

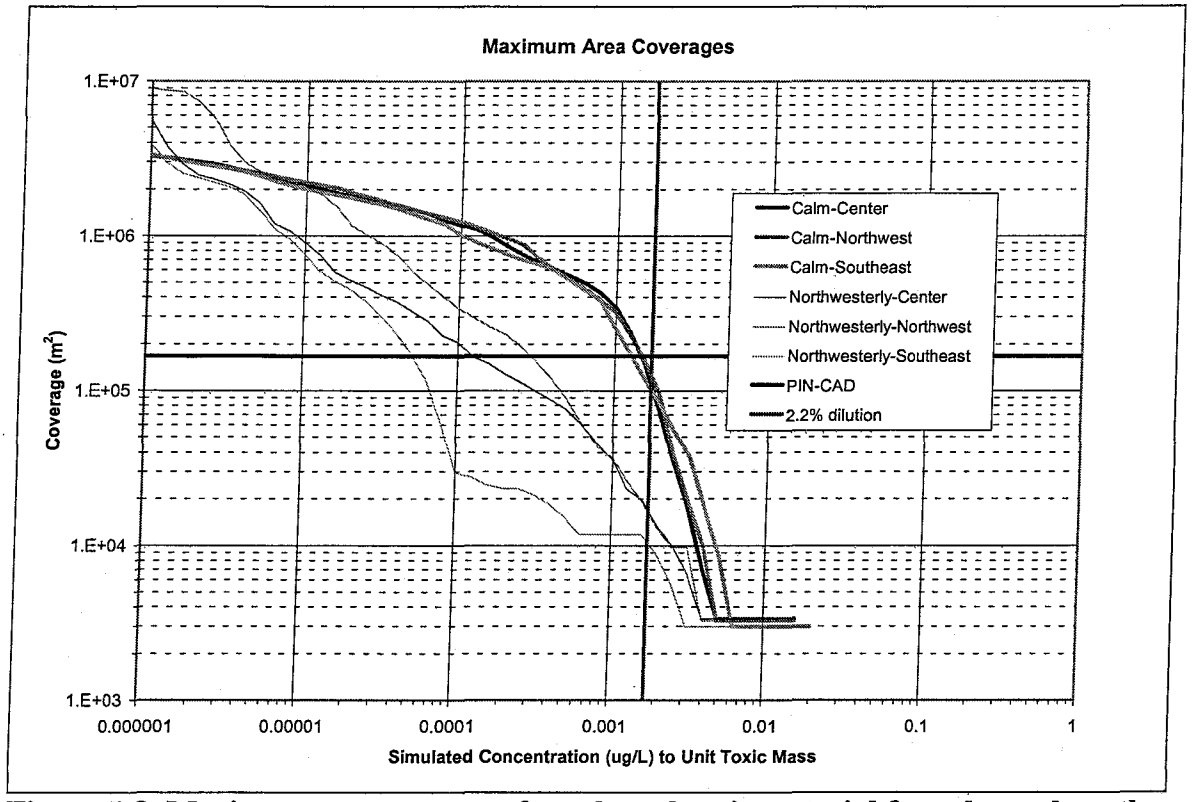


Figure 5-8. Maximum area coverage for released toxic material for calm and northwesterly winds.

6. Summary and Conclusions

The field-obtained elevations and velocities were examined to determine that tides and wind were the primary forces that drove the circulation in New Bedford Harbor. Hydrodynamic simulations were successfully conducted to verify model performance for the period of the field measurement program. Nine basic hydrodynamic conditions were prepared to provide the advection data to the pollutant and sediment transport models based on the combination of three tidal ranges (neap, mean and spring) and three most likely wind conditions (calm, southwesterly and northwesterly directions).

The SSFATE (Suspended Sediment Fate) model was used to simulate TSS (Total Suspended Solid) concentrations due to the proposed excavation of the CAD (Confined Aquatic Disposal) cells and the disposal of dredged material into one of the cells. Resultant TSS distributions showed that combinations of the wind induced circulation and bathymetry played a key role. When the sediment plumes were carried into the deeper sections of the harbor, the duration and size of sediment cloud were more extensive than when the sediment plumes were carried into the shallower sections, where the sediment settled out more quickly.

A series of dissolved phase pollutant fate and transport simulations were performed to estimate the water quality impacts in the water column at north of Popes Island, using BFMASS (Boundary Fitted Mass Transport Model). Simulations were performed for various pollutant

constituents whose elutriate concentrations exceeded the U. S. EPA water quality guidance levels: metals (aluminum, copper, nickel and silver), and polychlorinated biphenyls (PCBs). The model simulated the fate and transport of disposal of dredged material at the PIN-CAD site (north of Popes Island). Disposal operations were assumed to last for 6 days and disposal taking place twice a day following the M_2 tidal cycle. Each release volume of dredged material was assumed to be 1,530 m^3 (2,000 yd^3).

None of pollutant elutriate concentrations exceeded the U. S. EPA water quality acute criteria except copper (4.8 ug/L) at two stations. Al, Cu, Ni, Ag, and PCB exceed chronic levels. The dilution of elutriate concentration for PCB to meet the chronic criteria ranged between 11 and 767, Cu had the next highest required dilutions (1 to 32) followed by Al (2 to 27), Ag (14) and Ni (2). One proposed site, Station NBH-202, located at another proposed CAD site denoted Channel Inner (CAD-CI), had the highest concentrations for all constituents. Station NBH-207, located north of Fish Island, was second highest.

The BFMASS simulation results indicated that the contaminant distribution patterns in the horizontal and vertical were similar for the three tide ranges. Concentration levels, however, were higher in the near field for neap tides than for spring tides because more energetic currents during the spring tides promote more dispersion and mixing. Different wind conditions resulted in different spatial distribution patterns and coverages. Among the nine environmental scenarios, the largest spatial coverage (area) was predicted for neap tides and calm wind conditions. The smallest coverage occurred for neap tides and northwesterly winds. This finding was consistent among three different release locations in the large PIN-CAD cell.

According to toxicity tests using sediments from the NBH-202 station sampled at CAD-CI, the combination of multiple pollutants was the cause of the observed acute toxicity effects. For example, half the toxicity to mysids was due to PCBs and the other half was due to a combination of copper and ammonia. From these results SAIC concluded a dilution to less than 2.2% of the elutriate concentration would be protective. The model results showed that for any environmental condition, area coverage for a concentration of 2.2% of the elutriate level was always smaller than the PIN-CAD area (1.67×105 m2 [41 ac]). The largest area coverage (1.2×105 m2 [30 ac]) of the 2.2% elutriate concentration occurred for a release during calm conditions while the smallest coverage (1.0×104 m2 [2.5 ac]) occurred for a release during northwesterly winds. Other sediments with lower elutriate concentrations, and presumably lower toxicity, would affect smaller areas.

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APPENDIX D

"Post-Dredge / Existing Conditions Report

New Bedford Harbor Dredge Project

Phase III"

(March 2010)

by Apex Companies, LLC

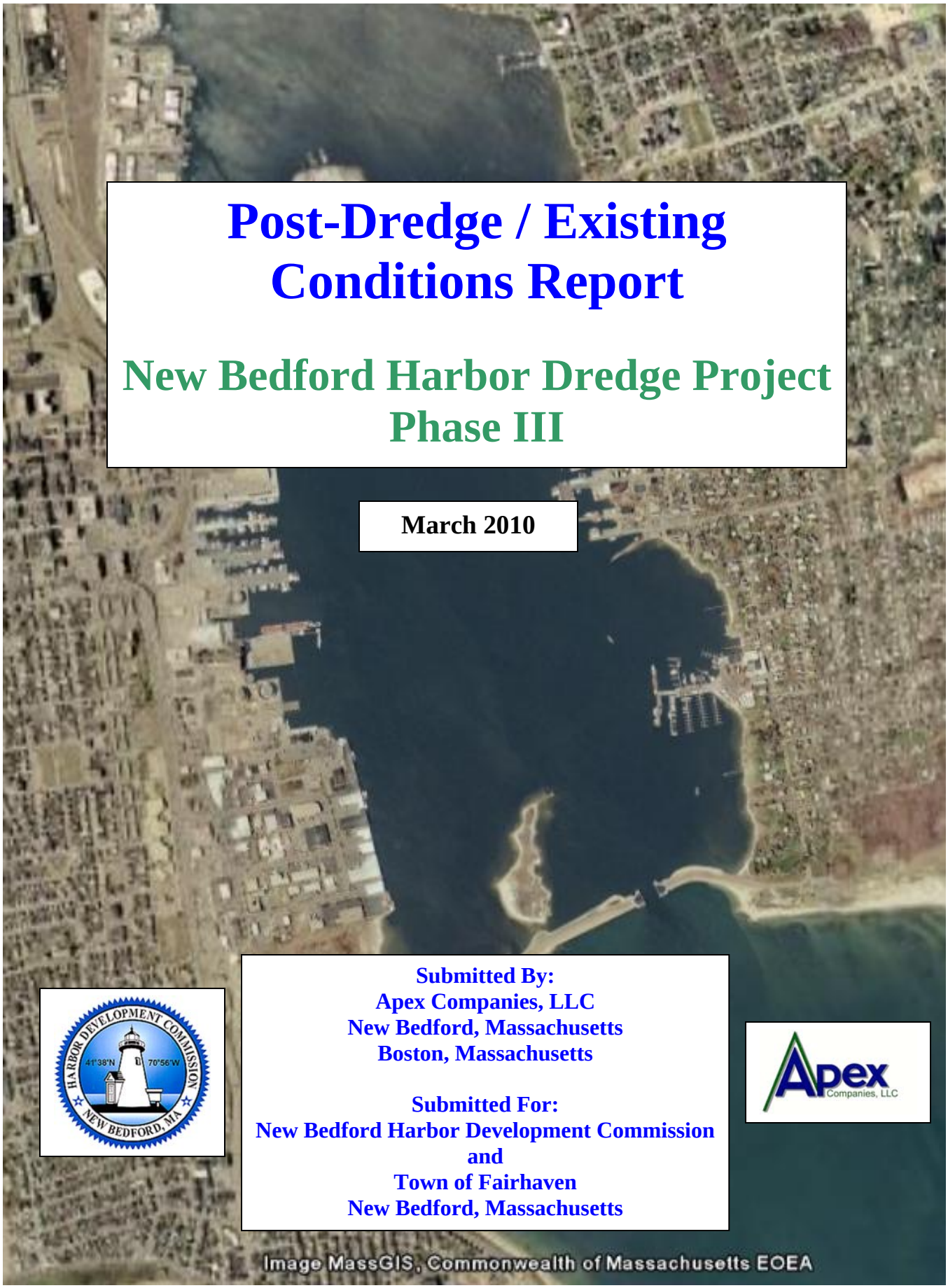
Post-Dredge / Existing Conditions Report

New Bedford Harbor Dredge Project Phase III

March 2010

Submitted By:
Apex Companies, LLC
New Bedford, Massachusetts
Boston, Massachusetts

Submitted For:
New Bedford Harbor Development Commission
and
Town of Fairhaven
New Bedford, Massachusetts



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Post-Dredge / Existing Conditions Report
New Bedford Harbor Dredge Project – Phase III
February 2010

1.0 Introduction

This Report of Existing Conditions has been prepared by Apex Companies, LLC for the New Bedford Harbor Development Commission (NBHDC) upon completion of the New Bedford Phase III Dredge Project. The New Bedford Harbor Dredge Project – Phase III included construction of CAD Cell #2 in two phases (Top of CAD and Bottom of CAD) and the maintenance dredging of portions of the New Bedford Rowing Facility boat basin, Packer Marine, Tonnesson Park, South Terminal, Gifford Street Boat Ramp, Niemiec Marine in New Bedford, Massachusetts and Linberg Marine, Olde North Wharf Fisheries, Fairhaven Shipyard, Steamship Authority, Union Wharf, Warren Alexander (South) in Fairhaven, Massachusetts. Work for NBHDC was completed under contract numbers HDC-FY08-006, HDC-FY08-007, HDC-FY09-001A and HDC-FY09-001B (Steamship Authority dredging was contracted privately).

2.0 Background

The City of New Bedford and the Town of Fairhaven are located on the south coast of Massachusetts between Cape Cod and Fall River, Massachusetts. New Bedford Harbor is an approximately mile-long, narrow, protected embayment that stretches from the mouth of the Acushnet River (at the north), to a large hurricane dyke and flood control structure at the entrance to Buzzards Bay (on the south). Historically, New Bedford Harbor was one of the dominant shipping ports on the east coast. During the 19th Century, textile mills and manufacturing facilities were built on the edge of the Harbor to take advantage of the access to the working waterfront. Electrical transformer manufacturing industries moved into the New Bedford Harbor waterfront area and operated from the 1940's to 1970's. With this electronic component manufacturing came new types of waste discharge into the Harbor. Polychlorinated Biphenyl (PCB) contaminated oils and byproducts made their way into the Harbor through sewer lines and other outfalls, contaminating the sediments on the bottom of the Harbor. By the 1970s, sediment sampling and testing conducted by environmental officials revealed that significant concentrations of metals and PCBs existed in the Harbor bottom sediments.

From the 1970s to the 1990s, the U.S. Environmental Protection Agency (USEPA) and the Massachusetts Department of Environmental Protection (MassDEP) studied the nature and extent of the contamination in the harbor, collecting the information required to develop a remedy for the problem. In 1998, the USEPA signed the Record of Decision (ROD) for the New Bedford Harbor Superfund Site, which prescribed that the remedy for the Harbor would be focused on the removal of contaminated sediments with PCB concentrations in excess of cleanup standards set for various locations within the Harbor. The cleanup standards varied depending upon the location of the contamination: 50 parts per million (ppm or mg/kg) was designated for deeper water areas, where direct contact was not likely; 10 ppm was designated for mudflat and shallow water areas accessible at low tide; 25 ppm was designated for beach combing shoreline areas; and 1 ppm was designated for residential shoreline areas. This designation effectively split the Harbor into two categories: those areas with sediments exceeding the cleanup standards where contaminated sediments would be removed by the USEPA; and those sediments with PCB concentrations below the cleanup standards that would be left in place. This remedy was presented in the ROD (see Section 2.3 below).

Because of the presence of contaminants in most of the sediments from the bottom of New Bedford Harbor, and the high cost and uncertainty of dealing with those contaminated sediments, maintenance dredging of Harbor areas for navigation has not occurred for over 40 years. As a result, sediment has collected in many critical areas within the Harbor: from the Federal Navigational Channel, to the slips and berthings at the piers, to the fairways and driveways of the Harbor wharf areas. As a result, many of the businesses that utilize the pier and wharf areas have experienced a decrease in the amount and type of vessels that can be accommodated. In order to maintain their existing maritime uses, and offer opportunities for growth and development, the City of New Bedford, the Town of Fairhaven, and the New Bedford Harbor Development Commission (NBHDC) have made maintenance dredging of critical Harbor areas a priority for the new millennium.

2.1 New Bedford Harbor Dredge – Phase I

The first phase of the New Bedford Harbor dredge project began with the deepening of the slip on the south side of the New Bedford State Pier in New Bedford Harbor, and the fairway and a portion of the channel leading up to the Pier. This project was identified by the City of New Bedford as a critical element in the revitalization of the working waterfront, as the City was actively trying to attract new and larger vessels to the City. Sediment build-up at the State Pier had precluded the use of the pier by some of the larger deep draft vessels the City was attempting to attract. Work on Phase I began in 2001, and dredging of the project area was completed by the end of 2002. For this project, approximately 75,000 yards of contaminated sediment was dredged from the area to the south of the State Pier and the fairways leading there-to. The material was dewatered and stabilized with a lime and cement mixture, and was placed on the CSX Rail Site next to New Bedford Harbor. The placed material was utilized to cap areas of the rail-yard site that contained levels of PCB contamination greater than the dredged sediments, utilizing the "anti-degradation" provision (310 CMR 40.0030) in the Massachusetts Contingency Plan. The dredged material was placed into berms around the edge of the rail-yard site, covered with topsoil and seeded with grass. The first phase of the dredging was done without the use of the State Enhanced Remedy (see Section 2.3).

2.2 New Bedford Harbor Dredge - Phase II

The New Bedford Harbor Dredge Project – Phase II included the maintenance dredging of portions of Maritime Terminal, Norpel Terminal, Whites Terminal, South-of-Route 6 Bridge, and Niemiec Marine in New Bedford, Massachusetts, and the Warren Alexander Property, D.N. Kelley & Son, Linberg Marine, and Pease Park properties, in Fairhaven, Massachusetts. These properties were included in the Phase II Dredge Project because of their need for dredging to remove shoaled sediment, and the economic benefit the area would receive form the increase in commerce. Bathymetric soundings of the areas of interest had been collected by Apex, and that information was compared with bathymetric charts and other data previously collected by the U.S. Army Corps of Engineers (USACE) and the US Environmental Protection Agency (USEPA). The data indicated that the conditions in the noted dredge areas represented a safety issue for certain types of vessels that visit those piers and wharfs. In order to address this situation, the New Bedford Harbor Development Commission and the Town of Fairhaven (through the NBHDC), decided to undertake the New Bedford Harbor Dredge Project – Phase II to deepen the aforementioned areas.

One of the most challenging aspects of the Phase II Dredge Project was identifying a suitable disposal alternative for the dredged contaminated sediments. During the late 1990's and into 2003, MACZM had undertaken a State-wide Dredge Materials Management Plan (DMMP) in order to address the issue of the disposal of contaminated dredge materials, which many of the Cities and Towns within the Commonwealth were wrestling with. As part of the State-wide DMMP study, MACZM evaluated the placement of Confined Aqueous Disposal (CAD) Cells in several harbors, including New Bedford

Harbor. After evaluation, MACZM determined that CAD Cells represented a viable sediment disposal alternative for New Bedford Harbor. After completion of a feasibility study and a siting analysis that evaluated several potential CAD Cell locations within the Harbor, MACZM determined that the most advantageous location for CAD Cells in New Bedford Harbor was the area to the north of Popes Island in the middle portion of New Bedford Harbor. A permitting program was undertaken by MACZM that involved all relevant resource and regulatory agencies, and resulted in the area to the north of Popes Island in New Bedford Harbor being permitted for CAD Cells for maintenance dredge materials.

Upon review of the viable sediment disposal options for maintenance dredge material, the New Bedford Harbor Dredge Project – Phase II project team determined that CAD Cells within New Bedford Harbor represented the most viable option for disposal of the maintenance dredge material from the Phase III Dredge Project. Design of CAD Cell #1 was completed by Apex, and the disposal of maintenance dredge materials from the Phase II Dredge project dredge areas was allowed for disposal in the newly designed CAD Cells.

The Phase II Dredge Project included the design and construction of a transitional Confined Aquatic Disposal (CAD) Cell located within the Borrow Pit as well as the design and construction of CAD Cell #1, located adjacent to the Borrow Pit. Clean sediment generated during construction of CAD Cell #1 was used to cap portions of OU-3, located immediately outside of the Hurricane Barrier. The New Bedford Harbor Phase II Dredge Project began in January 2005 and was completed in two parts: the initial area of dredging occurred on the north side of Fish Island in New Bedford Harbor; the second part involved dredging at the remainder of the North Terminal area and other Fairhaven areas. The NBHDC completed Phase II harbor maintenance dredging in January 2006, removing more than 156,000 cubic yards (cy) of material from sites in New Bedford and Fairhaven.

2.3 Permitting – State Enhanced Remedy (SER)

Because contaminated sediments exist over much of the bottom of New Bedford Harbor, the usual navigational dredging process would simply not work. Upland disposal of the million or so total cubic yards of material that will ultimately need to be removed from the Harbor to keep it fully functional was not an option, both from a cost standpoint (costs for upland disposal would have been prohibitive), and from a logistics standpoint (there simply was not a local disposal site that could accommodate the volumes). Also, because of the PCB contamination, the USEPA signed a Record of Decision (ROD) for the remediation of the New Bedford Harbor Superfund Site in 1998. The ROD included a provision called the State Enhanced Remedy (SER) [see 40CFR300.515(f)], which allowed for certain maintenance dredging to fall within the Superfund process. The MassDEP requested that the SER be included in the ROD and was endorsed by the City of New Bedford, Massachusetts Executive Office of Environmental Affairs (EOEA), and the local state representatives. The SER provision allowed for maintenance dredging to occur without following the full permitting process usually required for maintenance dredge projects. This streamlining of the approval process for individual dredge projects, and the adoption of a programmatic approach to maintenance dredging in New Bedford Harbor has allowed maintenance dredging to move forward, and allowed the New Bedford Harbor Dredge Project – Phase III to be completed.

The State Enhanced Remedy (SER) under the New Bedford Harbor Superfund Site requires oversight management by MassDEP, with coordination with a number of Federal, State and Local authorities including MassDEP, USACE, USEPA, the National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Division of Marine Fisheries (DMF), Massachusetts Coastal Zone Management (MACZM), EOEA, and the Coalition for Buzzards Bay. The SER process requires the completion of As-Built Plans and the submission of After-Action Submittals after the completion of dredge projects completed under the SER.

Under the SER, NBHDC and Apex discuss project plans and performance standards with the Resource Agencies mentioned above. Project plans and performance standards were reviewed and updated after receiving comments from the Resource Agencies. The NBHDC and Apex attended meetings between Resource Agencies and prepared and submitted planning and information documents for use by Resource Agencies.

The NBHDC and Apex prepared and submitted planning and information documents for applicable Resource Agencies under the SER. These documents included a Project Work Plan, a Sampling and Analysis Plan, project plans and proposed dredge footprints, and a specifications package. Prior to completion of planning documents, Apex discussed project plans with the Town of Fairhaven, the NBHDC and Resource Agencies to determine any requirements and/or concerns that needed to be covered under the information documents. The NBHDC and Apex worked closely with the MassDEP Project Manager to expedite conversations between agencies. The NBHDC and Apex addressed any comments made by agencies and revised documents as necessary.

The NBHDC and Apex conducted the necessary regulatory interface with MassDEP during the course of this work. Regulatory interface was required to ensure that the SER process was followed and that the sampling and analysis activities conducted were consistent with the enhanced remedy. The MassDEP Project Manager was the regulatory point-of-contact for the NBHDC and Apex, and interacted with USEPA and the other State resource agencies as appropriate to ensure that all agencies were afforded appropriate review of SER submittals (i.e. SAP) and input regarding project planning. As part of the regulatory interface the MassDEP field oversight during the dredging.

2.4 Dredge Area Engineering

The New Bedford Harbor Phase III Dredge Project began in September 2006 and was completed in four parts: the removal of the top of CAD Cell #2 (with the placement of the material within CAD Cell #1), the dredging of clean sediment from within CAD Cell #2 (with disposal of some material at the Cape Cod Bay Disposal Site and some material used as a pilot cap for the Borrow Pit CAD Cell), the dredging of areas north of the Coggeshall Street Bridge (Phase III Navigational Dredge – Part B), and the dredging of areas south of the Coggeshall Street Bridge (Phase III Navigational Dredge – Part A).

The navigational dredging portion of the project, totaled sixteen separate dredge footprints at eleven separate properties (See also Figure 1), including:

- Packer Marine – 2,288 cy
- Niemiec Marine – 2,312 cy
- South Terminal – 2,691 cy
- Gifford Street Boat Ramp – 10,880 cy
- New Bedford Rowing Facility – 4,190 cy
- Tonnesson Park – 1,266 cy
- Olde North Wharf Fisheries – 1,403 cy
- Fairhaven Shipyard – 344 cy
- Union Wharf – 1,109 cy
- Linberg Marine – 1,773 cy
- Warren Alexander (South) – 2,142 cy
- Steamship Authority – 22,381 cy
- Summary Total Phase III Navigational Dredging: 52,779 cy

As part of the dredging project, CAD Cell #2 was constructed. CAD Cell #2 was sited immediately to the north of the Borrow Pit CAD Cell and CAD Cell #1, north and northwest of Pope's Island. The construction of the CAD Cell proceeded as two separate projects, with 34,210 cy of material presumed to be impacted with PCBs excavated from the top of the CAD Cell and placed within CAD Cell #1. Subsequent to the removal of the Top of CAD Cell material, 120,060 cy of material was excavated and transported to the Cape Cod Bay Disposal Site to finish creation of CAD Cell #2. CAD Cell #2 received sediment from the Phase III dredge sites in New Bedford and Fairhaven, with some additional capacity reserved for future use. The dredging for Phase III was completed in September of 2009, when the last of the Phase III dredging at South Terminal and Gifford Street Boat Ramp were completed.

Under this contract and Dredge Project, Apex has submitted the following documents to the New Bedford Harbor Development Commission:

- Pre-Design Investigations Work Plan: August 2006
- Pre-Design Investigations Sampling and Analysis Plan: August 2006
- Pre-Design Investigations Site Specific Health and Safety Plan: August 2006
- CAD Cell Siting and Pre-Design Investigations Work Plan: April, 2007
- CAD Cell Siting and Pre-Design Investigations Sampling and Analysis Plan: June, 2007
- Top of CAD Cell Subsurface Data Conditions Report: May 2008
- Top of CAD Cell, Plans and Specifications: May 2008
- Top of CAD Contractor Oversight Plan (COP): May 2008
- Top of CAD Water Quality Monitoring Plan: May 2008
- Top of CAD Site Specific Health and Safety Plan: May 2008
- Steamship Authority, Plans and Specifications: May 2008
- Bottom of CAD Cell Subsurface Data Conditions Report: June 2008
- Bottom of CAD Cell, Plans and Specifications: June 2008
- Steamship Authority Contractor Oversight Plan (COP): July 2008
- Steamship Authority Water Quality Monitoring Plan: July 2008
- Steamship Authority Site Specific Health and Safety Plan: July 2008
- Bottom of CAD Contractor Oversight Plan (COP): August 2008
- Bottom of CAD Water Quality Monitoring Plan: August 2008
- Bottom of CAD Site Specific Health and Safety Plan: August 2008
- Navigational Dredging Subsurface Data Conditions Report for New Bedford Harbor Dredge – Phase III: January 2009
- New Bedford Harbor Navigational Dredge Phase III – Part A, Plans and Specifications – January 2009
- New Bedford Harbor Navigational Dredge Phase III – Part B, Plans and Specifications – January 2009
- Navigational Dredging Contractor Oversight Plan: February 2009
- Navigational Dredging Site Specific Health and Safety Plan: February 2009
- Navigational Dredging Water Quality Monitoring Plan: February 2009

2.5 Monitoring and Oversight

Throughout the Dredge Project, Apex made sure the work was monitored order to ensure that work progressed smoothly and as safely as possible, in line with the Healthy and Safety Plan. A member of Apex personnel was at the site and directly involved with overseeing the project.

In order to monitor the success and progress of the work itself, bathymetric surveys were conducted in excavation and placement areas. The scow location during placement and dewatering of the scows were also closely monitored. Apex personnel used a Global Positioning System (GPS) to double check that scows were placed in the correct locations.

Additionally, as a means of monitoring the sediment of the maintenance material, several methods of examination were used on a regular basis. Sediment probes were utilized in order to measure the thickness of the maintenance material. Vibracores were used as a way of surveying the benthic organisms present in the sediment. Furthermore, chemical analyses were performed before and after dredging events to monitor the levels of various chemicals that may have been present before and after dredging.

3.0 Construction

The NBHDC managed and oversaw the construction activities. Construction operations were performed in such a manner as to comply with the specific performance criteria established during the design phase of the project. Where possible, the intent was to allow the contractor to determine appropriate means and methods of construction, subject to the controls and performance criteria contained in the project specifications. Proposed means and methods and adherence to design and performance criteria were evaluated using the pre-construction submittal review process. A control plan to ensure conformance to performance criteria was a Contractor submittal requirement.

3.1 Construction Oversight – CAD Cells

CAD Cell construction as well as CAD Cell filling operations were subject to operational controls developed during Phase II project design and updated and continued for utilization during Phase III. Project-specific water quality criteria developed by MassDEP with the assistance of other Resource Agencies that participate in the State Enhanced Remedy applied to CAD Cell construction, filling operations, as well as dredging and other operations (such as sediment dewatering). Means and methods for discharge of materials into CAD Cell were developed to ensure compliance with water quality criteria. The discussions between MassDEP, and USACE and USEPA (as part of the design process) regarding previous projects were valuable relative to evaluating discharge requirements. Methods evaluated included use of split hull barges, as well as placement of sediment into the cell using clamshell equipment. Some combination of operational controls were required during filling operations, such as use of silt curtains down-gradient or around the active CAD cell or dredge area, use of oil-absorbent booms, discharge at depth vs. at surface, etc. Details were determined during the design process, and were modified as necessary during construction operations.

3.1.1 CAD Cell Construction

The project involved the construction of CAD Cell #2, a 92,000 cubic yard CAD cell north and northwest of Pope's Island in New Bedford Harbor. CAD Cell #2 was located to the north of the Borrow Pit CAD Cell as well as CAD Cell #1. Dredging of the top of CAD Cell #2 and placement of material in CAD Cell #1 began in June 2008, operating 24 hours a day, and was completed in July of 2008. Dredging of the bottom of CAD Cell #2 and placement of material as a pilot cap on the Borrow Pit CAD Cell or disposal of material at the Cape Cod Bay Disposal site began in August of 2008 and was completed in October of 2008. The material removed during Bottom of CAD had been tested for standard offshore disposal chemical parameters, and the material had been designated as acceptable offshore disposal at the Cape Cod Bay Disposal Site by the USACE. The construction of the CAD cell was an important aspect of the project because PCB contaminated material located throughout the harbor were removed as part of the New Bedford Harbor Dredge Project – Phase III and disposed of in the CAD cell.

During the dredging, Apex provided resident engineering services and acted as Owner's Representative for construction oversight and Quality Control of the project to ensure all phases were performed expeditiously and in accordance with the plans and specifications. The initial scope of work for this project included pre-engineering studies, design, and implementation of the sampling and analysis program.

Apex performed a preliminary engineering evaluation during the planning phase of the project. These activities included; establishing preliminary dredge limits with associated volume estimates for the construction of the CAD cell, research and evaluation of disposal options including off-shore disposal in the USACE Cape Cod Bay Disposal Site (CCBDS) and/or the placement of the material as a cap over the Borrow Pit, upland disposal, use of the material as beach nourishment, use of the material for capping at OU-3, and the preparation of a preliminary conceptual methodology for the project.

Apex conducted a sediment sampling and analysis program of the proposed dredge area in addition to completing multiple bathymetric surveys, detailed sediment characterization, and cultural and hazard identification survey utilizing a complimentary suite of marine geophysical techniques, including side-scan sonar, sub-bottom profiling, and marine magnetics.

3.2 Construction Oversight – Dredge Areas

3.2.1 Dredge Area Introduction

Establishment of performance standards, including water quality criteria, mandated dredging operations. Dredge methods were selected to achieve water quality standards. Dredging of material required implementation of controls such as use of an environmental (sealed) bucket, silt curtains, oil absorbent booms, reduced cycle times, etc. Specifications and requirement details were determined through the design process. In accordance with the New Bedford Harbor Development Commission – Phase III work plan, Apex completed navigational dredging at locations (listed below) within New Bedford Harbor.

3.2.2 Dredge Area Descriptions

The New Bedford Harbor Dredge Project – Phase III included construction of CAD Cell #2 in two phases (Top of CAD and Bottom of CAD) and the maintenance dredging of portions of the New Bedford Rowing Facility boat basin, Packer Marine, Tonnesson Park, South Terminal, Gifford Street Boat Ramp, Niemiec Marine in New Bedford, Massachusetts and Linberg Marine, Olde North Wharf Fisheries, Fairhaven Shipyard, Union Wharf, Steamship Authority, and Warren Alexander (South) in Fairhaven, Massachusetts. The work performed is described below:

<u>Top of CAD Cell #2</u>
Soft organic maintenance-type material was removed from the surface of the New Bedford CAD Cell #2. The initial excavation at the (removal of contaminated organics) CAD cell was dredged from an average elevation of between -4 MLLW and -7 MLLW to an average depth of between -6 and -9 MLLW. Dredged material from CAD Cell #2 was placed into CAD Cell #1, a CAD Cell created during the New Bedford Harbor Dredge Project – Phase II, but had not been completely filled during that project. It was intended that the remaining space within CAD Cell #1 be reserved for the top of CAD Cell #2. Similarly, space within CAD Cell #2 will be reserved for the top of a future CAD Cell. Approximately 34,210 cy of material was excavated and disposed of within CAD Cell #1 as part of this portion of the project. The Top of CAD Cell project began on June 13, 2008 and was completed on July 13, 2008. Top of CAD Cell Drawings are attached as Figures 1 through 4.

Steamship Authority

The first navigational dredging project completed during Phase III was the dredging of the Steamship Authority Terminal in Fairhaven, Massachusetts. The Steamship Authority pier is located on the southern end of the Designated Port Area of Fairhaven, Massachusetts. It is a filled pier that has docking on both the northern and southern sides of the pier. The work at the facility was part of a larger project that involved rehabilitation of the facility, installation of sheet piling and a new storage and office facility. Dredging at Steamship Authority began on July 31, 2008 and ended on September 11, 2008. At the time that Steamship Authority dredging commenced, CAD Cell #2 was not complete; however, there was sufficient space within CAD Cell #1 (after placement of the Top of CAD Cell #2) for the dredge material from Steamship Authority. Therefore, the dredge spoils from Steamship Authority were placed within CAD Cell #2. Both the northern and southern footprints were dredged to -15 MLLW. Steamship Authority Drawings are attached as Figures 5 through 6.

Bottom of CAD Cell #2

On August 26, 2008, dredging to complete the excavation of CAD Cell #2 to its full capacity began. 120,060 cubic yards of clean material was excavated from within the CAD footprint to create the desired disposal volume space, and the clean material removed from the CAD footprint was either barged to the Cape Cod Bay Disposal Site (CCBDS) or to the Borrow Pit, where it was placed over a portion of the CAD Cell as a pilot cap. The excavation and disposal/capping was completed on October 9, 2008. Bottom of CAD Cell Drawings are attached as Figures 7 through 10.

Navigational Dredge – Part B

On March 20, 2009, work began on Part B of the Phase III Navigational Dredge Project. The Navigational Dredge Project was broken into two parts that were bid separately due to logistical issues associated with Part B that required a separate set of equipment from that within Part A. Specifically, the work within Part B was to take place north of the Route 195 and Coggeshall Street Bridges, within the Upper New Bedford Harbor. The clearance under these bridges is extremely low, and required specific modifications to equipment (including ballasting scows to lower their elevation) in order to complete the work. It was anticipated that Part A of Navigational Dredging would require more conventional techniques, and therefore it seemed prudent to bid the work out separately. The only dredge footprint that was completed during Part B of Navigational Dredging was the New Bedford Rowing Facility footprint. That footprint was dredged to -5 MLLW, and 4,190 cubic yards of material were removed and placed within CAD Cell #2. Part B of Navigational Dredging was completed on April 14, 2009.

Navigational Dredge – Part A

Part A of the Phase III Navigational Dredge Project included the remaining navigational dredging properties, including Packer Marine, Tonnesson Park, South Terminal, Gifford Street Boat Ramp, and Niemiec Marine in New Bedford and Linberg Marine, Olde North Wharf Fisheries, Fairhaven Shipyard, Union Wharf, and Warren Alexander (South) in Fairhaven. The selected contractor for Part A chose to move from dredge footprint to dredge footprint frequently. As a result, it is difficult to list start and end dates for individual footprints; however, Part A as a whole began on April 20, 2009 and was completed on September 24, 2009. For dredge volumes and target dredge depths, please see the table within the next section.

Summary

The following is a table outlining the target dredge depths and volumes dredged for Top of CAD, Steamship Authority, and both Part A and Part B of the Navigational Dredge:

Dredge Area	Dredge Volume (cy)	Target Dredge Depth(s) (MLLW)
Top of CAD Cell 2	34,210	-6 to -9
Bottom of CAD Cell 2	120,060	-40
Total CAD Cell 2	154,270	N/A
Steamship Authority	22,381	-15
New Bedford Rowing Facility	4,190	-5
Gifford Street Boat Ramp	10,880	-7 and -9
South Terminal	2,691	-20
Tonnesson Park	1,266	-6, -8, and -15
Niemiec Marine	2,312	-10
Packer Marine	2,288	-14
Linberg Marine	1,773	-10
Olde North Wharf Fisheries	1,403	-6, -10 and -12
Fairhaven Shipyard	344	-17 and -18
Union Wharf	1,109	-8 and -16
Warren Alexander (South)	2,142	-13 and -15
Phase III Navigational Dredging:	52,779	N/A
Total Phase III Dredging:	207,049	N/A
Total Phase II Dredging:	156,000	N/A
Total Phase I Dredging:	75,000	N/A
Totals of Phase I, Phase II, and Phase III:	438,409	N/A

4.0 Post-Dredge Conditions

Following the completion of the Dredge Project, further monitoring was conducted as a means of examining the conditions of the dredge areas post-construction. Re-sampling and surveying were completed to verify that sustainable conditions were present in the Harbor. Samples of sediment were collected and analyzed for the presence of PCBs. Bathymetric surveys were conducted by Apex, in an effort to confirm Apex's findings. Conditions necessary to resolve contract issues were met and satisfied in order to come to project closure.

4.1 Sediment Chemistry: Pre- and Post-Dredge

The following sections describe sampling and analysis activities that were conducted prior to dredging of the Phase III dredge areas and sampling and analysis that occurred after the dredging in order to document post-dredge conditions.

4.1.1 Pre-Dredge Sediment Chemistry

Prior to the start of dredging, sediment samples were collected in order to characterize background conditions of sediment chemistry within the proposed dredge footprints. The samples were analyzed for PCBs, via the 21 NOAA congeners. The 18 NOAA Congeners were selected from the 21 analyzed congeners, were added and multiplied by 2.6 (a factor identified by USEPA as a good correlation between the 18 congeners and a "total PCBs" number) in order to calculate total PCBs in sediment. Seventeen pre-dredge samples were collected from the various footprints within Part A and Part B of Navigational Dredging. Some data collected by USEPA (during its investigation into the New Bedford Superfund Site) was utilized to characterize the dredge material within the New Bedford Rowing Facility footprint.

In addition to PCBs, some samples were also collected and analyzed for the following constituents: MassDEP EPH, RCRA 8 Metals, and reactive sulfide. Of all the pre-dredge PCB levels recorded, the highest value was 370 ppm (within a sample collected by USEPA within the New Bedford Rowing Facility Footprint). South of the Coggeshall Street Bridge, the highest concentration was 61.3 ppm (collected within the Packer Marine footprint). The range of PCB levels that was recorded was 0.2 ppm to 370 ppm. Pre-Dredge analytical data is summarized within Tables 1 through 5. Pre-Dredge analytical data reports are attached within Appendix A. Pre-Dredge sample locations are indicated on Figures 33 through 41.

4.1.2 Post-Dredge Sediment Chemistry

In an effort to compare Post-Dredge sediment PCB impacts with Pre-Dredge conditions, and evaluate the improvement of particular areas, Apex sampled the sediment after dredging was complete and recorded the remaining conditions. After dredging was complete, eight sediment samples were collected, all being tested for PCBs. Again, NOAA Congener reporting was used, which is consistent with the pre-dredge method, and the summation of the 18 NOAA congeners was calculated in accordance with USEPA's methodology (via summation and multiplication by a factor of 2.6) to generate a Total PCB result. Therefore, comparison of PCB levels provides an accurate representation of the Pre- and Post- dredge difference. Each Post-Dredge sediment sample collected indicated a decrease (or no change) in PCB concentrations in sediment. The highest reported value of PCBs recorded from the post-dredge samples was 37.1 ppm, from a sample taken in the New Bedford Rowing Facility area (north of the Coggeshall Street Bridge). The Pre-Dredge sample results from this location ranged from 4.3 ppm to 370 ppm. The overall range of PCB levels among the Post-Dredge samples was found to be 0.03 ppm to 37.1 ppm. Post-Dredge analytical data is summarized within Table 6. Post-Dredge analytical data reports are attached within Appendix A. Post-Dredge sample locations are indicated on Figures 33 through 41.

The following table outlines the Pre-Dredge sampling results and compares them to the Post-Dredge Sampling results:

PRE-DREDGE AND POST DREDGE SAMPLE RESULTS

Location	Pre-Dredge PCB Result (ppm)			Post-Dredge PCB Result (ppm)		
	Sample ID	Date	Result	Sample ID	Date	Result
Gifford Street Boat Basin	VC-05-08	11/13/2008	7.7	POST_012010_G1	1/20/2010	2.1
	VC-16-08 (0-1.5')	11/21/2008	7.0			
Tonnesson Park	VC-07C-08	11/17/2008	22.1	POST_012010_TP2	1/20/2010	0.03
Union Wharf	325 0-1	10/25/2006	17.0	POST_012010_UW1	1/20/2010	5.0
	321 0-1	10/25/2006	4.6			
Packer Marine	VC_24-08 (0-1')	11/24/2008	61.3	POST_012010_PACK1	1/20/2010	0.1
New Bedford Rowing Facility	S-3613-2.1-2.6	8/20/2001	370	POST_012010_BHB1	1/20/2010	37.1
	S-3613-2.6-3.1	8/20/2001	4.3			
	S-205316	None Listed	83			
Olde North Wharf Fisheries	309 0-1	10/24/2006	4.4	POST_012010_ONWF1	1/20/2010	1.8
	310 0-1	10/24/2006	13.2			
	311 0-1	10/24/2006	5.3			
Steamship Authority	329 0-1	10/23/2006	7.2	Steamship Composite 1	8/5/2009	3.4
	330 0-1	10/23/2006	18.0			
	331 0-1	10/25/2006	0.2	POST_012010_SA1	1/20/2010	0.2
	332A 0-1	10/23/2006	0.2			

4.1.3 PCB Mass Removal Calculations

In order to attempt to quantify the mass of PCBs that has been removed during Steamship Authority, Part A and Part B of Phase III Navigational Dredging several sets of calculations were completed. PCB mass is a relatively qualitative measure for determining the environmental benefit created during sediment removal and therefore, there is no one specific methodology for calculating the mass removed. Several methodologies were considered before utilizing the methodology outlined below. The Pre-Dredge concentrations were averaged over the area of a footprint. For the New Bedford Rowing Facility, data was available from USEPA along a vertical profile (instead of multiple locations at the surface). Due to relatively high concentrations at this location, and its relative influence over the total mass removed, it was determined to average over the vertical profile of the pre-dredge samples, rather than to average the shallowest sample with the post-dredge sample; as a result, instead of averaging the pre- and post-dredge analytical data, the data was subtracted instead. It was assumed (for the purposes of this exercise) that the difference between the two concentrations would be representative of the concentration of the dredged sediment, since an average over the vertical profile had already been included within the calculations for the New Bedford Rowing Facility. The difference was then multiplied by the final dredge volume, which was assumed to have a density of 1.5 tons per cubic yard. The final mass was calculated in pounds of PCBs removed.

Sample Calculation: 5.3 mg/kg PCBs X 2.2 kg/lb / 1,000,000 mg/kg / 2.2 kg/lb X 2,691 cy X 1.5 tons/cy X 2000 lbs/ton = approx. 42.78 lbs PCBs removed.

The following chart shows the calculated masses and the total estimated mass removed.

Estimate of PCB Mass Removed (Phase III Navigational Dredging)

Dredge Area	Final Volume (CY)	Pre-Dredge Conc. (mg/kg)	Post (mg/kg)	Difference (mg/kg)	Mass Removed (lbs)
South Terminal	2,691	7.35	2.1	5.3	43
Union Wharf	1,109	10.8	5	5.8	19
Tonnesson Park	1,266	22.1	0.03	22.1	84
Gifford Street Boat Ramp	10,880	7.35	2.1	5.3	173
Olde North Wharf Fisheries (North)	1,295	8.8	1.8	7.0	27
Warren Alexander (South)	2,142	12.6	3.4	9.2	59
Olde North Wharf Fisheries (South)	108	5.3	1.8	3.5	1.1
Niemiec Marine	2,312	1.2	N/A	N/A	N/A
Fairhaven Shipyard	344	N/A	N/A	N/A	N/A
Linberg Marine	1,773	N/A	N/A	N/A	N/A
Packer Marine	2,288	61.3	0.1	61.2	420
New Bedford Rowing Facility	4,190	152.4	37.1	115.3	1449
Steamship Authority North	5,686	12.6	3.4	9.2	157
Steamship Authority South	16,695	0.222	0.206	0.02	1
				Total Mass Removed:	**2,433**

5.0 Monitoring Results

The water quality was monitored during CAD Cell construction, and during the dredging and material placement operations for the New Bedford Harbor Dredge – Phase III from June 13, 2008 through August 25, 2009. Water quality monitoring was performed in accordance with the following Water Quality Monitoring Plans (WQMP):

- Top of CAD Water Quality Monitoring Plan: May 2008
- Steamship Authority Water Quality Monitoring Plan: July 2008
- Bottom of CAD Water Quality Monitoring Plan: August 2008
- Navigational Dredging Water Quality Monitoring Plan: February 2009

Following the guidelines of the respective WQMP, monitoring locations for water turbidity recorded an average turbidity over various water depths, up and down-current from the dredge or material placement operations, depending on tide. The values recorded as the Reference Site Turbidity were taken from up-current monitoring locations, or from monitoring events which occurred before dredge or material placement operations began. The Reference Turbidity Value was then compared to down-current turbidity values measured at regular time intervals after operations had begun.

The monitoring results were broken up into 5 periods of dredging and material placement that Apex oversaw in New Bedford Harbor during Phase III of the State Enhanced Remedy Dredge Project (Top of CAD, Steamship Authority, Bottom of CAD, Part B of Navigational Dredging and Part A of Navigational

Dredging). At each monitoring location, various samples around the area were taken in order to get a thorough indication of water quality.

The Top of CAD project took place between June 13, 2008 and July 13, 2008 and included approximately 34,210 cubic yards of material being dredged from the area in which CAD Cell #2 was to be constructed, and placed into CAD Cell #1. In monitoring the water quality, no exceedances of the WQMP turbidity guidelines were detected for either dredging or disposal operations.

The Steamship Authority navigational dredge project took place between July 31, 2008 and September 11, 2008 and involved the dredging areas north and south of the Steamship Authority pier and placement of that material within CAD Cell #1. This portion of the project involved dredging 22,381 cubic yards of material. In monitoring the water quality for the dredging, no exceedances of the WQMP turbidity guidelines were detected for either dredging or disposal operations. On 8/26/08, turbidity measurements at the Steamship Authority down-current location [18.47 NTU] were 18.17 NTU higher than the measurements at the up-current location [0.3 NTU]. This event represented the greatest difference between up-current and down-current turbidity monitoring detected during Phase III dredging; however, the difference was not greater than the WQMP turbidity guidelines [which stipulates that if the reference site turbidity is less than 10 NTU, that the permissible turbidity increase is no more than the reference plus 20 NTU].

The Bottom of CAD project took place between August 26, 2008 and October 9, 2008 and involved the excavation of clean material from CAD Cell #2, and the use of that material either during the placement of a pilot cap at the Borrow Pit or the transportation and disposal of the material at the Cape Cod Bay Disposal Site (CCBDS). In monitoring the water quality, no exceedances of the WQMP turbidity guidelines was detected for Bottom of CAD operations.

The Navigational Dredge – Part B project took place between March 20, 2009 and April 14, 2009 and involved the dredging of 4,190 cubic yards from the New Bedford Rowing Facility area and the placement of that material within CAD Cell #2. In monitoring the water quality, exceedances of the WQMP turbidity guidelines were not detected for the Navigational Dredge – Part B operations.

The Navigational Dredge – Part A project took place between April 20, 2009 and September 24, 2009 and involved the dredging of 26,208 cubic yards from Packer Marine, Tonnesson Park, South Terminal, Gifford Street Boat Ramp, and Niemiec Marine in New Bedford and Linberg Marine, Olde North Wharf Fisheries, Fairhaven Shipyard, Union Wharf, and Warren Alexander (South) in Fairhaven and the placement of that material within CAD Cell #2. In monitoring the water quality, exceedances of the WQMP turbidity guidelines were not detected for the Navigational Dredge – Part A operations.

Copies of the water quality monitoring sheets completed in the field are attached as Appendix B. Water quality monitoring data is summarized within Table 7.

TABLES

Table 1:
Analytical Data: Linberg Marine Pre-Dredge Locations
Phase III Harbor Maintenance Dredge Program
New Bedford, Massachusetts

		Extractable Petroleum Hydrocarbons (μg/kg)																				
Sample Name	Collection Date	C9-C18 Aliphatics	C19-C36 Aliphatics	C11-C22 Aromatics	Unadjusted C11-C22 Aroma	Naphthalene	2-Methylnaphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene
307A 0-1	10/23/2006	300000	1300000	310000	320000	830	830	830	830	830	830	830	1000	2000	990	890	1300	830	920	1700	1700	830
308 0-1	10/23/2006	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

		Metals (mg/kg)							
Sample Name	Collection Date	Arsenic	Barium	Cadmium	Chromium	Lead	Selenium	Silver	Mercury
307A 0-1	10/23/2006	5.9	32	4.4	260	190	1.4	1.8	0.94
308 0-1	10/23/2006	NS	NS	NS	NS	NS	NS	NS	NS

		PCB Congeners (μg/kg)																							
Sample Name	Collection Date	Cl2-BZ#5/#8	Cl3-BZ#18	Cl3-BZ#28/#31	Cl4-BZ#44	Cl4-BZ#52	Cl4-BZ#43/#49	Cl4-BZ#66	Cl5-BZ#101/#84	Cl5-BZ#87	Cl7-BZ#184	Cl5-BZ#105	Cl5-BZ#118	Cl7-BZ#183	Cl6-BZ#167/#128	Cl6-BZ#138/#163	Cl6-BZ#153	Cl7-BZ#170/#190	Cl7-BZ#180	Cl7-BZ#182/#187	Cl8-BZ#195	Cl9-BZ#206	Cl10-BZ#209	Summation of Congeners (mg/kg) [NOAA 18]	Reactive Sulfide (mg/kg)
307A 0-1	10/23/2006	87	300	1500	370	570	620	740	920	270	0.31	290	760	29	130	540	460	54	100	66	9.2	19	3.8	18.0	150
308 0-1	10/23/2006	14	33	190	39	84	94	84	120	32	0.24	36	110	4.1	20	80	80	8.3	12	9.6	1.1	1.6	1.1	2.4	NS

Notes:
U = Concentration is below the laboratory's method detection limit.
NS = Not sampled.

Table 2:
Analytical Data: Olde North Wharf Fisheries Pre-Dredge Locations
Phase III Harbor Maintenance Dredge Program
New Bedford, Massachusetts

		Extractable Petroleum Hydrocarbons (μg/kg)																				
Sample Name	Collection Date	C9-C18 Aliphatics	C19-C36 Aliphatics	C11-C22 Aromatics	Unadjusted C11-C22 Aroma	Naphthalene	2-Methylnaphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene
309 0-1	10/24/2006	48000	300000	100000	110000	650	650	650	650	650	650	650	860	1800	650	650	650	650	650	1300	1300	650
310 0-1	10/24/2006	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
311 0-1	10/24/2006	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

		Metals (mg/kg)							
Sample Name	Collection Date	Arsenic	Barium	Cadmium	Chromium	Lead	Selenium	Silver	Mercury
309 0-1	10/24/2006	6	160	1	56	360	1	1	0
310 0-1	10/24/2006	NS	NS	NS	NS	NS	NS	NS	NS
311 0-1	10/24/2006	NS	NS	NS	NS	NS	NS	NS	NS

		PCB Congeners (μg/kg)																							Summation of Congeners (mg/kg) [NOAA 18]	Reactive Sulfide (mg/kg)
Sample Name	Collection Date	Cl2-BZ#5/#8	Cl3-BZ#18	Cl3-BZ#28/#31	Cl4-BZ#44	Cl4-BZ#52	Cl4-BZ#43/#49	Cl4-BZ#66	Cl5-BZ#101/#84	Cl5-BZ#87	Cl7-BZ#184	Cl5-BZ#105	Cl5-BZ#118	Cl7-BZ#183	Cl6-BZ#167/#128	Cl6-BZ#138/#163	Cl6-BZ#153	Cl7-BZ#170/#190	Cl7-BZ#180	Cl7-BZ#182/#187	Cl8-BZ#195	Cl9-BZ#206	Cl10-BZ#209		
309 0-1	10/24/2006	26	57	330	73	160	180	140	240	61	0	65	200	7	36	150	140	15	24	16	2	3	2	4.4	190
310 0-1	10/24/2006	85	260	1100	280	420	420	460	700	220	0	210	530	19	98	420	350	42	65	46	6	5	3	13.2	NS
311 0-1	10/24/2006	29	65	390	95	170	200	190	300	78	0	81	240	9	43	180	160	20	32	21	3	3	1	5.3	NS

Notes:
U = Concentration is below the laboratory's method detection limit.
NS = Not sampled.

Table 3:
Analytical Data: Union Wharf Pre-Dredge Locations
Phase III Harbor Maintenance Dredge Program
New Bedford, Massachusetts

		Extractable Petroleum Hydrocarbons (µg/kg)																				
Sample Name	Collection Date	C9-C18 Aliphatics	C19-C36 Aliphatics	C11-C22 Aromatics	Unadjusted C11-C22 Aroma	Naphthalene	2-Methylnaphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene
321 0-1	10/25/2006	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
325 0-1	10/25/2006	880000	2200000	1000000	1100000	1000	1000	1000	1000	1000	2400	1200	8500	10000	5700	5200	5600	2400	4100	3700	3700	2800

		Metals (mg/kg)							
Sample Name	Collection Date	Arsenic	Barium	Cadmium	Chromium	Lead	Selenium	Silver	Mercury
321 0-1	10/25/2006	NS	NS	NS	NS	NS	NS	NS	NS
325 0-1	10/25/2006	20	330	5.1	200	3000	3.0	1.2	7.3

		PCB Congeners (µg/kg)																								
Sample Name	Collection Date	Cl2-BZ#5/#8	Cl3-BZ#18	Cl3-BZ#28/#31	Cl4-BZ#44	Cl4-BZ#52	Cl4-BZ#43/#49	Cl4-BZ#66	Cl5-BZ#101/#84	Cl5-BZ#87	Cl7-BZ#184	Cl5-BZ#105	Cl5-BZ#118	Cl7-BZ#183	Cl6-BZ#167/#128	Cl6-BZ#138/#163	Cl6-BZ#153	Cl7-BZ#170/#190	Cl7-BZ#180	Cl7-BZ#182/#187	Cl8-BZ#195	Cl9-BZ#206	Cl10-BZ#209	Summation of Congeners (mg/kg) [NOAA 18]	Reactive Sulfide (mg/kg)
321 0-1	10/25/2006	24	68	270	82	120	110	140	170	45	0.28	46	97	43	22	180	180	77	170	96	18	8.8	0.36	4.6	NS
325 0-1	10/25/2006	73	150	720	220	370	320	350	940	280	0.37	250	620	120	150	810	870	210	440	300	42	33	9.4	17.0	79

Notes:
U = Concentration is below the laboratory's method detection limit.
NS = Not sampled.

Table 4:
Analytical Data: Steamship Authority Pre-Dredge Locations
Phase III Harbor Maintenance Dredge Program
New Bedford, Massachusetts

		PCB Congeners (μg/kg)																					
Sample Name	Collection Date	Cl2-BZ#5/#8	Cl3-BZ#18	Cl3-BZ#28/#31	Cl4-BZ#44	Cl4-BZ#52	Cl4-BZ#43/#49	Cl4-BZ#66	Cl5-BZ#101/#84	Cl5-BZ#87	Cl7-BZ#184	Cl5-BZ#105	Cl5-BZ#118	Cl7-BZ#183	Cl6-BZ#167/#128	Cl6-BZ#138/#163	Cl6-BZ#153	Cl7-BZ#170/#190	Cl7-BZ#180	Cl7-BZ#182/#187	Cl8-BZ#195	Cl9-BZ#206	Cl10-BZ#209
329 0-1	10/23/2006	48	87	540	120	260	290	220	370	90	0.7 U	97	310	18	57	240	260	37	69	46	7.3	7.3	1.7
330 0-1	10/23/2006	140	260	1300	340	600	620	600	930	260	2.4 U	250	680	56	140	580	570	110	210	140	26.0	22.0	6.3
331 0-1	10/25/2006	2	3	14	4	8	9	6	12	2	0.33 U	3	9	2	3	8	10	2	4	3	0.33 U	0.33 U	0.33 U
332A 0-1	10/23/2006	2	3	14	4	7	8	5	11	3	0.19 U	3	8	1	2	7	8	1	3	2	0.7	0.19 U	0.3

Summation of Congeners (mg/kg) [NOAA 18]
7.2
18.0
0.234
0.210

Notes:
U = Concentration is below the laboratory's method detection limit.
NS = Not sampled.

Table 5:
Analytical Data: Additional Pre-Dredge Locations
Phase III Harbor Maintenance Dredge Program
New Bedford, Massachusetts

		Extractable Petroleum Hydrocarbons (µg/kg)																			
Sample Name	Collection Date	C9-C18 Aliphatics	C19-C36 Aliphatics	C11-C22 Aromatics	Unadjusted C11-C22 Aromatics	Naphthalene	2-Methylnaphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene
VC-07G-08	11/17/2008	25000	213000	152000	185000	803 U	803 U	803 U	803 U	803 U	3790	803	6330	5250	2920	3180	2740	2470	2520	2040	803	1880
VC-21-08 (0-1')	11/24/2008	116000	919000	499000	517000	926 U	926 U	926 U	926 U	926 U	1290	926 U	2740	2890	1400	1670	1640	1660	1890	1330	926 U	1330

		Metals (mg/kg)							
Sample Name	Collection Date	Arsenic	Barium	Cadmium	Chromium	Lead	Selenium	Silver	Mercury
VC-05-08	11/13/2008	4.58	20	1.59	82.7	64.4	0.729	0.793	0.283
VC-07C-08	11/17/2008	6.6	87.2	8.01	86.5	547	0.744	11.9	0.803
VC-16-08	11/21/2008	8.22	44.4	0.948	57.7	107	1.2	0.524	0.641
VC-19-08	11/24/2008	9.39	83.5	5.31	707	265	1.57	3.74	0.907
VC-23-08	11/24/2008	1.98	4.54	0.128	16.1	15.3	0.269	0.146	0.0345
VC-24-08	11/24/2008	13.6	92.1	6.27	442	508	1.94	2.67	1.4

		PCB Congeners (µg/kg)																					
Sample Name	Collection Date	Cl2-BZ#5/#8	Cl3-BZ#18	Cl3-BZ#28/#31	Cl4-BZ#44	Cl4-BZ#52	Cl4-BZ#43/#49	Cl4-BZ#66	Cl5-BZ#101/#84	Cl5-BZ#87	Cl7-BZ#184	Cl5-BZ#105	Cl5-BZ#118	Cl7-BZ#183	Cl6-BZ#167/#128	Cl6-BZ#138/#163	Cl6-BZ#153	Cl7-BZ#170/#190	Cl7-BZ#180	Cl7-BZ#182/#187	Cl8-BZ#195	Cl9-BZ#206	Cl10-BZ#209
VC-05-08	11/13/2008	39.7	166	529	156	296	209	184	359	127	1.13 U	127	386	10.8	72.5	320	224	29.9	38.3	23.8	2.47	3.49	1.35
VC-07C-08	11/17/2008	576	1490	2150	656	1240	620	285	504	174	1.03 U	143	390	23.2	97.3	400	309	57	90.9	66.9	9.52	16.5	2.77
VC-16-08 (0-1.5')	11/21/2008	17.2	95.9	153	145	340	132	96.9	207	207	1.22 U	163	478	13.8	108	464	300	41.8	50.1	27.2	1.22 U	6.62	3.85
VC-19-08 (0-1')	11/24/2008	205	1430	4830	1340	2530	1860	1880	2520	704	1.22 U	677	2420	77.6	407	1800	1390	196	260	154	15.3	20.9	6.53
VC-23-08 (0-2')	11/24/2008	3.83	27.7	96.4	29.0	71.1	58.2	31.0	49.3	7.96	0.871 U	9.31	49.4	1.73	9.29	37.3	38.4	5.97	6.52	4.20	6.65	0.871 U	0.871 U
VC_24-08 (0-1')	11/24/2008	307	1890	4890	1980	3620	2440	1340	2410	499	16.5 U	452	2230	80	417	1780	1500	210	294	200	18.8	39.2	16.5

Summation of Congeners (mg/kg) [NOAA 18]
7.7
22.1
7.0
57.4
1.2
61.3

Sample Name	Collection Date	Total PCBs (mg/kg)
S-3613-2.1-2.6	8/20/2001	370
S-205316	Unknown	83

Notes:
U = Concentration is below the laboratory's method detection limit.
NS = Not sampled.
Samples S-3613-2.1-2.6 and S-205316 represent USEPA collected data. Collection date for S-205316 not listed on USEPA website.

Table 6:
Analytical Data: Post-Dredge Sample Results
Phase III Harbor Maintenance Dredge Program
New Bedford, Massachusetts

		PCB Congeners (µg/kg)																					
Sample Name	Collection Date	Cl2-BZ#5/#8	Cl3-BZ#18	Cl3-BZ#28/#31	Cl4-BZ#44	Cl4-BZ#52	Cl4-BZ#43/#49	Cl4-BZ#66	Cl5-BZ#101/#84	Cl5-BZ#87	Cl7-BZ#184	Cl5-BZ#105	Cl5-BZ#118	Cl7-BZ#183	Cl6-BZ#167/#128	Cl6-BZ#138/#163	Cl6-BZ#153	Cl7-BZ#170/#190	Cl7-BZ#180	Cl7-BZ#182/#187	Cl8-BZ#195	Cl9-BZ#206	Cl10-BZ#209
POST_012010_G1	1/20/2010	20.4	64.8	204	58.5	129	70.3	25.0	75.7	0.954 U	0.954 U	25.3	76.9	0.954 U	10.4	66.7	30.4	7.11	7.56	4.11	0.954 U	0.954 U	0.954 U
POST_012010_TP2	1/20/2010	1.08 U	1.08 U	1.08 U	1.08 U	1.08 U	1.08 U	1.08 U	1.08 U	1.08 U	1.08 U	1.08 U	1.08 U	1.08 U	1.08 U	1.08 U	1.08 U	1.08 U	1.08 U	1.08 U	1.08 U	1.08 U	1.08 U
POST_012010_UW1	1/20/2010	30.1	192	397	112	218	92.1	42.4	158	2.10 U	2.10 U	70.3	170	9.25	41.0	209	102	45.5	67.9	54.1	2.10 U	2.10 U	2.10 U
POST_012010_PACK1	1/20/2010	0.923 U	1.74	8.85	1.98	5.71	4.04	4.04	4.46	0.923 U	0.923 U	0.923 U	2.96	0.923 U	0.923 U	2.58	2.48	0.923 U	0.923 U	0.923 U	0.923 U	0.923 U	0.923 U
POST_012010_BHB1	1/20/2010	568	1780	4900	1590	2530	1620	466	756	0.988 U	0.988 U	140	631	6.06	39.4	413	356	31.8	30.3	28.7	0.988 U	4.35	1.74
POST_012010_ONWF1	1/20/2010	8.68	47.0	143	49.3	92.8	50.7	17.6	72.8	0.965 U	0.965 U	21.2	77.2	0.965 U	19.7	80.4	37.0	4.90	11.3	6.66	0.965 U	0.965 U	0.965 U
POST_012010_SA1	1/20/2010	0.925 U	0.925 U	18.4	0.925 U	15.2	6.46	2.28	8.49	0.925 U	0.925 U	0.925 U	10.8	0.925 U	0.925 U	10.4	8.73	0.925 U	0.925 U	0.925 U	0.925 U	0.925 U	0.925 U
Steamship Composite 1	8/5/2009	1.49 U	1.49 U	1.49 U	1.49 U	173	84.2	55.5	60.9	59.8	1.49 U	98.1	189	17.3	76.4	313	144	42	81.9	45.7	11.8	7.7	2.31

Summation of Congeners (mg/kg) [NOAA 18]
2.1
0.03
5.0
0.1
37.1
1.8
0.206
3.4

Notes:
U = Concentration is below the laboratory's method detection limit.
NS = Not sampled.
1). When a compound is below the laboratory's method detection limit, 1/2 of the method detection limit is utilized in calcluating the Summation of Congeners.

TABLE 7 - NEW BEDFORD HARBOR DREDGE - PHASE III

Water Quality Monitoring - Turbidity Measurements

June 12, 2008 -- August 25, 2009

Date	Time of Up Current	Average of Up Current	Time of Down Current	Average of Down Current	Difference (Down Current - Up Current)	Time of Disposal Location	Average of Disposal Location	Project Title	Project and/or Location
06/13/08	11:15	0.00	10:45	0.00	0.00	-	-	TOP of CAD II	TOP of CAD II
06/14/08	7:20	0.00	8:25	0.23	0.23	-	-	TOP of CAD II	TOP of CAD II
06/14/08	10:15	0.90	10:35	2.00	1.10	-	-	TOP of CAD II	TOP of CAD II
06/14/08	12:40	0.00	12:50	1.00	1.00	-	-	TOP of CAD II	TOP of CAD II
06/14/08	16:30	2.03	16:55	1.17	-0.87	-	-	TOP of CAD II	TOP of CAD II
06/16/08	16:45	14.63	16:30	0.00	-14.63	17:00	1.29	TOP of CAD II	CAD I (Disposal Only)
06/19/08	8:00	6.07	8:30	2.17	-3.90	-	-	TOP of CAD II	TOP of CAD II
06/19/08	12:00	23.43	12:30	4.23	-19.20	12:05	1.77	TOP of CAD II	CAD I (Disposal Only)
06/24/08	7:50	0.07	8:00	0.20	0.13	-	-	TOP of CAD II	TOP of CAD II
06/24/08	10:00	0.57	10:10	0.23	-0.33	-	-	TOP of CAD II	TOP of CAD II
06/26/08	10:05	1.67	10:10	0.47	-1.20	-	-	TOP of CAD II	TOP of CAD II
06/26/08	11:50	0.67	11:55	3.17	2.50	-	-	TOP of CAD II	TOP of CAD II
06/26/08	18:00	0.00	18:05	6.60	6.60	-	-	TOP of CAD II	TOP of CAD II
06/26/08	16:00	0.00	16:07	5.10	5.10	-	-	TOP of CAD II	TOP of CAD II
06/30/08	7:00	0.00	7:10	0.27	0.27	-	-	TOP of CAD II	TOP of CAD II
06/30/08	16:10	4.33	16:05	0.23	-4.10	-	-	TOP of CAD II	TOP of CAD II
06/30/08	14:25	2.87	14:20	2.73	-0.13	-	-	TOP of CAD II	TOP of CAD II
06/30/08	12:15	6.87	12:20	2.10	-4.77	-	-	TOP of CAD II	TOP of CAD II
06/30/08	10:00	0.63	10:04	1.70	1.07	-	-	TOP of CAD II	TOP of CAD II
07/03/08	15:40	4.17	15:55	6.13	1.97	-	-	TOP of CAD II	TOP of CAD II
07/03/08	13:30	5.50	13:35	4.93	-0.57	-	-	TOP of CAD II	TOP of CAD II
07/03/08	12:20	1.77	12:40	3.60	1.83	12:30	20.97	TOP of CAD II	CAD I (Disposal Only)
07/03/08	10:40	0.00	10:45	4.50	4.50	-	-	TOP of CAD II	TOP of CAD II
07/03/08	8:40	15.03	8:45	6.00	-9.03	-	-	TOP of CAD II	TOP of CAD II
07/03/08	6:46	0.83	6:55	0.97	0.13	6:50	6.77	TOP of CAD II	CAD I (Disposal Only)
07/08/08	12:00	0.30	12:10	1.53	1.23	12:25	7.17	TOP of CAD II	CAD I (Disposal Only)
07/08/08	10:05	14.33	10:23	7.60	-6.73	-	-	TOP of CAD II	TOP of CAD II
07/08/08	7:40	0.93	7:45	0.87	-0.07	-	-	TOP of CAD II	TOP of CAD II
07/08/08	7:05	3.10	7:25	2.10	-1.00	7:32	19.13	TOP of CAD II	CAD I (Disposal Only)
07/31/08	7:10	0.40	7:20	0.20	-0.20	-	-	Steamship	Steamship
07/31/08	9:10	8.86	9:25	0.10	-8.76	-	-	Steamship	Steamship
07/31/08	11:10	1.15	11:17	0.00	-1.15	-	-	Steamship	Steamship
07/31/08	14:18	0.30	14:25	5.26	4.96	-	-	Steamship	Steamship
07/31/08	16:45	2.43	16:35	0.43	-2.00	-	-	Steamship	Steamship
08/04/08	12:00	2.53	12:35	0.53	-2.00	12:25	-	Steamship	CAD I (Disposal Only)
08/05/08	7:40	0.26	7:50	0.00	-0.26	-	-	Steamship	Steamship
08/05/08	9:40	1.33	9:50	1.63	0.30	-	-	Steamship	Steamship

TABLE 7 - NEW BEDFORD HARBOR DREDGE - PHASE III

Water Quality Monitoring - Turbidity Measurements

June 12, 2008 -- August 25, 2009

Date	Time of Up Current	Average of Up Current	Time of Down Current	Average of Down Current	Difference (Down Current - Up Current)	Time of Disposal Location	Average of Disposal Location	Project Title	Project and/or Location
08/05/08	12:00	22.40	12:10	2.53	-19.87	-	-	Steamship	Steamship
08/05/08	14:05	1.17	14:20	16.20	15.03	-	-	Steamship	Steamship
08/05/08	16:46	2.53	16:55	0.66	-1.87	16:45	-	Steamship	CAD I (Disposal Only)
08/07/08	10:00	0.00	10:30	0.00	0.00	-	-	Steamship	Steamship
08/07/08	11:45	0.03	12:00	0.83	0.80	-	-	Steamship	Steamship
08/07/08	14:20	0.00	14:30	0.93	0.93	-	-	Steamship	Steamship
08/07/08	15:30	0.00	15:55	6.70	6.70	0.65	-	Steamship	CAD I (Disposal Only)
08/07/08	17:15	0.00	17:25	0.00	0.00	-	-	Steamship	Steamship
08/08/08	7:15	0.00	7:25	0.00	0.00	-	-	Steamship	Steamship
08/08/08	13:30	0.16	13:40	11.07	10.91	-	-	Steamship	Steamship
08/08/08	15:45	0.30	16:01	0.93	0.63		-	Steamship	Steamship
08/11/08	8:50	4.00	8:40	0.00	-4.00	-	-	Steamship	Steamship
08/11/08	16:30	1.23	16:50	2.00	0.77	-	-	Steamship	Steamship
08/12/08	11:20	0.00	11:30	1.40	1.40	-	-	Steamship	Steamship
08/12/08	13:40	0.00	13:30	2.93	2.93	-	-	Steamship	Steamship
08/12/08	15:30	0.00	15:40	4.26	4.26	-	-	Steamship	Steamship
08/18/08	8:30	0.00	8:40	0.96	0.96	-	-	Steamship	Steamship
08/18/08	10:30	8.53	10:44	0.00	-8.53			Steamship	Steamship
08/18/08	12:30	5.93	12:40	2.97	-2.96	-	-	Steamship	Steamship
08/18/08	15:28	5.90	15:32	2.70	-3.20			Steamship	Steamship
08/18/08	17:34	0.83	17:40	2.97	2.14		-	Steamship	Steamship
08/21/08	9:50	1.03	10:15	0.13	-0.90	-	-	Steamship	Steamship
08/21/08	12:45	3.90	12:50	0.00	-3.90	-	-	Steamship	Steamship
08/21/08	14:59	5.53	14:50	0.63	-4.90	-	-	Steamship	Steamship
08/21/08	17:22	5.60	17:26	0.83	-4.77	-	-	Steamship	Steamship
08/21/08	16:04	2.20	17:04	2.86	0.66	16:00	-	Steamship	CAD I (Disposal Only)
08/26/08	7:00	4.10	7:10	0.50	-3.60	-	-	Steamship	Steamship
08/26/08	8:55	0.30	9:02	18.47	18.17	-	-	Steamship	Steamship
08/26/08	11:05	4.97	11:15	5.43	0.46	-	-	Steamship	Steamship
08/26/08	13:00	2.77	13:12	9.73	6.96	-	-	Steamship	Steamship
08/28/08	7:30	3.77	7:40	3.37	-0.40	-	-	Steamship	Steamship
08/28/08	9:30	5.10	9:35	6.30	1.20	-	-	Steamship	Steamship
08/28/08	11:40	2.67	11:35	6.27	3.60	-	-	Steamship	Steamship
08/28/08	15:35	10.10	15:28	6.50	-3.60	-	-	Steamship	Steamship
08/28/08	8:50	24.10	8:57	9.63	-14.47	-	-	Steamship	Steamship
09/03/08	9:00	1.03	9:11	6.57	5.54	-	-	Steamship	Steamship
09/03/08	11:25	1.00	11:32	16.13	15.13	-	-	Steamship	Steamship

TABLE 7 - NEW BEDFORD HARBOR DREDGE - PHASE III

Water Quality Monitoring - Turbidity Measurements

June 12, 2008 -- August 25, 2009

Date	Time of Up Current	Average of Up Current	Time of Down Current	Average of Down Current	Difference (Down Current - Up Current)	Time of Disposal Location	Average of Disposal Location	Project Title	Project and/or Location
09/03/08	13:52	1.47	13:44	1.27	-0.20	-	-	Steamship	Steamship
08/27/08	13:47	2.83	13:40	8.57	5.74	N/A*[2]	N/A*[2]	BOC II	BOC II
08/27/08	15:42	2.10	15:35	4.23	2.13	N/A*[2]	N/A*[2]	BOC II	BOC II
08/27/08	17:30	2.23	17:42	3.16	0.93	N/A*[2]	N/A*[2]	BOC II	BOC II
08/28/08	8:00	1.90	8:10	1.53	-0.37	N/A*[2]	N/A*[2]	BOC II	BOC II
08/28/08	10:30	4.23	10:24	3.17	-1.06	N/A*[2]	N/A*[2]	BOC II	BOC II
08/28/08	12:22	3.73	12:27	2.23	-1.50	N/A*[2]	N/A*[2]	BOC II	BOC II
08/28/08	14:45	9.00	14:50	1.83	-7.17	N/A*[2]	N/A*[2]	BOC II	BOC II
08/28/08	16:40	1.60	16:50	4.13	2.53	N/A*[2]	N/A*[2]	BOC II	BOC II
09/03/08	8:10	3.33	8:05	19.23	15.90	N/A*[2]	N/A*[2]	BOC II	BOC II
09/03/08	10:54	4.10	11:02	1.93	-2.17	N/A*[2]	N/A*[2]	BOC II	BOC II
09/03/08	13:05	1.63	13:17	9.13	7.50	N/A*[2]	N/A*[2]	BOC II	BOC II
09/11/08	8:22	1.63	8:49	4.67	3.04	N/A*[2]	N/A*[2]	BOC II	BOC II
09/11/08	10:40	1.67	10:32	1.63	-0.04	N/A*[2]	N/A*[2]	BOC II	BOC II
09/11/08	13:00	1.30	13:05	1.73	0.43	N/A*[2]	N/A*[2]	BOC II	BOC II
09/11/08	16:42	2.33	17:00	3.80	1.47	N/A*[2]	N/A*[2]	BOC II	BOC II
09/16/08	9:50	1.50	10:00	2.37	0.87	N/A*[2]	N/A*[2]	BOC II	BOC II
09/16/08	11:50	3.50	11:56	1.67	-1.83	N/A*[2]	N/A*[2]	BOC II	BOC II
09/16/08	14:41	10.20	14:30	3.60	-6.60	N/A*[2]	N/A*[2]	BOC II	BOC II
09/16/08	16:20	5.33	16:16	4.73	-0.60	N/A*[2]	N/A*[2]	BOC II	BOC II
09/18/08	11:40	1.13	11:50	2.10	0.97	N/A*[2]	N/A*[2]	BOC II	BOC II
09/18/08	15:36	3.20	15:45	3.57	0.37	N/A*[2]	N/A*[2]	BOC II	BOC II
03/23/09	*[1]	1.45	*[1]	1.85	0.40	-	N/A*[3]	PH III PART B	NBRF
03/25/09	11:25	1.10	12:25	3.59	2.49	12:15	N/A*[3]	PH III PART B	NBRF (Disposal Only)
03/27/09	12:20	0.40	12:30	0.30	-0.10	12:14	N/A*[3]	PH III PART B	NBRF (Disposal Only)
04/05/09	11:40	1.55	13:00	1.73	0.18	11:55	N/A*[3]	PH III PART B	NBRF (Disposal Only)
04/08/09	13:20	2.94	13:35	2.43	-0.51	13:25	N/A*[3]	PH III PART B	NBRF (Disposal Only)
04/10/09	14:15	1.10	14:50	1.33	0.23	14:25	N/A*[3]	PH III PART B	NBRF (Disposal Only)
04/13/09	14:20	1.04	14:45	1.75	0.71	-	N/A*[3]	PH III PART B	NBRF
04/14/09	17:00	3.63	17:30	2.39	-1.24	17:15	N/A*[3]	PH III PART B	NBRF (Disposal Only)
04/21/09	10:14	2.21	11:00	5.05	2.84	10:50	N/A*[3]	PH III PART A	Gifford St.
04/22/09	8:15	1.70	8:28	4.07	2.37	8:20	N/A*[3]	PH III PART A	Gifford St.
04/22/09	13:50	1.60	14:10	2.17	0.57	-	N/A*[3]	PH III PART A	Gifford St.

TABLE 7 - NEW BEDFORD HARBOR DREDGE - PHASE III

Water Quality Monitoring - Turbidity Measurements

June 12, 2008 -- August 25, 2009

Date	Time of Up Current	Average of Up Current	Time of Down Current	Average of Down Current	Difference (Down Current - Up Current)	Time of Disposal Location	Average of Disposal Location	Project Title	Project and/or Location
04/23/09	* [1]	1.83	* [1]	2.00	0.17	7:35	N/A*[3]	PH III PART A	Gifford St., South Terminal
04/24/09	8:35	1.43	9:35	1.73	0.30	9:25	N/A*[3]	PH III PART A	CAD II (Disposal only)
04/26/09	12:25	0.85	13:05	1.37	0.52	12:45	N/A*[3]	PH III PART A	Gifford St., South Terminal
05/04/09	11:30	3.02	* [1]	1.22	-1.80	11:45	N/A*[3]	PH III PART A	CAD II (Disposal only)
05/06/09	11:45	1.70	12:00	1.80	0.10	11:50	N/A*[3]	PH III PART A	CAD II (Disposal only)
05/06/09	16:45	2.50	16:58	14.30	11.80	-	N/A*[3]	PH III PART A	Gifford St.
05/07/09	15:00	13.00	15:20	2.73	-10.27	-	N/A*[3]	PH III PART A	South Terminal
05/13/09	13:30	1.37	13:50	1.47	0.10	13:36	N/A*[3]	PH III PART A	CAD II (Disposal only)
05/14/09	8:20	0.60	8:45	2.27	1.67	8:35	N/A*[3]	PH III PART A	CAD II (Disposal only)
05/16/09	12:30	2.09	13:25	0.61	-1.48	-	N/A*[3]	PH III PART A	Union Wharf
05/20/09	14:00	21.60	14:20	3.19	-18.41	-	N/A*[3]	PH III PART A	Gifford St.
05/22/09	8:00	0.81	8:15	0.29	-0.52	8:05	N/A*[3]	PH III PART A	CAD II (Disposal only)
05/28/09	10:13	1.09	10:25	1.85	0.76	-	N/A*[3]	PH III PART A	Linberg Marine
05/28/09	14:00	1.06	14:45	1.71	0.65	14:20	N/A*[3]	PH III PART A	CAD II (Disposal only)
06/04/09	14:35	1.60	14:52	3.53	1.93	-	N/A*[3]	PH III PART A	Linberg Marine
06/04/09	16:20	1.90	16:55	3.13	1.23	16:35	N/A*[3]	PH III PART A	CAD II (Disposal only)
06/06/09	14:05	1.47	14:30	3.76	2.29	-	N/A*[3]	PH III PART A	Linberg Marine
06/14/09	8:40	3.07	9:15	3.17	0.10	8:50	N/A*[3]	PH III PART A	CAD II (Disposal only)
06/17/09	15:25	2.99	15:40	4.05	1.06	-	N/A*[3]	PH III PART A	WA-S
06/18/09	8:30	0.87	9:00	1.30	0.43	8:45	N/A*[3]	PH III PART A	CAD II (Disposal only)
06/22/09	11:15	1.66	11:35	1.04	-0.62	-	N/A*[3]	PH III PART A	ONWF
06/24/09	10:10	4.54	10:25	0.46	-4.08	-	N/A*[3]	PH III PART A	Gifford St.
07/01/09	14:40	2.88	15:17	3.83	0.95	-	N/A*[3]	PH III PART A	Gifford St.
07/02/09	16:45	2.28	17:15	5.23	2.95	-	N/A*[3]	PH III PART A	Gifford St.
07/08/09	11:55	1.93	12:15	1.83	-0.10	-	N/A*[3]	PH III PART A	NL
07/08/09	14:33	3.60	14:40	18.00	14.40	14:35	N/A*[3]	PH III PART A	CAD II (Disposal only)
07/10/09	9:30	0.73	10:15	1.05	0.32	-	N/A*[3]	PH III PART A	Packer Marine

TABLE 7 - NEW BEDFORD HARBOR DREDGE - PHASE III

Water Quality Monitoring - Turbidity Measurements

June 12, 2008 -- August 25, 2009

Date	Time of Up Current	Average of Up Current	Time of Down Current	Average of Down Current	Difference (Down Current - Up Current)	Time of Disposal Location	Average of Disposal Location	Project Title	Project and/or Location
07/15/09	13:58	1.97	14:05	5.57	3.60	-	N/A*[3]	PH III PART A	Gifford St.
07/17/09	13:48	2.13	14:05	1.59	-0.54	-	N/A*[3]	PH III PART A	WA-S
07/22/09	13:35	2.59	14:00	3.63	1.04	-	N/A*[3]	PH III PART A	South Terminal
07/23/09	15:30	4.22	15:40	2.70	-1.52	-	N/A*[3]	PH III PART A	South Terminal
07/28/09	8:55	4.62	9:10	4.35	-0.27	-	N/A*[3]	PH III PART A	South Terminal
08/12/09	13:40	2.90	14:10	4.51	1.61	-	N/A*[3]	PH III PART A	Gifford St.
08/13/09	17:48	1.90	18:05	2.60	0.70	-	N/A*[3]	PH III PART A	South Terminal
08/17/09	10:10	0.77	10:25	2.07	1.30	-	N/A*[3]	PH III PART A	Packer Marine
08/20/09	14:25	2.28	14:45	2.79	0.51	-	N/A*[3]	PH III PART A	Packer Marine
08/25/09	16:46	5.62	17:00	3.23	-2.39	-	N/A*[3]	PH III PART A	South Terminal

Comments:

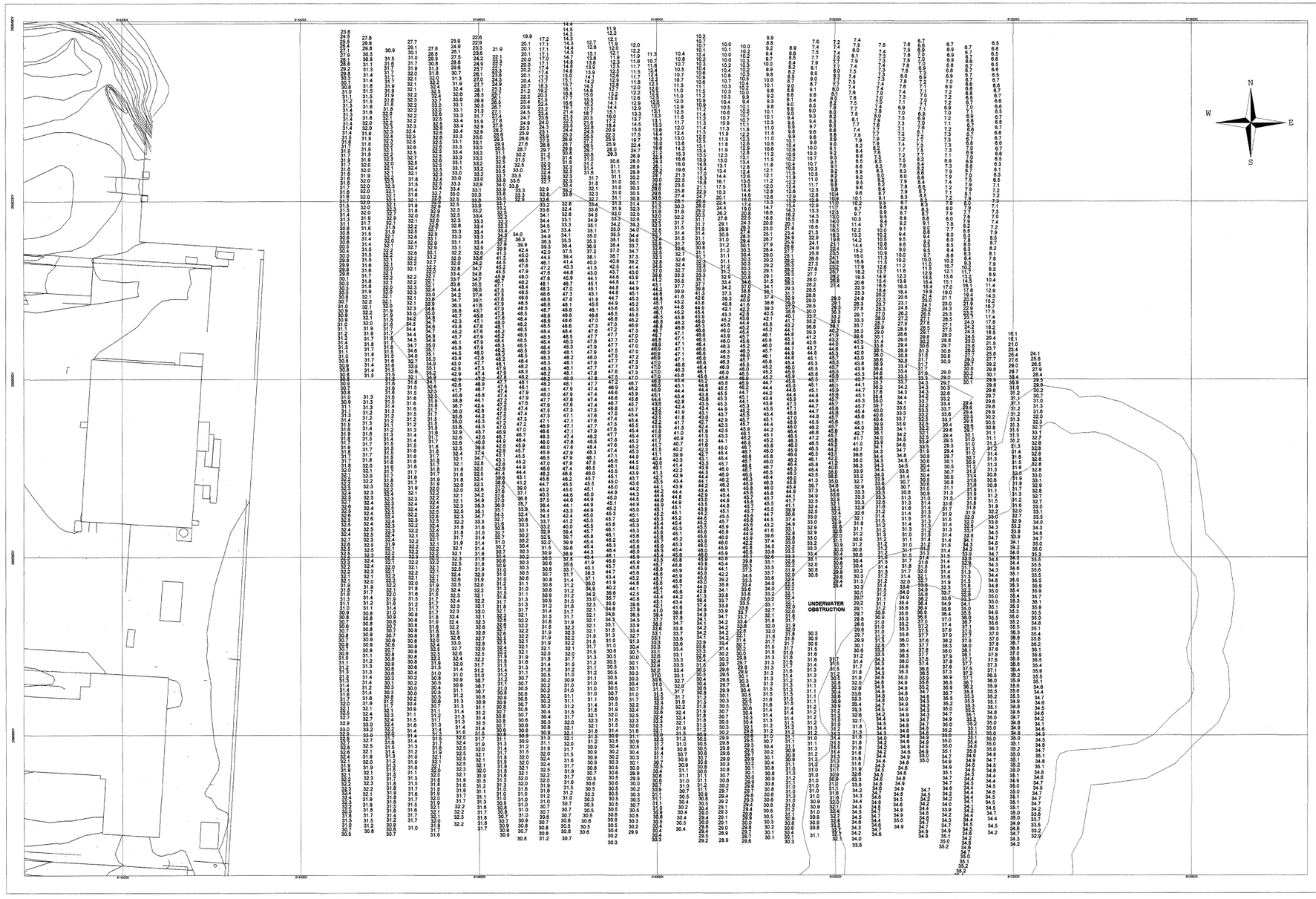
- Denotes a non-disposal event

*[1] Time field left blank on original field sheet/log-book

*[2] Bottom of CAD disposal events were off shore and water quality montitoring was not completed

*[3] PH III Part A and Part B Dredging were completed with a silt curtain around CAD II therefore no disposal location readings were taken (up-current and down-current measurements were taken outside the silt curtain.

FIGURES



NO.	DESCRIPTION	DATE	APPROVED

REVISIONS

NOTES

1. THE SOUNDING INFORMATION PRESENTED ON THIS PLAN REPRESENTS THE RESULTS OF A SURVEY PERFORMED BY COLER & COLANTONIO, INC. ON JUNE 18, 2008 AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS EXISTING AT THAT TIME. REUSE OF THIS INFORMATION BY THE CLIENT OR OTHERS BEYOND THE SPECIFIC SCOPE OF WORK FOR WHICH IT WAS ACQUIRED SHALL BE AT THE SOLE RISK OF THE USER AND WITHOUT LIABILITY TO COLER & COLANTONIO, INC.
2. SURVEY VESSEL POSITIONING AND TIDE MONITORING WAS BY REAL-TIME KINEMATIC (RTK) GPS.
3. THE DEPTHS SHOWN ON THIS PLAN ARE EXPRESSED IN FEET AND TENTHS AND ARE REFERENCED TO THE MEAN LOWER LOW WATER (MLLW) TIDAL DATUM. THE BENCHMARK FOR THIS PROJECT IS NATIONAL OCEAN SERVICE (NOS) TIDAL BENCHMARK 7584 JODY 1971 LOCATED IN NEW BEDFORD HARBOR, NEW BEDFORD, MASSACHUSETTS.
4. OTHER THAN SOUNDINGS ANY BASE PLAN DETAIL, INCLUDING THE SHORELINE, HARBOR INFRASTRUCTURE, DREDGE AND CHANNEL LIMITS, WAS PROVIDED BY APEX COMPANIES, LLC.
5. UNLESS OTHERWISE INDICATED ON THIS PLAN UTILITIES OR OBSTRUCTIONS LOCATED ON OR BENEATH THE SEABED ARE UNKNOWN AT THIS TIME.
6. NOT TO BE USED FOR NAVIGATION.

GEODETIC DATUM INFORMATION

HORIZONTAL DATUM
NORTH AMERICAN DATUM 1983 (NAD 83)
MASSACHUSETTS STATE PLANE COORDINATE SYSTEM, ZONE 2001

VERTICAL DATUM
BASE PLAN DETAIL VERTICAL DATUM UNKNOWN

SOUNDING DATUM
MEAN LOWER LOW WATER (MLLW)
TIDAL EPOCH 1960 - 1978 (NATIONAL OCEAN SERVICE)

SCALE: 1" = 40'

40 0 40 80 120

CHECK GRAPHIC SCALE BEFORE USING

NEW BEDFORD HARBOR – CAD CELL 1 DISPOSAL AREA

NEW BEDFORD, MASSACHUSETTS

EXISTING CONDITIONS HYDROGRAPHIC SURVEY

CAD CELL 1

SHEET 1 OF 1

PREPARED FOR:

APEX COMPANIES, LLC.
115 BROAD STREET, SUITE 200
BOSTON, MASSACHUSETTS 02110

PROJECT MANAGER:	COMPUTED BY:	DRAWN BY:	REVIEWED BY:
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PROJECT NO.:	DATE:	DRAWING NO.:	DRAWING SIZE:
21-00008.01	JUNE 19, 2008	EC_40.PLT	ANSI F

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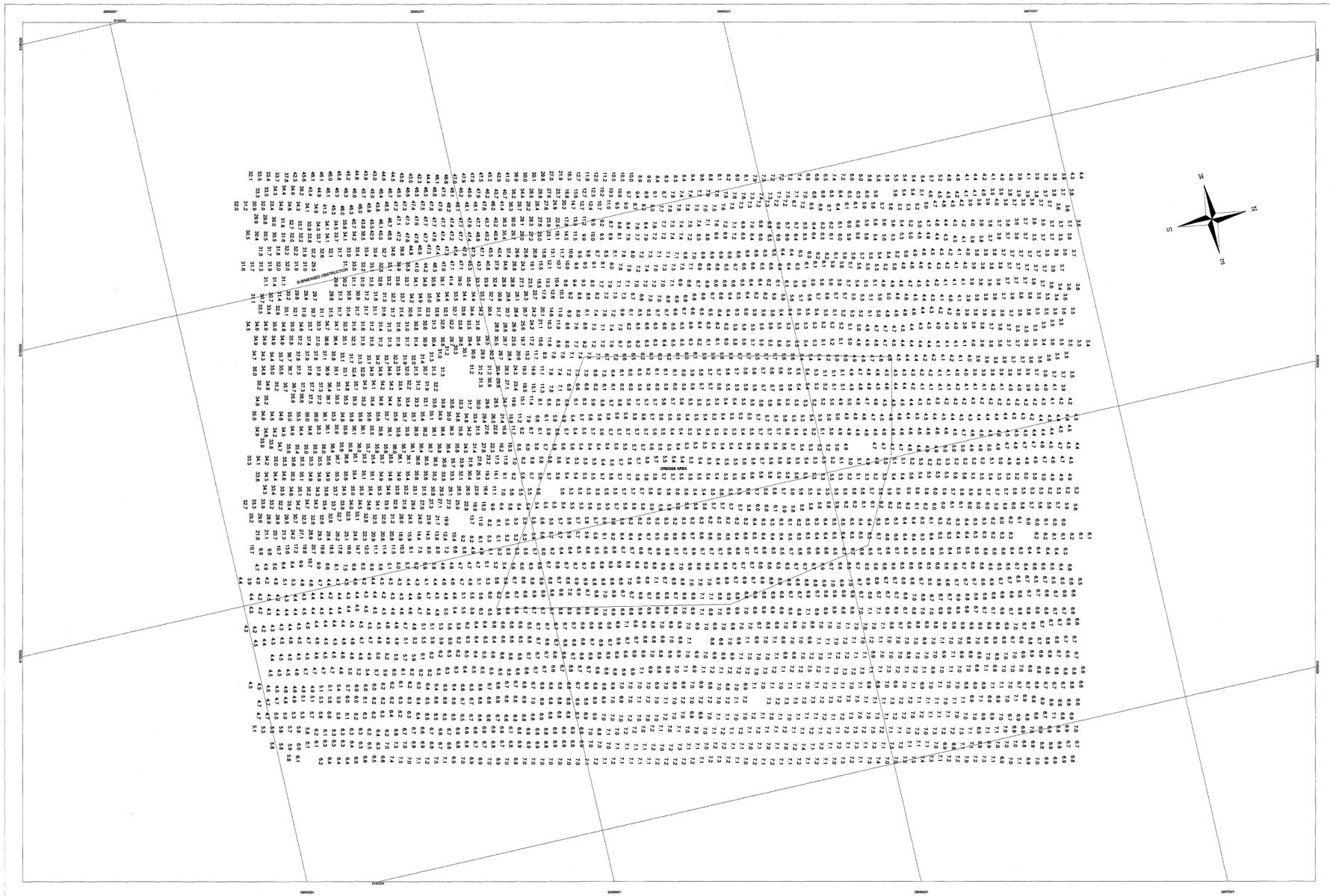
COLER & COLANTONIO, INC.
ENGINEERING AND SCIENTISTS



ERIC J. POREDA
No. 41812
STATE OF FLORIDA
PROFESSIONAL SURVEYOR & MAPPER

6-6-08

NO.	DESCRIPTION	DATE	APPROVED

REVISIONS

NOTES

1. THE SOUNDING INFORMATION PRESENTED ON THIS PLAN REPRESENTS THE RESULTS OF A SURVEY PERFORMED BY COLER & COLANTONIO, INC. ON JUNE 5, 2008 AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS EXISTING AT THAT TIME. REUSE OF THIS INFORMATION BY THE CLIENT OR OTHERS BEYOND THE SPECIFIC SCOPE OF WORK FOR WHICH IT WAS ACQUIRED SHALL BE AT THE SOLE RISK OF THE USER AND WITHOUT LIABILITY TO COLER & COLANTONIO, INC.
2. SURVEY VESSEL POSITIONING AND TIDE MONITORING WAS BY REAL-TIME KINEMATIC (RTK) GPS.
3. THE DEPTHS SHOWN ON THIS PLAN ARE EXPRESSED IN FEET AND TENTHS AND ARE REFERENCED TO THE MEAN LOWER LOW WATER (MLLW) TIDAL DATUM. THE BENCHMARK FOR THIS PROJECT IS NATIONAL OCEAN SERVICE (NOS) TIDAL BENCHMARK 7394 JODY 1977 LOCATED IN NEW BEDFORD HARBOR, NEW BEDFORD, MASSACHUSETTS.
4. OTHER THAN SOUNDINGS ANY BASE PLAN DETAIL, INCLUDING THE SHORELINE, HARBOR INFRASTRUCTURE, DREDGE AND CHANNEL LIMITS, WAS PROVIDED BY APEX COMPANIES, LLC.
5. UNLESS OTHERWISE INDICATED ON THIS PLAN UTILITIES OR OBSTRUCTIONS LOCATED ON OR BENEATH THE SEABED ARE UNKNOWN AT THIS TIME.
6. NOT TO BE USED FOR NAVIGATION.

GEODETIC DATUM INFORMATION

HORIZONTAL DATUM
NORTH AMERICAN DATUM 1983 (NAD 83)
MASSACHUSETTS STATE PLANE COORDINATE SYSTEM, ZONE 2001

VERTICAL DATUM
BASE PLAN DETAIL VERTICAL DATUM UNKNOWN

SOUNDING DATUM
MEAN LOWER LOW WATER (MLLW)
TIDAL EPOCH 1960 - 1978 (NATIONAL OCEAN SERVICE)

SCALE: 1" = 60'

60 0 60 120 180

CHECK GRAPHIC SCALE BEFORE USING

NEW BEDFORD HARBOR – CAD CELL 2

NEW BEDFORD, MASSACHUSETTS

PRE-DREDGE HYDROGRAPHIC SURVEY
TOP OF CAD CELL

SHEET 1 OF 1

PREPARED FOR:

APEX COMPANIES, LLC.
115 BROAD STREET, SUITE 200
BOSTON, MASSACHUSETTS 02110

PROJECT MANAGER:	COMPUTED BY:	DRAWN BY:	REVIEWED BY:
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PROJECT NO.:	DATE:	DRAWING NO.:	DRAWING SIZE:
21-00008.00	JUNE 5, 2008	PS_SLPLT	ANSI F

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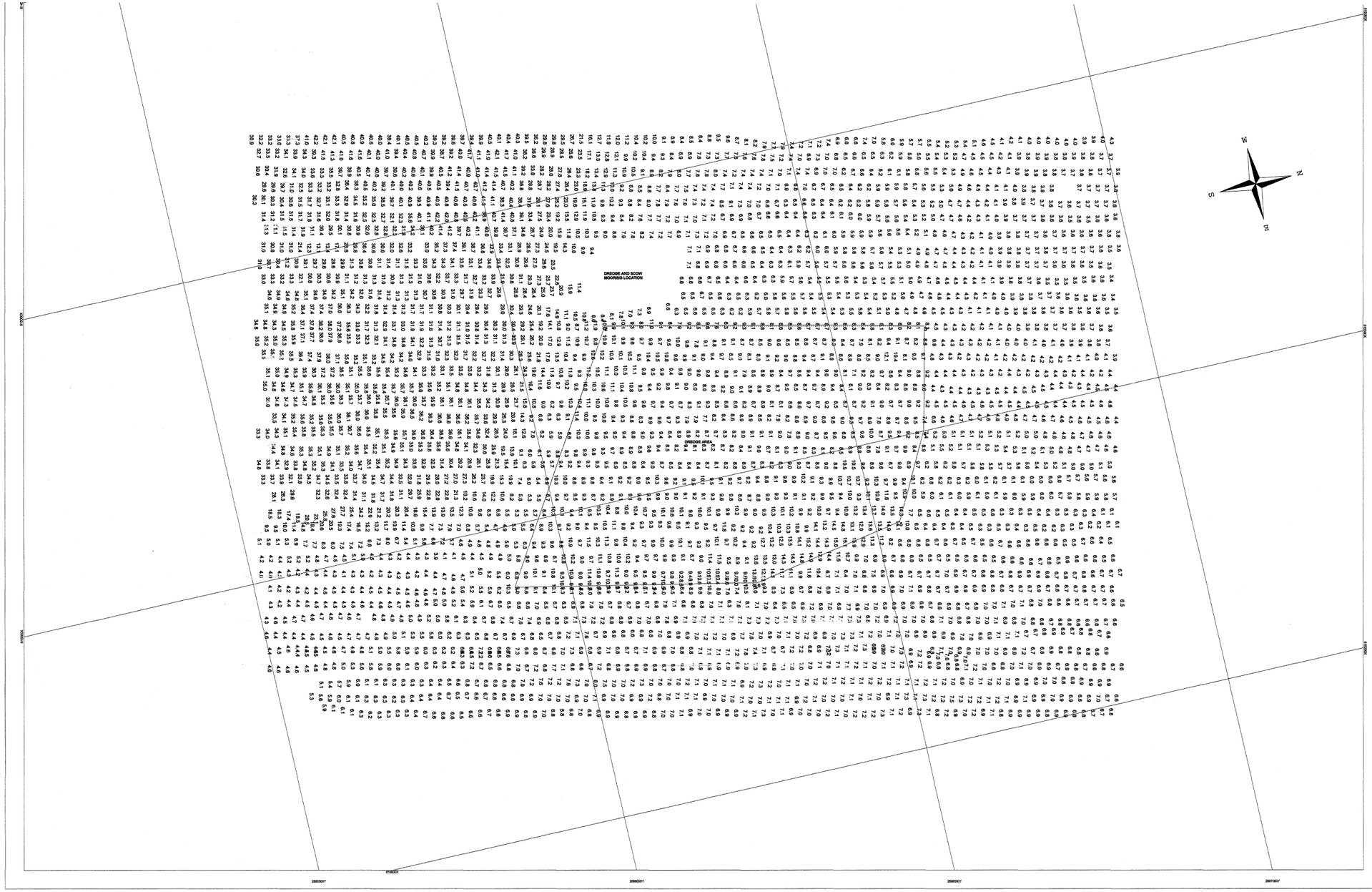
COLER & COLANTONIO INC
CIVIL ENGINEERS LAND SURVEYORS



NO.	DESCRIPTION	DATE	APPROVED

REVISIONS

NOTES

1. THE SOUNDING INFORMATION PRESENTED ON THIS PLAN REPRESENTS THE RESULTS OF A SURVEY PERFORMED BY COLER & COLANTONIO, INC. ON JULY 17, 2008 AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS EXISTING AT THAT TIME. REUSE OF THIS INFORMATION BY THE CLIENT OR OTHERS BEYOND THE SPECIFIC SCOPE OF WORK FOR WHICH IT WAS ACQUIRED SHALL BE AT THE SOLE RISK OF THE USER AND WITHOUT LIABILITY TO COLER & COLANTONIO, INC.
2. SURVEY VESSEL POSITIONING AND TIDE MONITORING WAS BY REAL-TIME KINEMATIC (RTK) GPS.
3. THE DEPTHS SHOWN ON THIS PLAN ARE EXPRESSED IN FEET AND TENTHS AND ARE REFERENCED TO THE MEAN LOWER LOW WATER (MLLW) TIDAL DATUM. THE BENCHMARK FOR THIS PROJECT IS NATIONAL OCEAN SERVICE (NOS) TIDAL BENCHMARK 7584 JOOY 1977 LOCATED IN NEW BEDFORD HARBOR, NEW BEDFORD, MASSACHUSETTS.
4. OTHER THAN SOUNDINGS ANY BASE PLAN DETAIL, INCLUDING THE SHORELINE, HARBOR INFRASTRUCTURE, DREDGE AND CHANNEL LIMITS, WAS PROVIDED BY APEX COMPANIES, LLC.
5. UNLESS OTHERWISE INDICATED ON THIS PLAN UTILITIES OR OBSTRUCTIONS LOCATED ON OR BENEATH THE SEABED ARE UNKNOWN AT THIS TIME.
6. NOT TO BE USED FOR NAVIGATION.

GEODETIC DATUM INFORMATION

HORIZONTAL DATUM
NORTH AMERICAN DATUM 1983 (NAD 83)
MASSACHUSETTS STATE PLANE COORDINATE SYSTEM, ZONE 2001

VERTICAL DATUM
BASE PLAN DETAIL VERTICAL DATUM UNKNOWN

SOUNDING DATUM
MEAN LOWER LOW WATER (MLLW)
TIDAL EPOCH 1960 - 1978 (NATIONAL OCEAN SERVICE)

SCALE: 1" = 60'

60 0 60 120 180

CHECK GRAPHIC SCALE BEFORE USING

NEW BEDFORD HARBOR – CAD CELL 2

NEW BEDFORD, MASSACHUSETTS

POST-DREDGE HYDROGRAPHIC SURVEY
TOP OF CAD CELL

SHEET 1 OF 1

PREPARED FOR:

APEX COMPANIES, LLC.
115 BROAD STREET, SUITE 200
BOSTON, MASSACHUSETTS 02110

PROJECT MANAGER:	COMPUTED BY:	DRAWN BY:	REVIEWED BY:
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COLER & COLANTONIO INC
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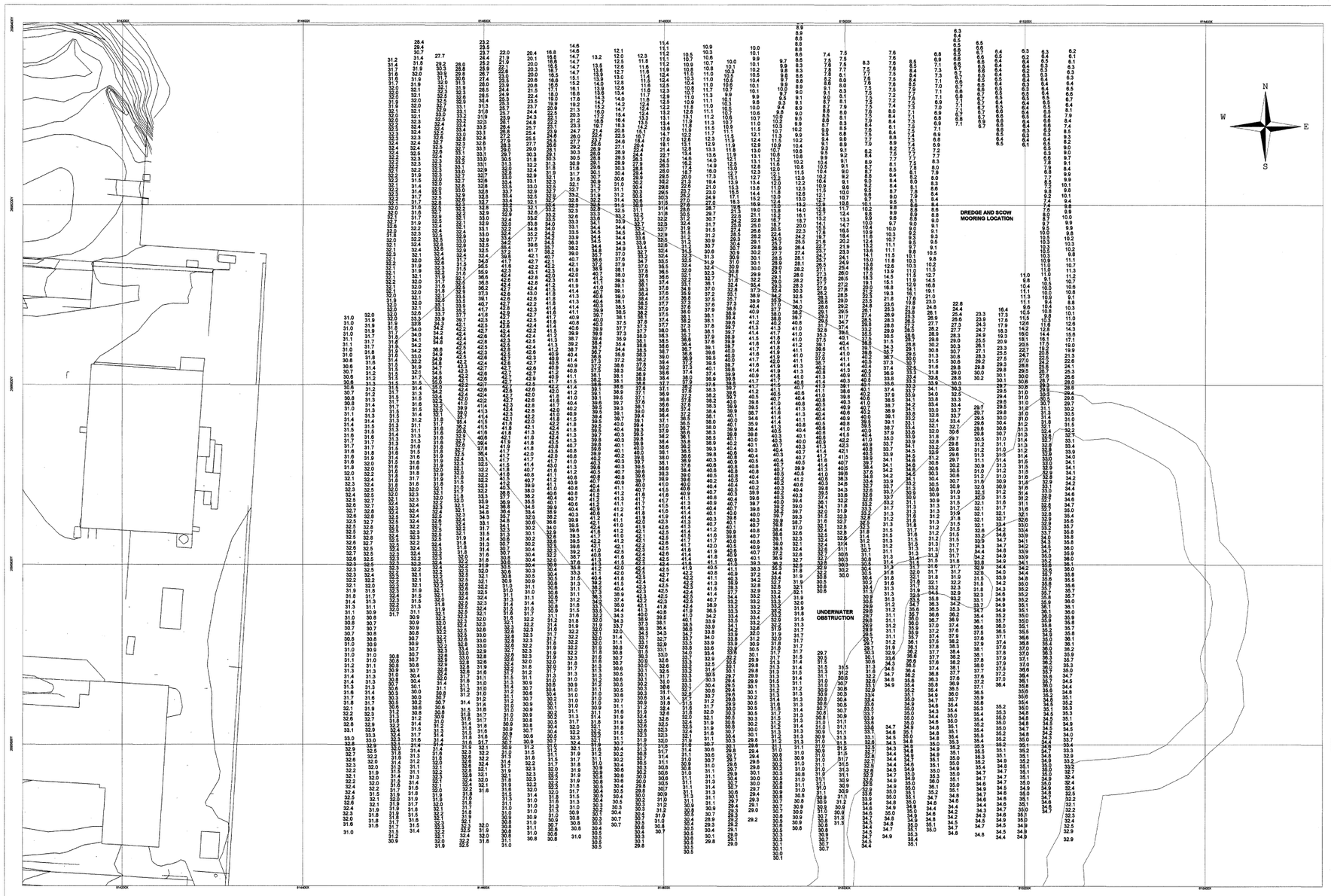

NO.	DESCRIPTION	DATE	APPROVED

REVISIONS

NOTES

1. THE SOUNDING INFORMATION PRESENTED ON THIS PLAN REPRESENTS THE RESULTS OF A SURVEY PERFORMED BY COLER & COLANTONIO, INC. ON JULY 26, 2006 AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS EXISTING AT THAT TIME. REUSE OF THIS INFORMATION BY THE CLIENT OR OTHERS BEYOND THE SPECIFIC SCOPE OF WORK FOR WHICH IT WAS ACQUIRED SHALL BE AT THE SOLE RISK OF THE USER AND WITHOUT LIABILITY TO COLER & COLANTONIO, INC.
2. SURVEY VESSEL POSITIONING AND TIDE MONITORING WAS BY REAL-TIME KINEMATIC (RTK) GPS.
3. THE DEPTHS SHOWN ON THIS PLAN ARE EXPRESSED IN FEET AND TENTHS AND ARE REFERENCED TO THE MEAN LOWER LOW WATER (MLLW) TIDAL DATUM. THE BENCHMARK FOR THIS PROJECT IS NATIONAL OCEAN SERVICE (NOS) TIDAL BENCHMARK 7584 JODY 1977 LOCATED IN NEW BEDFORD HARBOR, NEW BEDFORD, MASSACHUSETTS.
4. OTHER THAN SOUNDINGS ANY BASE PLAN DETAIL, INCLUDING THE SHORELINE, HARBOR INFRASTRUCTURE, DREDGE AND CHANNEL LIMITS, WAS PROVIDED BY APEX COMPANIES, LLC.
5. UNLESS OTHERWISE INDICATED ON THIS PLAN UTILITIES OR OBSTRUCTIONS LOCATED ON OR BENEATH THE SEABED ARE UNKNOWN AT THIS TIME.
6. NOT TO BE USED FOR NAVIGATION.

GEODETIC DATUM INFORMATION

HORIZONTAL DATUM
NORTH AMERICAN DATUM 1983 (NAD 83)
MASSACHUSETTS STATE PLANE COORDINATE SYSTEM, ZONE 2001

VERTICAL DATUM
BASE PLAN DETAIL VERTICAL DATUM UNKNOWN

SOUNDING DATUM
MEAN LOWER LOW WATER (MLLW)
TIDAL EPOCH 1960 - 1978 (NATIONAL OCEAN SERVICE)

SCALE: 1" = 40'

40 0 40 80 120

CHECK GRAPHIC SCALE BEFORE USING

NEW BEDFORD HARBOR – CAD CELL 1 DISPOSAL AREA

NEW BEDFORD, MASSACHUSETTS

EXISTING CONDITIONS HYDROGRAPHIC SURVEY

CAD CELL 1

SHEET 1 OF 1

PREPARED FOR:

APEX COMPANIES, LLC.
115 BROAD STREET, SUITE 200
BOSTON, MASSACHUSETTS 02110

PROJECT MANAGER:	COMPUTED BY:	DRAWN BY:	REVIEWED BY:
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PROJECT NO.:	DATE:	DRAWING NO.:	DRAWING SIZE:
21-00008.03	JULY 27, 2006	EC_40.PLT	ANSI F

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COLER & COLANTONIO INC
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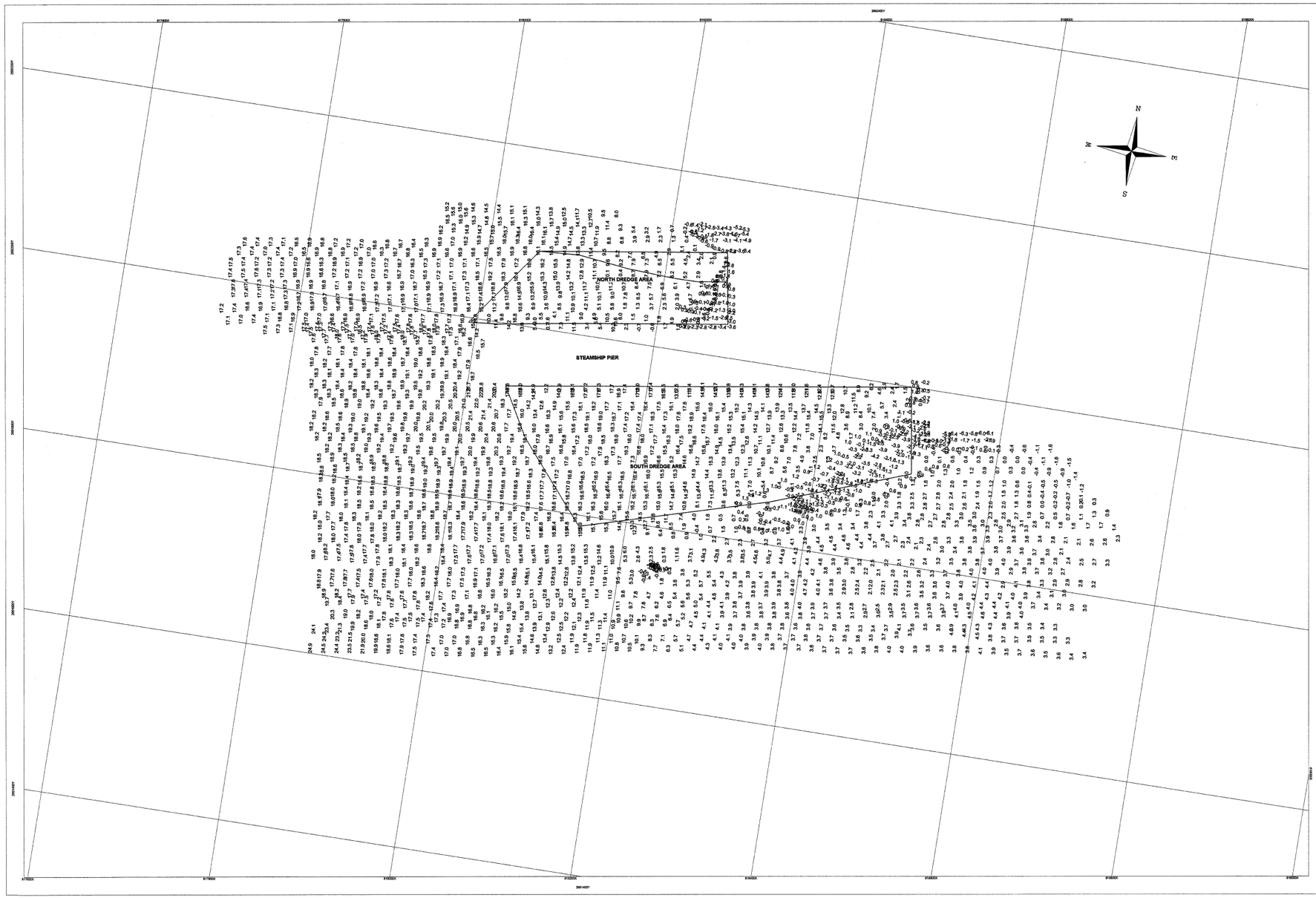


NO.	DESCRIPTION	DATE	APPROVED

REVISIONS

NOTES

1. THE SOUNDING INFORMATION PRESENTED ON THIS PLAN REPRESENTS THE RESULTS OF A SURVEY PERFORMED BY COLER & COLANTONIO, INC. DURING THE PERIOD JULY 22 – 23, 2008 AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS EXISTING AT THAT TIME. REUSE OF THIS INFORMATION BY THE CLIENT OR OTHERS BEYOND THE SPECIFIC SCOPE OF WORK FOR WHICH IT WAS ACQUIRED SHALL BE AT THE SOLE RISK OF THE USER AND WITHOUT LIABILITY TO COLER & COLANTONIO, INC.
2. SURVEY VESSEL POSITIONING AND TIDE MONITORING WAS BY REAL-TIME KINEMATIC (RTK) GPS.
3. THE DEPTHS SHOWN ON THIS PLAN ARE EXPRESSED IN FEET AND TENTHS AND ARE REFERENCED TO THE MEAN LOWER LOW WATER (MLLW) TIDAL DATUM. THE BENCHMARK FOR THIS PROJECT IS NATIONAL OCEAN SERVICE (NOS) TIDAL BENCHMARK 7564 JOOY 1977 LOCATED IN NEW BEDFORD HARBOR, NEW BEDFORD, MASSACHUSETTS.
4. OTHER THAN SOUNDINGS ANY BASE PLAN DETAIL, INCLUDING THE SHORELINE, HARBOR INFRASTRUCTURE, DREDGE AND CHANNEL LIMITS, WAS PROVIDED BY APEX COMPANIES, LLC.
5. UNLESS OTHERWISE INDICATED ON THIS PLAN UTILITIES OR OBSTRUCTIONS LOCATED ON OR BENEATH THE SEABED ARE UNKNOWN AT THIS TIME.
6. NOT TO BE USED FOR NAVIGATION.

GEODETIC DATUM INFORMATION

HORIZONTAL DATUM
NORTH AMERICAN DATUM 1983 (NAD 83)
MASSACHUSETTS STATE PLANE COORDINATE SYSTEM, ZONE 2001

VERTICAL DATUM
MEAN LOWER LOW WATER (MLLW)
TIDAL EPOCH 1960 – 1978 (NATIONAL OCEAN SERVICE)

SOUNDING DATUM
MEAN LOWER LOW WATER (MLLW)
TIDAL EPOCH 1960 – 1978 (NATIONAL OCEAN SERVICE)

SCALE: 1" = 40'

40 0 40 80 120

CHECK GRAPHIC SCALE BEFORE USING

STEAMSHIP AUTHORITY MAINTENANCE TERMINAL

FAIRHAVEN, MASSACHUSETTS

PRE-DREDGE HYDROGRAPHIC & TOPOGRAPHIC SURVEY

SHEET 1 OF 1

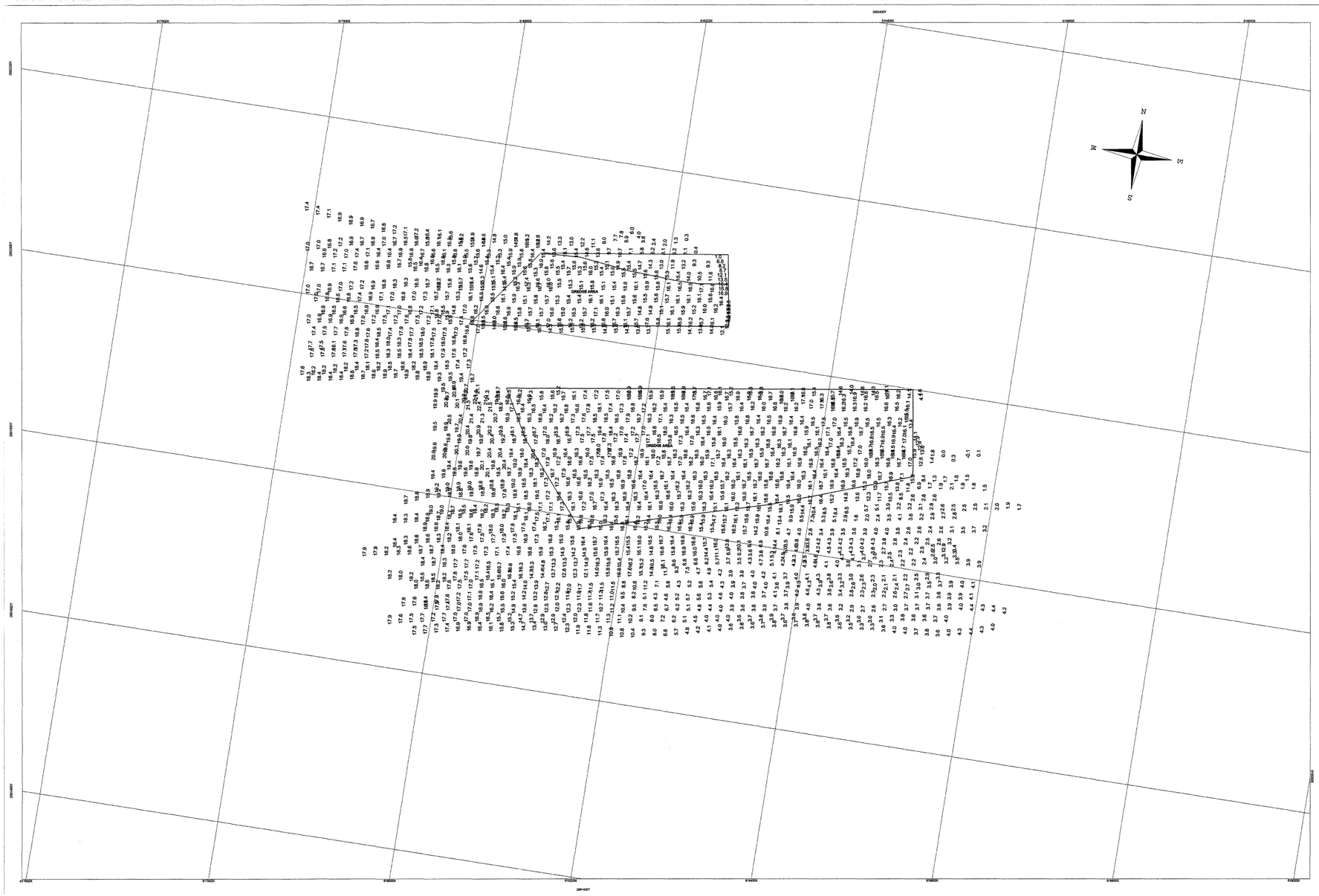
PREPARED FOR:

APEX COMPANIES, LLC.
115 BROAD STREET, SUITE 200
BOSTON, MASSACHUSETTS 02110

PROJECT MANAGER:	COMPUTED BY:	DRAWN BY:	REVIEWED BY:
MARK W. ROHDE	MARK W. ROHDE	MARK W. ROHDE	ERIC J. POREDA
PROJECT NO.:	DATE:	DRAWING NO.:	DRAWING SIZE:
21-00008.02	JULY 27, 2009	PR_40.PLT	ANSI F

COLER & COLANTONIO, INC.
161 ACCORD PARK DRIVE
NORWELL, MA 02061-1655
TEL: (781) 982-9400
FAX: (781) 982-9480

COLER & COLANTONIO, INC.
ENGINEERS AND SCIENTISTS



NO. | DESCRIPTION | DATE | APPROVED

REVISIONS

NOTES

1. THE SOUNDING INFORMATION PRESENTED ON THIS PLAN REPRESENTS THE RESULTS OF A SURVEY PERFORMED BY COLER & COLANTONIO, INC. ON SEPTEMBER 4TH AND 11TH, 2008 AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS EXISTING AT THAT TIME. REUSE OF THIS INFORMATION BY THE CLIENT OR OTHERS BEYOND THE SPECIFIC SCOPE OF WORK FOR WHICH IT WAS ACQUIRED SHALL BE AT THE SOLE RISK OF THE USER AND WITHOUT LIABILITY TO COLER & COLANTONIO, INC.
2. SURVEY VESSEL POSITIONING AND TIDE MONITORING WAS BY REAL-TIME KINEMATIC (RTK) GPS.
3. THE DEPTHS SHOWN ON THIS PLAN ARE EXPRESSED IN FEET AND TENTHS AND ARE REFERENCED TO THE MEAN LOWER LOW WATER (MLLW) TIDAL DATUM. THE BENCHMARK FOR THIS PROJECT IS NATIONAL OCEAN SERVICE (NOS) TIDAL BENCHMARK 7594 JODY 1977 LOCATED IN NEW BEDFORD HARBOR, NEW BEDFORD, MASSACHUSETTS.
4. OTHER THAN SOUNDINGS ANY BASE PLAN DETAIL, INCLUDING THE SHORELINE, HARBOR INFRASTRUCTURE, DREDGE AND CHANNEL LIMITS, WAS PROVIDED BY APEX COMPANIES, LLC.
5. UNLESS OTHERWISE INDICATED ON THIS PLAN UTILITIES OR OBSTRUCTIONS LOCATED ON OR BENEATH THE SEABED ARE UNKNOWN AT THIS TIME.
6. NOT TO BE USED FOR NAVIGATION.

GEODETIC DATUM INFORMATION

HORIZONTAL DATUM
NORTH AMERICAN DATUM 1983 (NAD 83)
MASSACHUSETTS STATE PLANE COORDINATE SYSTEM, ZONE 2001

VERTICAL DATUM
MEAN LOWER LOW WATER (MLLW)
TIDAL EPOCH 1960 – 1978 (NATIONAL OCEAN SERVICE)

SOUNDING DATUM
MEAN LOWER LOW WATER (MLLW)
TIDAL EPOCH 1960 – 1978 (NATIONAL OCEAN SERVICE)

SCALE: 1" = 40'

40 0 40 80 120

CHECK GRAPHIC SCALE BEFORE USING

STEAMSHIP AUTHORITY MAINTENANCE TERMINAL

FAIRHAVEN, MASSACHUSETTS

POST-DREDGE HYDROGRAPHIC SURVEY

SHEET 1 OF 1

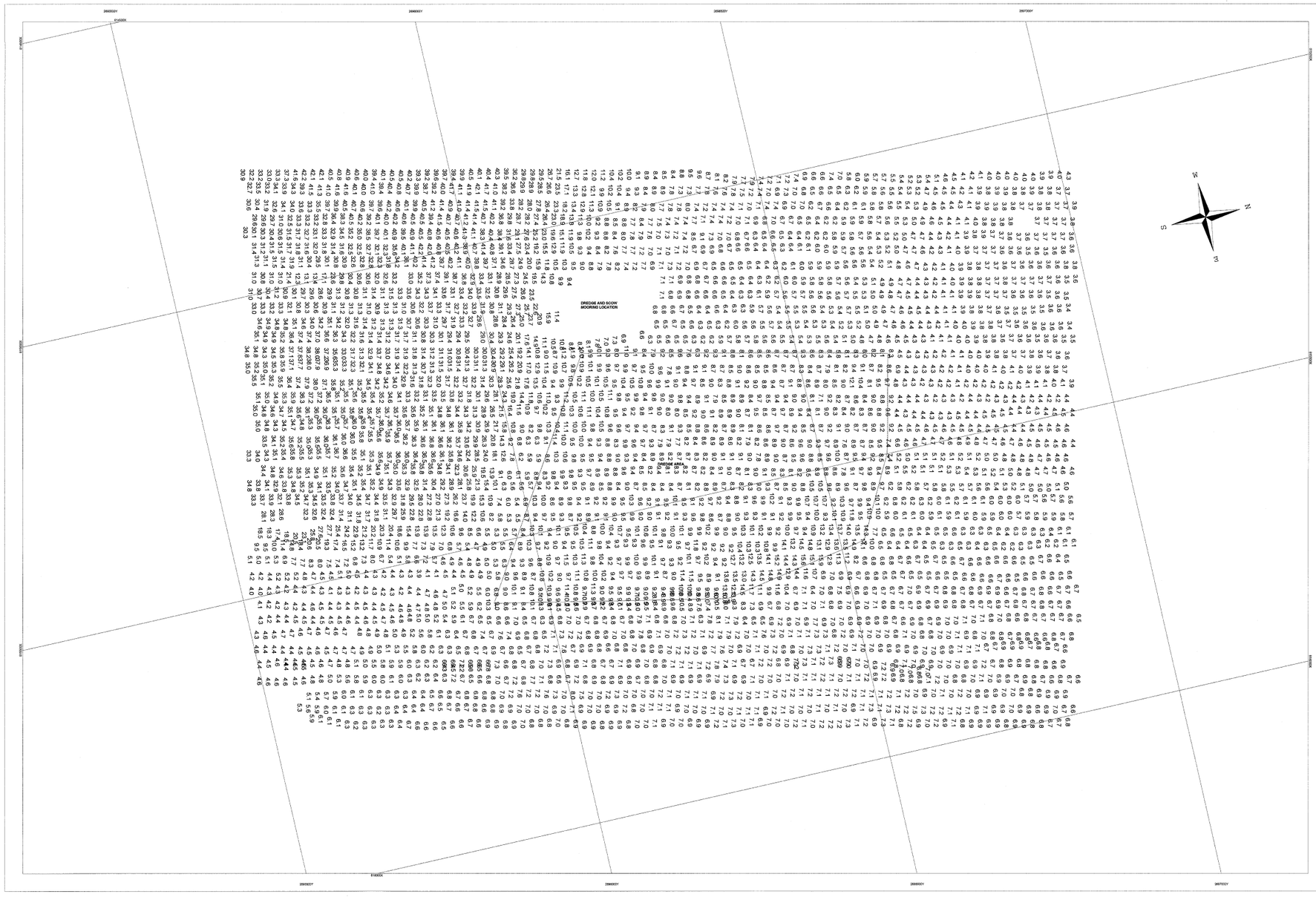
PREPARED FOR:

APEX COMPANIES, LLC.
115 BROAD STREET, SUITE 200
BOSTON, MASSACHUSETTS 02110

PROJECT MANAGER:	COMPUTED BY:	DRAWN BY:	REVIEWED BY:
MARK W. ROHDE	MARK W. ROHDE	MARK W. ROHDE	ERIC J. POREDA
PROJECT NO.:	DATE:	DRAWING NO.:	DRAWING SIZE:
21-00006.02	SEPTEMBER 15, 2008	PO_40.PLT	ANSI F

COLER & COLANTONIO, INC.
101 ACCORD PARK DRIVE
NORWELL, MA 02061-1655
TEL: (781) 982-5400
FAX: (781) 982-5490

COLER & COLANTONIO INC
ENGINEERS AND SCIENTISTS



NO.	DESCRIPTION	DATE	APPROVED

REVISIONS

NOTES

1. THE SOUNDING INFORMATION PRESENTED ON THIS PLAN REPRESENTS THE RESULTS OF A SURVEY PERFORMED BY COLER & COLANTONIO, INC. ON JULY 17, 2008 AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS EXISTING AT THAT TIME. REUSE OF THIS INFORMATION BY THE CLIENT OR OTHERS BEYOND THE SPECIFIC SCOPE OF WORK FOR WHICH IT WAS ACQUIRED SHALL BE AT THE SOLE RISK OF THE USER AND WITHOUT LIABILITY TO COLER & COLANTONIO, INC.
2. SURVEY VESSEL POSITIONING AND TIDE MONITORING WAS BY REAL-TIME KINEMATIC (RTK) GPS.
3. THE DEPTHS SHOWN ON THIS PLAN ARE EXPRESSED IN FEET AND TENTHS AND ARE REFERENCED TO THE MEAN LOWER LOW WATER (MLLW) TIDAL DATUM. THE BENCHMARK FOR THIS PROJECT IS NATIONAL OCEAN SERVICE (NOS) TIDAL BENCHMARK 7594 JODY 1977 LOCATED IN NEW BEDFORD HARBOR, NEW BEDFORD, MASSACHUSETTS.
4. OTHER THAN SOUNDINGS ANY BASE PLAN DETAIL, INCLUDING THE SHORELINE, HARBOR INFRASTRUCTURE, DREDGE AND CHANNEL LIMITS, WAS PROVIDED BY APEX COMPANIES, LLC.
5. UNLESS OTHERWISE INDICATED ON THIS PLAN UTILITIES OR OBSTRUCTIONS LOCATED ON OR BENEATH THE SEABED ARE UNKNOWN AT THIS TIME.
6. NOT TO BE USED FOR NAVIGATION.

GEODETIC DATUM INFORMATION

HORIZONTAL DATUM
NORTH AMERICAN DATUM 1983 (NAD 83)
MASSACHUSETTS STATE PLANE COORDINATE SYSTEM, ZONE 2001

VERTICAL DATUM
BASE PLAN DETAIL VERTICAL DATUM UNKNOWN

SOUNDING DATUM
MEAN LOWER LOW WATER (MLLW)
TIDAL EPOCH 1960 - 1978 (NATIONAL OCEAN SERVICE)

SCALE: 1" = 60'

60 0 60 120 180

CHECK GRAPHIC SCALE BEFORE USING

NEW BEDFORD HARBOR – CAD CELL 2

NEW BEDFORD, MASSACHUSETTS

PRE-DREDGE HYGROGRAPHIC SURVEY

BOTTOM OF CAD CELL

SHEET 1 OF 1

PREPARED FOR:

APEX COMPANIES, LLC
115 BROAD STREET, SUITE 200
BOSTON, MASSACHUSETTS 02110

PROJECT MANAGER:	COMPUTED BY:	DRAWN BY:	REVIEWED BY:
MARK W. ROHDE	MARK W. ROHDE	MARK W. ROHDE	ERIC J. POREDA
PROJECT NO.:	DATE:	DRAWING NO.:	DRAWING SIZE:
21-00008.00	SEPTEMBER 2, 2008	PO_B0.PLT	ANSI F

COLER & COLANTONIO, INC.
101 ACCORD PARK DRIVE
NORWELL, MA 02061-1685
TEL: (781) 982-5400
FAX: (781) 982-5490

COLER & COLANTONIO INC
ENGINEERS AND SCIENTISTS

ERIC
A.
POREDA
No. 49815
COLER & COLANTONIO, INC.
REGISTERED PROFESSIONAL LAND SURVEYOR
8-25-09

NO.	DESCRIPTION	DATE	APPROVED

REVISIONS

NOTES

1. THE SOUNDING INFORMATION PRESENTED ON THIS PLAN REPRESENTS THE RESULTS OF A SURVEY PERFORMED BY COLER & COLANTONIO, INC. ON AUGUST 20, 2009 AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS EXISTING AT THAT TIME. REUSE OF THIS INFORMATION BY THE CLIENT OR OTHERS BEYOND THE SPECIFIC SCOPE OF WORK FOR WHICH IT WAS ACQUIRED SHALL BE AT THE SOLE RISK OF THE USER AND WITHOUT LIABILITY TO COLER & COLANTONIO, INC.
2. SURVEY VESSEL POSITIONING AND TIDE MONITORING WAS BY REAL-TIME KINEMATIC (RTK) GPS.
3. THE DEPTHS SHOWN ON THIS PLAN ARE EXPRESSED IN FEET AND TENTHS AND ARE REFERENCED TO THE MEAN LOWER LOW WATER (MLLW) TIDAL DATUM. THE BENCHMARK FOR THIS PROJECT IS NATIONAL OCEAN SERVICE (NOS) TIDAL BENCHMARK 7594 JODY 1977 LOCATED IN NEW BEDFORD HARBOR, NEW BEDFORD, MASSACHUSETTS.
4. OTHER THAN SOUNDINGS ANY BASE PLAN DETAIL, INCLUDING THE SHORELINE, HARBOR INFRASTRUCTURE, DREDGE AND CHANNEL LIMITS, WAS PROVIDED BY APEX COMPANIES, LLC.
5. UNLESS OTHERWISE INDICATED ON THIS PLAN UTILITIES OR OBSTRUCTIONS LOCATED ON OR BENEATH THE SEABED ARE UNKNOWN AT THIS TIME.
6. NOT TO BE USED FOR NAVIGATION.

GEODETIC DATUM INFORMATION

HORIZONTAL DATUM
NORTH AMERICAN DATUM 1983 (NAD 83)
MASSACHUSETTS STATE PLANE COORDINATE SYSTEM, ZONE 2001

VERTICAL DATUM
BASE PLAN DETAIL VERTICAL DATUM UNKNOWN

SOUNDING DATUM
MEAN LOWER LOW WATER (MLLW)
TIDAL EPOCH 1960 - 1978 (NATIONAL OCEAN SERVICE)

SCALE: 1" = 40'

40 0 40 80 120

CHECK GRAPHIC SCALE BEFORE USING

NEW BEDFORD HARBOR DREDGE – PHASE III

NEW BEDFORD, MASSACHUSETTS

EXISTING CONDITIONS HYDROGRAPHIC SURVEY
BORROW PIT CAD DISPOSAL AREA

SHEET 1 OF 1

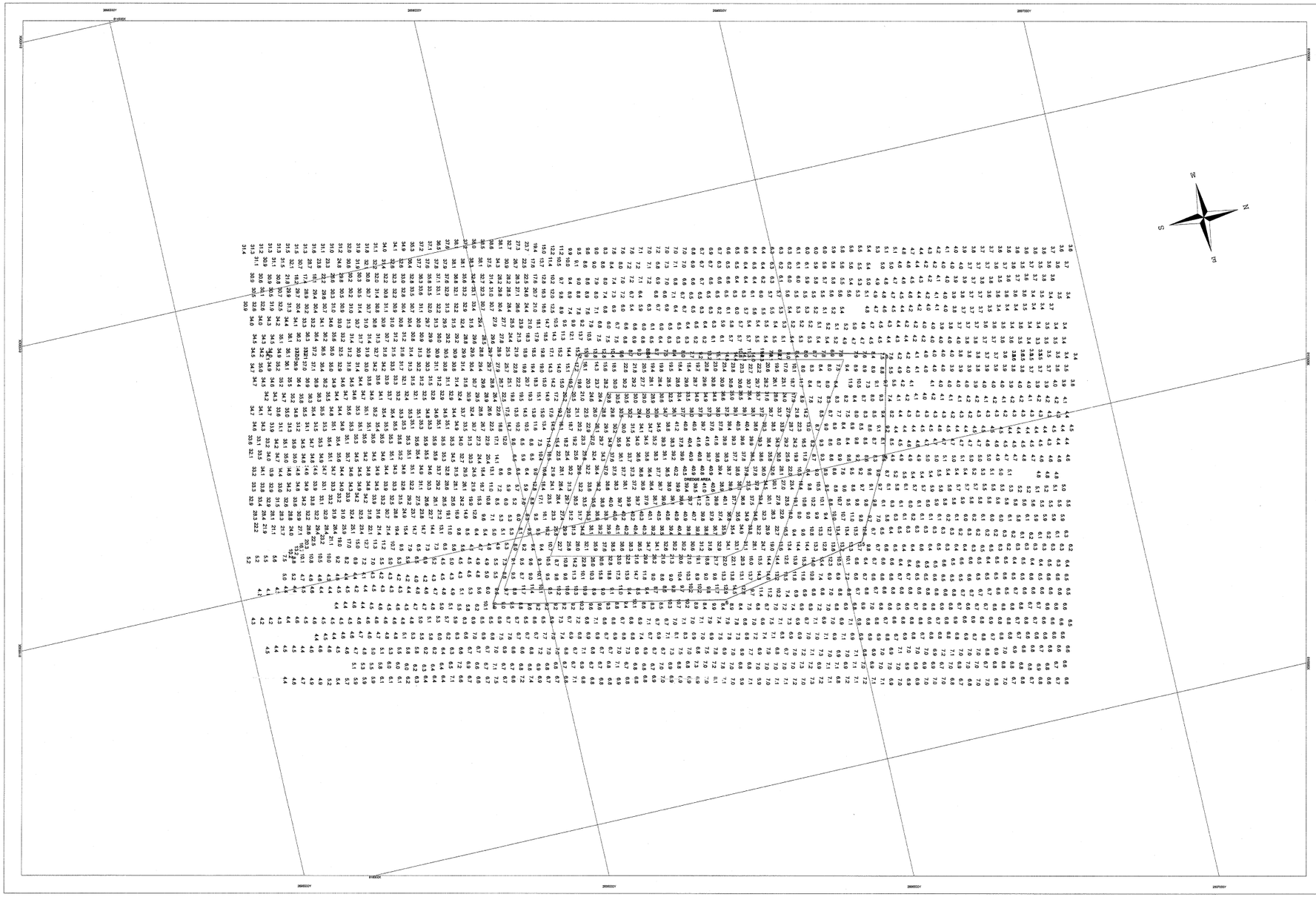
PREPARED FOR:

APEX COMPANIES, LLC.
115 BROAD STREET, SUITE 200
BOSTON, MASSACHUSETTS 02110

PROJECT MANAGER:	COMPUTED BY:	DRAWN BY:	REVIEWED BY:
MARK W. ROHDE	MARK W. ROHDE	MARK W. ROHDE	ERIC J. POREDA
PROJECT NO.:	DATE:	DRAWING NO.:	DRAWING SIZE:
21-09008.04	AUGUST 22, 2009	EC_40.PLT	ANSI F

COLER & COLANTONIO, INC.
101 ACCORD PARK DRIVE
NORWELL, MA 02061-1025
TEL: (781) 982-5400
FAX: (781) 982-5490

COLER & COLANTONIO INC
HYDROGRAPHIC AND SEA SURVEYORS



NO. | DESCRIPTION | DATE | APPROVED

REVISIONS

NOTES

1. THE SOUNDING INFORMATION PRESENTED ON THIS PLAN REPRESENTS THE RESULTS OF A SURVEY PERFORMED BY COLER & COLANTONIO, INC. ON OCTOBER 13, 2008 AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS EXISTING AT THAT TIME. REUSE OF THIS INFORMATION BY THE CLIENT OR OTHERS BEYOND THE SPECIFIC SCOPE OF WORK FOR WHICH IT WAS ACQUIRED SHALL BE AT THE SOLE RISK OF THE USER AND WITHOUT LIABILITY TO COLER & COLANTONIO, INC.
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6. NOT TO BE USED FOR NAVIGATION.

GEODETIC DATUM INFORMATION

HORIZONTAL DATUM
NORTH AMERICAN DATUM 1983 (NAD 83)
MASSACHUSETTS STATE PLANE COORDINATE SYSTEM, ZONE 2001

VERTICAL DATUM
BASE PLAN DETAIL VERTICAL DATUM UNKNOWN

SOUNDING DATUM
MEAN LOWER LOW WATER (MLLW)
TIDAL EPOCH 1960 - 1978 (NATIONAL OCEAN SERVICE)

SCALE: 1" = 60'

60 0 60 120 180

CHECK GRAPHIC SCALE BEFORE USING

NEW BEDFORD HARBOR – CAD CELL 2

NEW BEDFORD, MASSACHUSETTS

POST-DREDGE HYDROGRAPHIC SURVEY
BOTTOM OF CAD CELL

SHEET 1 OF 1

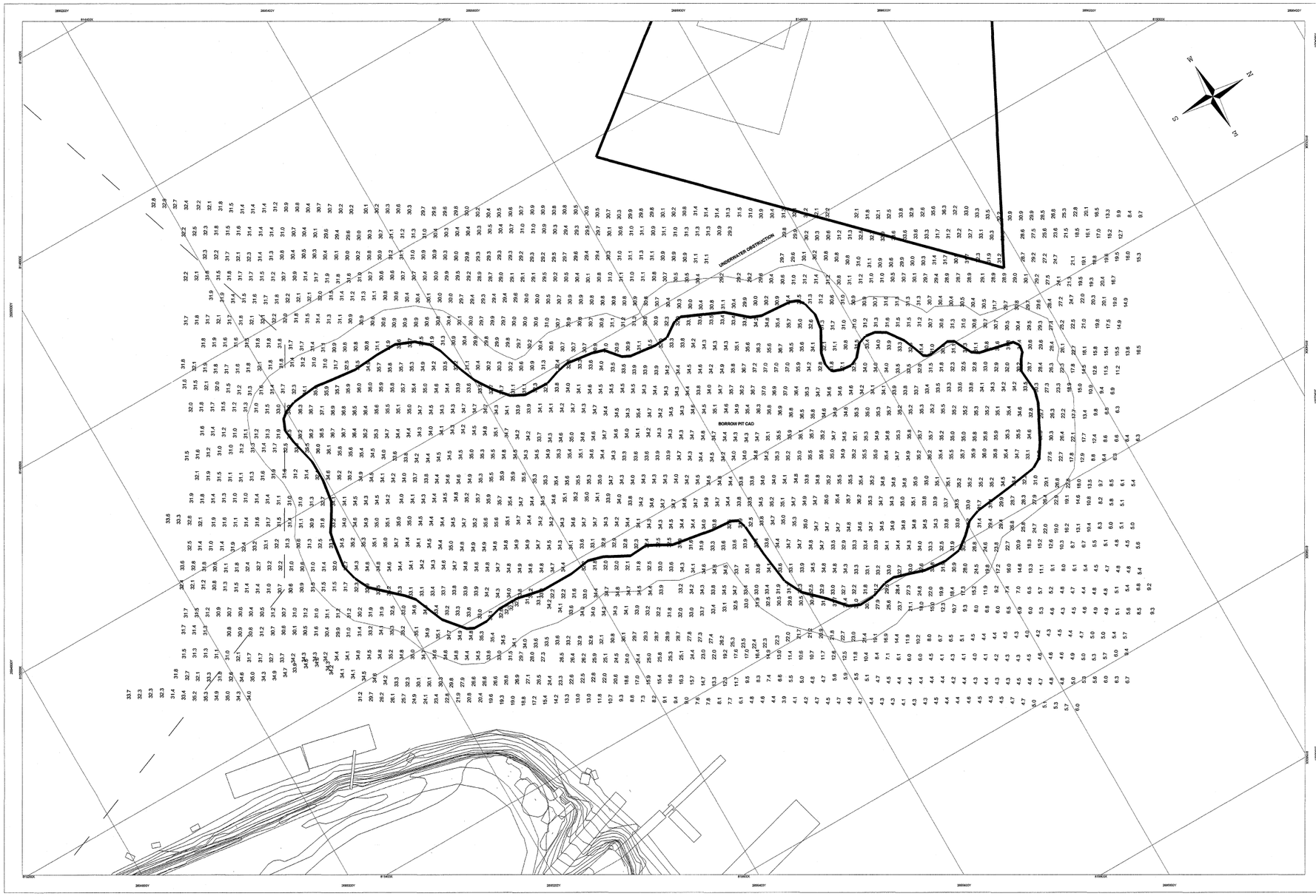
PREPARED FOR:

APEX COMPANIES, LLC.
115 BROAD STREET, SUITE 200
BOSTON, MASSACHUSETTS 02110

PROJECT MANAGER:	COMPUTED BY:	DRAWN BY:	REVIEWED BY:
MARK W. ROHDE	MARK W. ROHDE	MARK W. ROHDE	ERIC J. POREDA
PROJECT NO.:	DATE:	DRAWING NO.:	DRAWING SIZE:
21-00005.05	OCTOBER 16, 2008	PO_60.PLT	ANSI F

COLER & COLANTONIO, INC.
101 ACCORD PARK DRIVE
NORWELL, MA 02061-1685
TEL: (781) 982-5400
FAX: (781) 982-5450

COLER & COLANTONIO, INC.
ENGINEERS AND SCIENTISTS



NO.	DESCRIPTION	DATE	APPROVED

REVISIONS

NOTES

1. THE SOUNDING INFORMATION PRESENTED ON THIS PLAN REPRESENTS THE RESULTS OF A SURVEY PERFORMED BY COLER & COLANTONIO, INC. ON OCTOBER 13, 2008 AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS EXISTING AT THAT TIME. REUSE OF THIS INFORMATION BY THE CLIENT OR OTHERS BEYOND THE SPECIFIC SCOPE OF WORK FOR WHICH IT WAS ACQUIRED SHALL BE AT THE SOLE RISK OF THE USER AND WITHOUT LIABILITY TO COLER & COLANTONIO, INC.
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6. NOT TO BE USED FOR NAVIGATION.

GEODETIC DATUM INFORMATION

HORIZONTAL DATUM
NORTH AMERICAN DATUM 1983 (NAD 83)
MASSACHUSETTS STATE PLANE COORDINATE SYSTEM, ZONE 2001

VERTICAL DATUM
BASE PLAN DETAIL VERTICAL DATUM UNKNOWN

SOUNDING DATUM
MEAN LOWER LOW WATER (MLLW)
TIDAL EPOCH 1960 - 1978 (NATIONAL OCEAN SERVICE)

SCALE: 1" = 40'

40 0 40 80 120

CHECK GRAPHIC SCALE BEFORE USING

NEW BEDFORD HARBOR DREDGE – PHASE III

NEW BEDFORD, MASSACHUSETTS

EXISTING CONDITIONS HYDROGRAPHIC SURVEY
BORROW PIT CAD DISPOSAL AREA

SHEET 1 OF 1

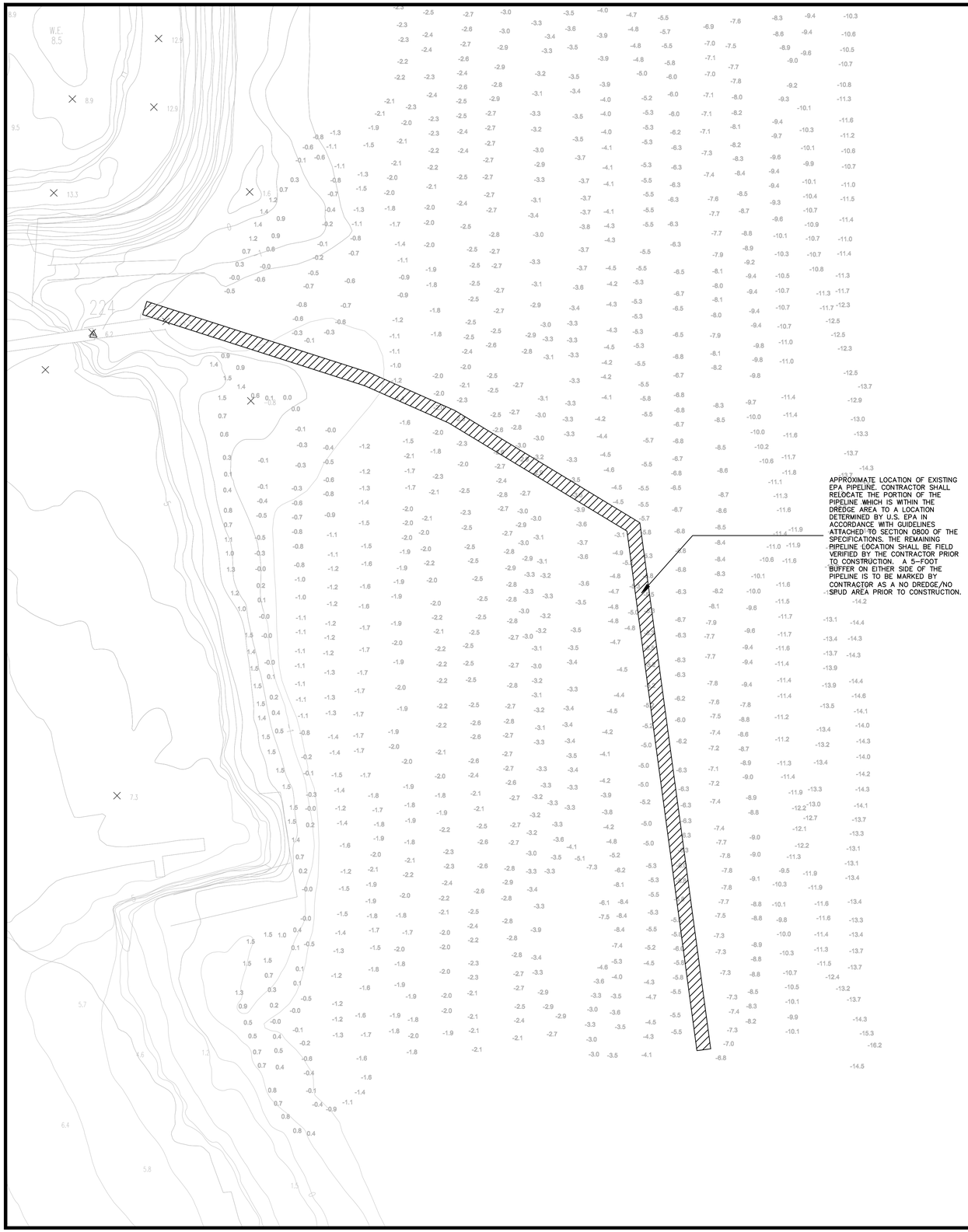
PREPARED FOR:

APEX COMPANIES, LLC.
115 BROAD STREET, SUITE 200
BOSTON, MASSACHUSETTS 02110

PROJECT MANAGER:	COMPUTED BY:	DRAWN BY:	REVIEWED BY:
MARK W. ROHDE	MARK W. ROHDE	MARK W. ROHDE	ERIC J. POREDA
PROJECT NO.:	DATE:	DRAWING NO.:	DRAWING SIZE:
21-00006.05	OCTOBER 16, 2008	EC_40.PLT	ANSI F

COLER & COLANTONIO, INC.
101 ACCORD PARK DRIVE
NORWELL, MA 02061-1665
TEL: (781) 982-5400
FAX: (781) 982-5490

COLER & COLANTONIO INC
ENGINEERS AND SCIENTISTS



NOTES

1. COORDINATES SHOWN ARE IN THE STATE PLANE COORDINATE SYSTEM, MASSACHUSETTS MAINLAND ZONE 2001, REFERENCED TO THE 1983 NORTH AMERICAN DATUM.

2. HYDROGRAPHIC SURVEY IS A COMPILATION OF SURVEYS PREFORMED BETWEEN 9-11-06 AND 11-6-08.

3. HYDROGRAPHIC SURVEY DATUM IS REFERENCED TO MEAN LOWER LOW WATER (MLLW) ON THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL OCEAN SERVICE TIDAL BENCHMARK BM7584 J 1977 - SURVEY DISK SET FLUSH IN THE SURFACE OF A CONCRETE SIDEWALK ON THE SOUTH SIDE OF U.S.HIGHWAY 6 ON THE NORTH SIDE OF THE MOBIL SERVICE STATION, 4 FEET (1 M) WEST OF A FIRE HYDRANT AND 1 FOOT (0.3 M) SOUTH OF U.S. HIGHWAY 6. DATUM SEPARATIONS WERE COMPUTED BY COLER AND COLANTONIO, INC. FEBRUARY 2002 AS MLLW - 1.52 FT = NGVD29 0.0 FT. TO OBTAIN VALUES IN NGVD29, SUBTRACT 1.52 FEET FROM THE INDICATED VALUE AT ANY POINT. HORIZONTAL CONTROL CAN BE OBTAINED FROM THE ENGINEER.

4. BASE PLAN FOR THIS FIGURE OBTAINED FROM U.S. ARMY CORPS OF ENGINEERS. EXISTING CONDITIONS SHALL BE FIELD VERIFIED BY THE CONTRACTOR.

5. HORIZONTAL AND VERTICAL CONTROL HAVE BEEN PROVIDED BY THE OWNER AND HAVE NOT BEEN INDEPENDENTLY VERIFIED. THE CONTRACTOR IS RESPONSIBLE FOR FIELD VERIFICATION OF CONTROL DATA.

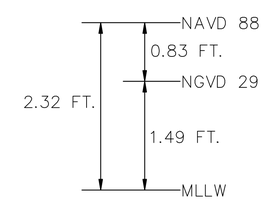
6. THE INFORMATION DEPICTED ON THIS DRAWING REPRESENTS THE RESULTS OF SURVEYS MADE ON THE DATES INDICATED ABOVE AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS AT THE TIME OF THE SURVEYS AND AT THE SOUNDING POINTS NOTED ON THE DRAWING.

7. EXISTING UTILITIES WITHIN THE SITE HAVE NOT BEEN IDENTIFIED. IDENTIFICATION AND PROTECTION OF EXISTING UTILITIES IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR.

8. LIMITS OF FEDERAL NAVIGATIONAL CHANNEL OBTAINED FROM U.S. ARMY CORPS OF ENGINEERS.

9. NO SPUDDING SHALL OCCUR IN ANY AREA DESIGNATED NO SPUD ZONE.

GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



Apex Companies, LLC.

115 BROAD STREET
SUITE 200
BOSTON MA 02110
(617) 728-0070

REVISIONS

NO.	DATE	DESCRIPTION
1.	9/05/08	PRELIM. DREDGE LAYOUT
2.	11/14/08	BID SET
3.	1/16/09	RE-BID

THESE DRAWINGS PREPARED BY APEX FOR THIS PROJECT ARE INSTRUMENTS OF APEX'S SERVICE FOR USE SOLELY WITH RESPECT TO THIS PROJECT, AND APEX SHALL BE DEEMED THE AUTHOR OF THE DRAWING AND SHALL RETAIN ALL COMMON LAW, STATUTORY AND OTHER RESERVED RIGHTS WITH RESPECT THERETO, INCLUDING COPYRIGHT. THE DOCUMENTS SHALL NOT BE USED ON OTHER PROJECTS, FOR ADDITIONS TO THIS PROJECT OR FOR COMPLETION OF THIS PROJECT BY OTHERS, EXCEPT BY AGREEMENT IN WRITING AND WITH APPROPRIATE COMPENSATION TO APEX.

PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE - PHASE III, PART B

PREPARED FOR:

THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

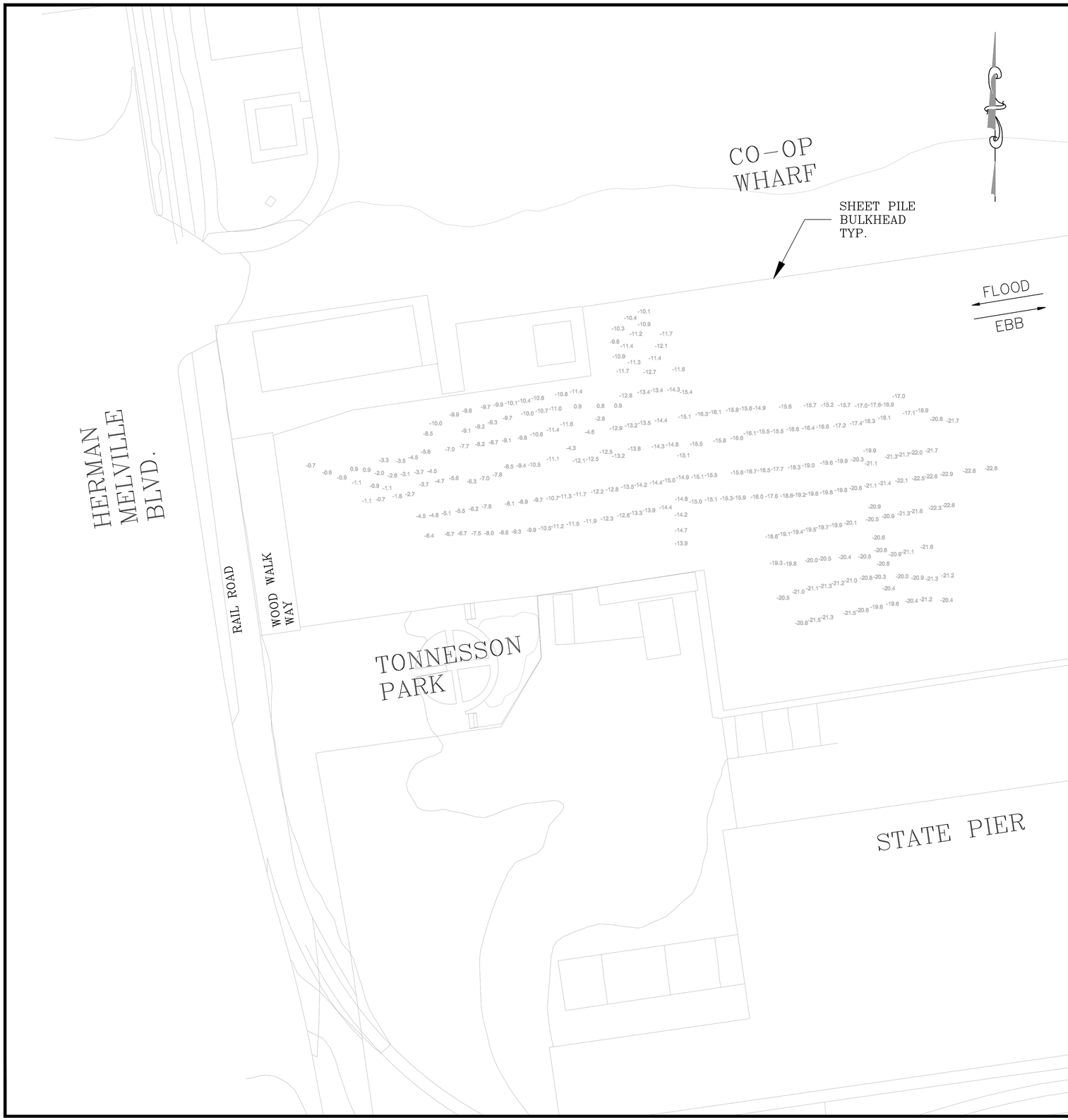
DRAWING TITLE:

NEW BEDFORD ROWING FACILITY DREDGE AREA - EXISTING CONDITIONS NOT FOR CONSTRUCTION

Scale: 1"=40'

0 20 40 80 100 FEET

Date 9/05/08	Drawing No.
Proj. Mgr. JAB	
Design CWM	
Check CM	E-1
Drawn CWM	
Job. No. 6615	
Last Rev. 1/16/09	



NOTES

1. COORDINATES SHOWN ARE IN THE STATE PLANE COORDINATE SYSTEM, MASSACHUSETTS MAINLAND ZONE 2001, REFERENCED TO THE 1983 NORTH AMERICAN DATUM.

2. HYDROGRAPHIC SURVEY IS A COMPILATION OF SURVEYS PREFORMED BETWEEN 9-11-06 AND 11-6-08.

3. HYDROGRAPHIC SURVEY DATUM IS REFERENCED TO MEAN LOWER LOW WATER (MLLW) ON THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL OCEAN SERVICE TIDAL BENCHMARK BM7584 J 1977 - SURVEY DISK SET FLUSH IN THE SURFACE OF A CONCRETE SIDEWALK ON THE SOUTH SIDE OF U.S.HIGHWAY 6 ON THE NORTH SIDE OF THE MOBIL SERVICE STATION, 4 FEET (1 M) WEST OF A FIRE HYDRANT AND 1 FOOT (0.3 M) SOUTH OF U.S. HIGHWAY 6. DATUM SEPARATIONS WERE COMPUTED BY COLER AND COLANTONIO, INC. FEBRUARY 2002 AS MLLW - 1.52 FT = NGVD29 0.0 FT. TO OBTAIN VALUES IN NGVD29, SUBTRACT 1.52 FEET FROM THE INDICATED VALUE AT ANY POINT. HORIZONTAL CONTROL CAN BE OBTAINED FROM THE ENGINEER.

4. BASE PLAN FOR THIS FIGURE OBTAINED FROM U.S. ARMY CORPS OF ENGINEERS. EXISTING CONDITIONS SHALL BE FIELD VERIFIED BY THE CONTRACTOR.

5. HORIZONTAL AND VERTICAL CONTROL HAVE BEEN PROVIDED BY THE OWNER AND HAVE NOT BEEN INDEPENDENTLY VERIFIED. THE CONTRACTOR IS RESPONSIBLE FOR FIELD VERIFICATION OF CONTROL DATA.

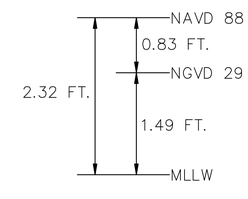
6. THE INFORMATION DEPICTED ON THIS DRAWING REPRESENTS THE RESULTS OF SURVEYS MADE ON THE DATES INDICATED ABOVE AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS AT THE TIME OF THE SURVEYS AND AT THE SOUNDING POINTS NOTED ON THE DRAWING.

7. EXISTING UTILITIES WITHIN THE SITE HAVE NOT BEEN IDENTIFIED. IDENTIFICATION AND PROTECTION OF EXISTING UTILITIES IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR.

8. LIMITS OF FEDERAL NAVIGATIONAL CHANNEL OBTAINED FROM U.S. ARMY CORPS OF ENGINEERS.

9. NO SPUDDING SHALL OCCUR IN ANY AREA DESIGNATED NO SPUD ZONE.

GRAPHIC DEPICTION OF
DATUM SEPARATIONS FOR
NEW BEDFORD HARBOR



Apex Companies, LLC.

115 BROAD STREET
SUITE 200
BOSTON MA 02110
(617) 728-0070

REVISIONS

NO.	DATE	DESCRIPTION
1.	9/05/08	PRELIM. DREDGE LAYOUT
2.	11/14/08	BID SET

THESE DRAWINGS PREPARED BY APEX FOR THIS PROJECT ARE INSTRUMENTS OF APEX'S SERVICE FOR USE SOLELY WITH RESPECT TO THIS PROJECT, AND APEX SHALL BE DEEMEND THE AUTHOR OF THE DRAWING AND SHALL RETAIN ALL COMMON LAW, STATUTORY AND OTHER RESERVED RIGHTS WITH RESPECT THERETO, INCLUDING COPYRIGHT. THE DOCUMENTS SHALL NOT BE USED ON OTHER PROJECTS, FOR ADDITIONS TO THIS PROJECT OR FOR COMPLETION OF THIS PROJECT BY OTHERS, EXCEPT BY AGREEMENT IN WRITING AND WITH APPROPRIATE COMPENSATION TO APEX.

TOWN OF FAIRHAVEN MA INCORPORATED FEB 22 1812

HARBOR DEVELOPMENT COMMISSION NEW BEDFORD, MA

PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE - PHASE III, PART A

PREPARED FOR:

THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

DRAWING TITLE:

TONNESSON PARK DREDGE AREAS- EXISTING CONDITIONS

NOT FOR CONSTRUCTION

Scale: 1"=20'

0 10 20 40 50 FEET

Date 9/5/08	Drawing No.
Proj. Mgr. JAB	
Design CW,M	
Check CM	E-1
Drawn CWM	
Job. No. 6615	
Last Rev. 10/30/08	

NOTES

1. COORDINATES SHOWN ARE IN THE STATE PLANE COORDINATE SYSTEM, MASSACHUSETTS MAINLAND ZONE 2001, REFERENCED TO THE 1983 NORTH AMERICAN DATUM.

2. HYDROGRAPHIC SURVEY IS A COMPILATION OF SURVEYS PREFORMED BETWEEN 9-11-06 AND 11-6-08.

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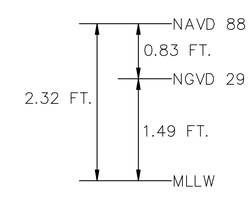
9. NO SPUDDING SHALL OCCUR IN ANY AREA DESIGNATED NO SPUD ZONE.

GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



Apex Companies, LLC.

115 BROAD STREET
SUITE 200
BOSTON MA 02110
(617) 728-0070

REVISIONS

NO.	DATE	DESCRIPTION
1.	9/05/08	PRELIM. DREDGE LAYOUT
2.	11/14/08	BID SET

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TOWN OF FAIRHAVEN MA · INCORPORATED FEB 22 1812

HARBOR DEVELOPMENT COMMISSION · NEW BEDFORD, MA

PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE - PHASE III, PART A

PREPARED FOR:

THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

DRAWING TITLE:

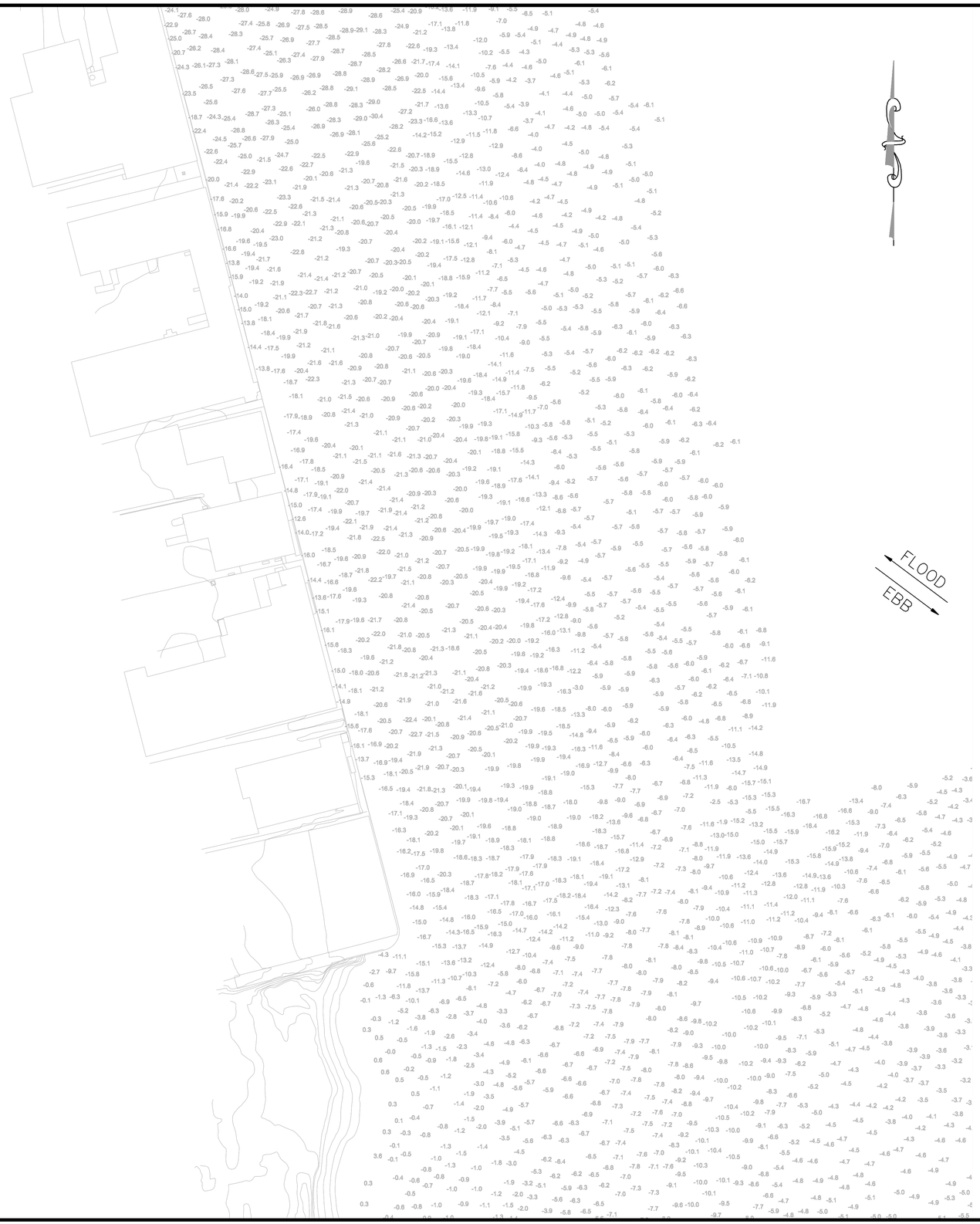
GIFFORD STREET BOAT RAMP DREDGE AREA - EXISTING CONDITIONS

NOT FOR CONSTRUCTION

Scale: 1"=60'

0 30 60 120 150 FEET

Date 9/05/08	Drawing No.
Proj. Mgr. JAB	
Design CWM	
Check CM	E-2
Drawn CWM	
Job. No. 6615	
Last Rev. 10/30/08	



NOTES

1. COORDINATES SHOWN ARE IN THE STATE PLANE COORDINATE SYSTEM, MASSACHUSETTS MAINLAND ZONE 2001, REFERENCED TO THE 1983 NORTH AMERICAN DATUM.

2. HYDROGRAPHIC SURVEY IS A COMPILATION OF SURVEYS PREFORMED BETWEEN 9-11-06 AND 11-6-08.

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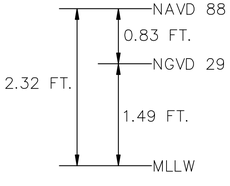
GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



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TOWN OF FAIRHAVEN MA — INCORPORATED FEB 22 1812

HARBOR DEVELOPMENT COMMISSION — NEW BEDFORD, MA

PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE - PHASE III, PART A

PREPARED FOR:

THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

DRAWING TITLE:

SOUTH TERMINAL DREDGE AREAS - EXISTING CONDITIONS

NOT FOR CONSTRUCTION

Scale: 1"=80'

0 40 80 160 200

Date 9/05/08	Drawing No.
Proj. Mgr. JAB	
Design CWM	
Check CM	
Drawn CWM	E-3
Job. No. 6615	
Last Rev. 10/30/08	

NOTES

1. COORDINATES SHOWN ARE IN THE STATE PLANE COORDINATE SYSTEM, MASSACHUSETTS MAINLAND ZONE 2001, REFERENCED TO THE 1983 NORTH AMERICAN DATUM.

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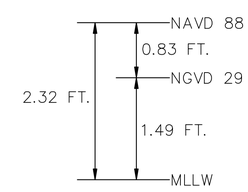
GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



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PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE - PHASE III, PART A

PREPARED FOR:

THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

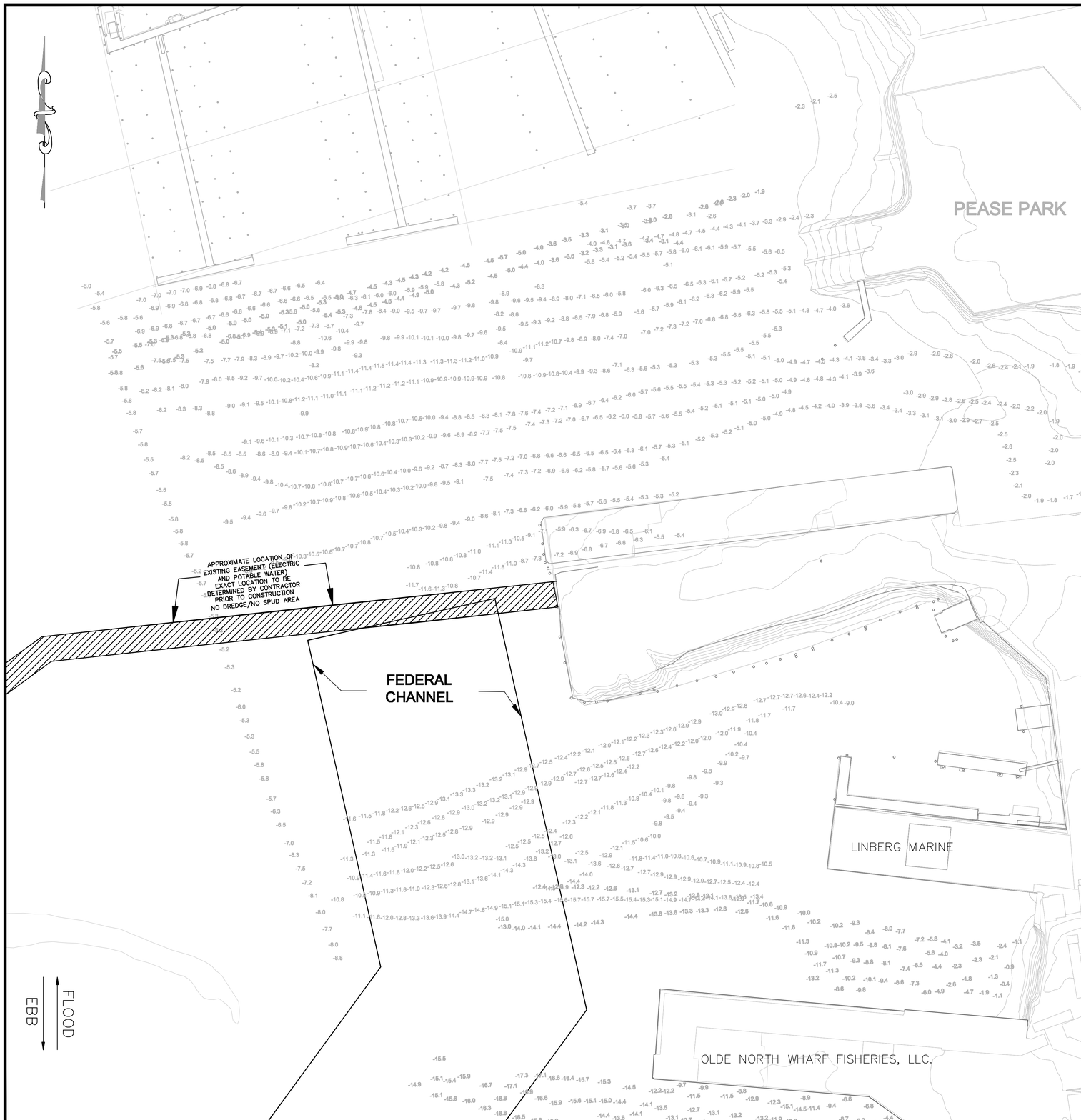
DRAWING TITLE:

WARREN ALEXANDER SOUTH AND UNION WHARF DREDGE AREAS- EXISTING CONDITIONS NOT FOR CONSTRUCTION

Scale: 1"=40'

0 20 40 80 100 FEET

Date 9/5/08	Drawing No.
Proj. Mgr. JAB	
Design CWM	
Check CM	E-4
Drawn CWM	
Job. No. 6615	
Last Rev. 10/30/08	



NOTES

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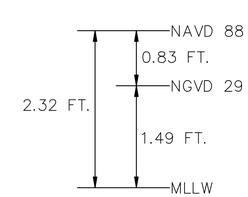
GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



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115 BROAD STREET
SUITE 200
BOSTON MA 02110
(617) 728-0070

REVISIONS

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TOWN OF FAIRHAVEN MA INCORPORATED FEB 22 1812

HARBOR DEVELOPMENT COMMISSION NEW BEDFORD, MA

PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE - PHASE III, PART A

PREPARED FOR:

THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

DRAWING TITLE:

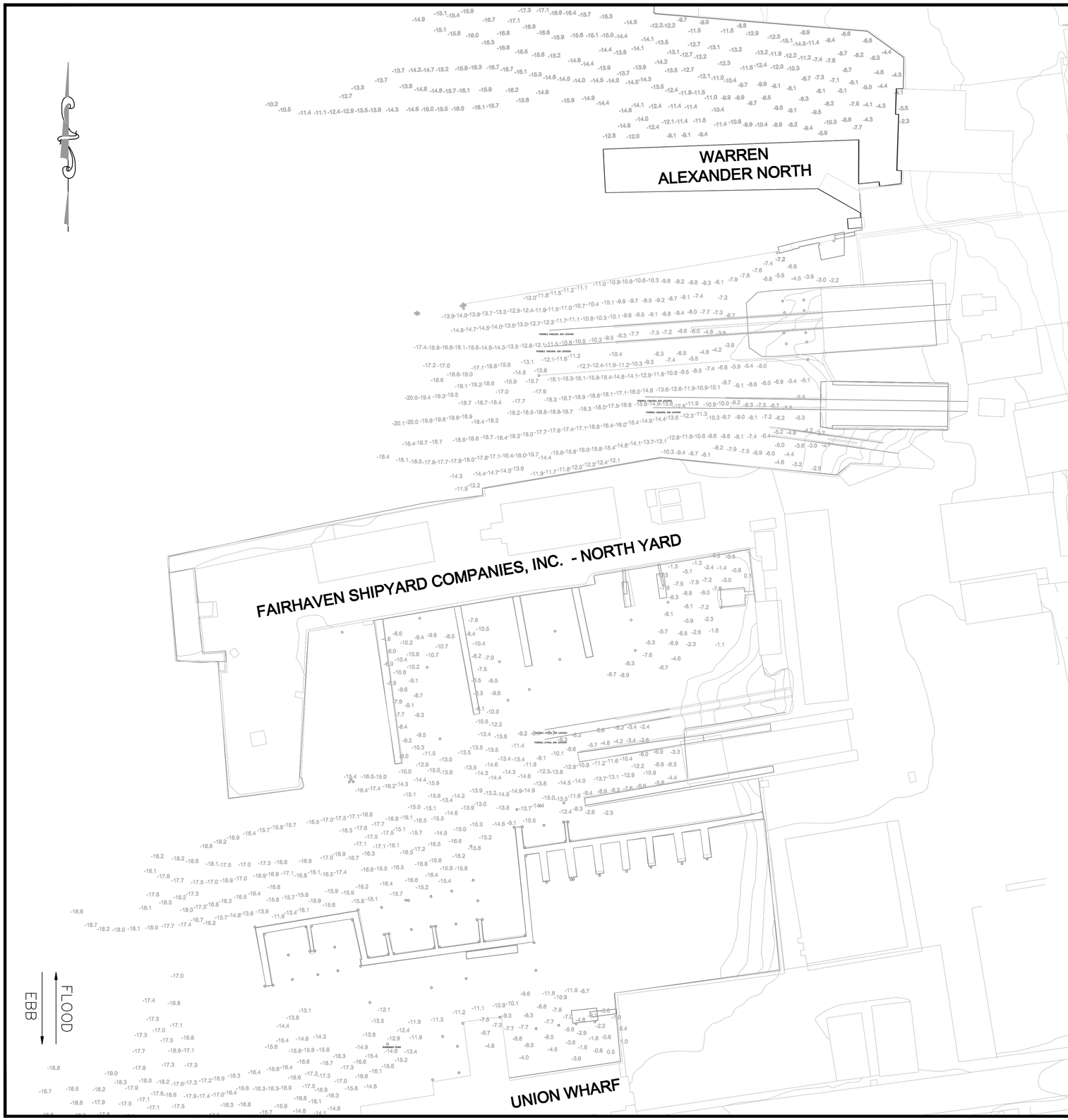
LINBERG DREDGE AREAS- EXISTING CONDITIONS

NOT FOR CONSTRUCTION

Scale: 1"=40'

0 20 40 80 100 FEET

Date 9/5/08	Drawing No.
Proj. Mgr. JAB	
Design CWM	
Check CM	E-5
Drawn CWM	
Job. No. 6615	
Last Rev. 10/30/08	



NOTES

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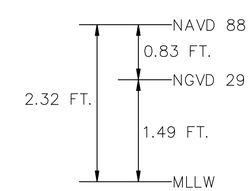
GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



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REVISIONS

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PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE - PHASE III, PART A

PREPARED FOR:

THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

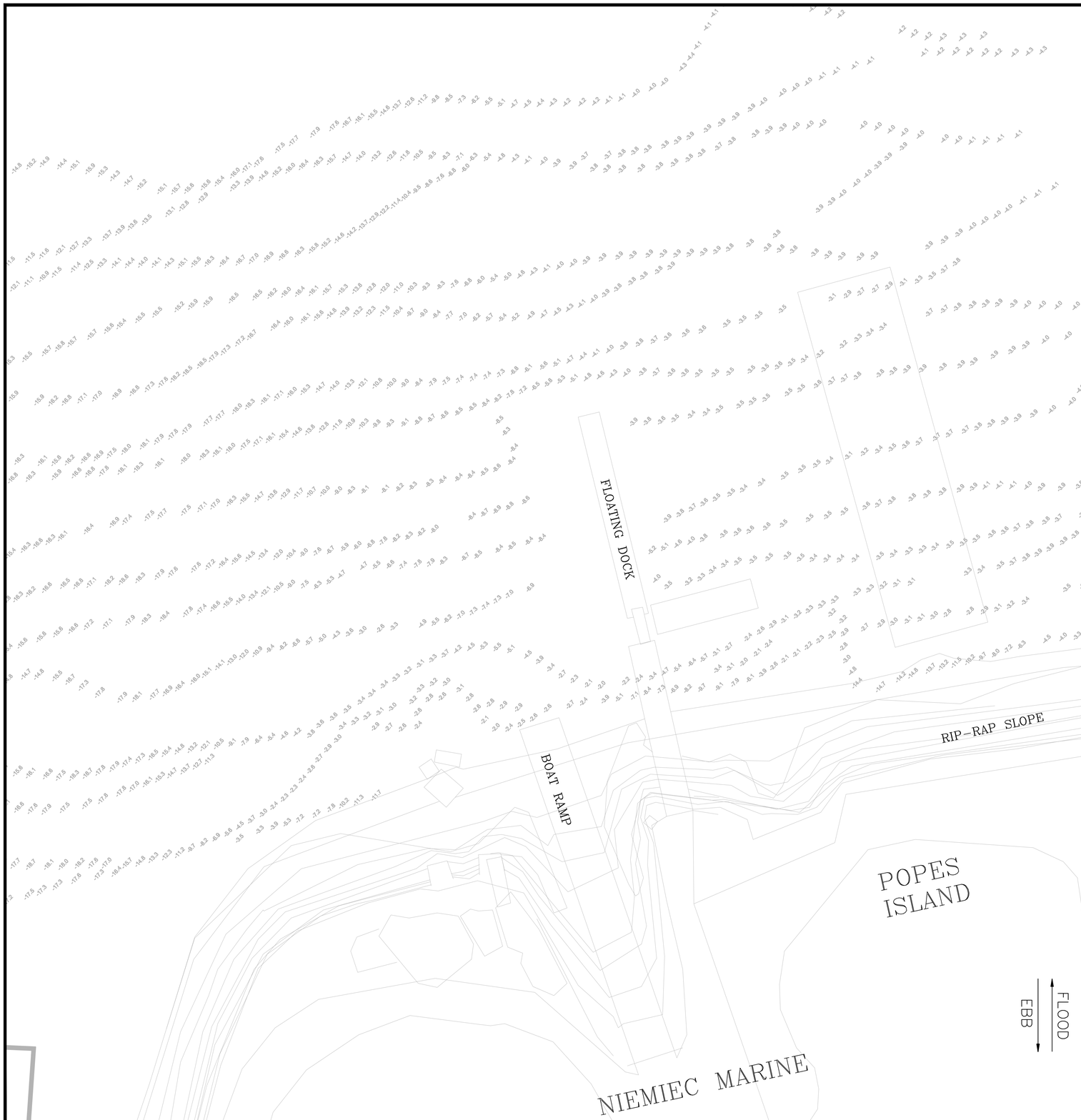
DRAWING TITLE:

WARREN ALEXANDER NORTH AND FAIRHAVEN SHIPYARD DREDGE AREAS - EXISTING CONDITIONS NOT FOR CONSTRUCTION

Scale: 1"=40'

0 20 40 80 100 FEET

Date 9/5/08	Drawing No.
Proj. Mgr. JAB	
Design CWM	
Check CM	E-6
Drawn CWM	
Job. No. 6615	
Last Rev. 10/30/08	



NOTES

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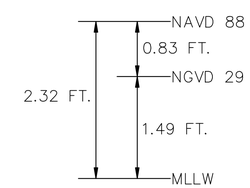

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PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE - PHASE III, PART A

PREPARED FOR:

THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

DRAWING TITLE:

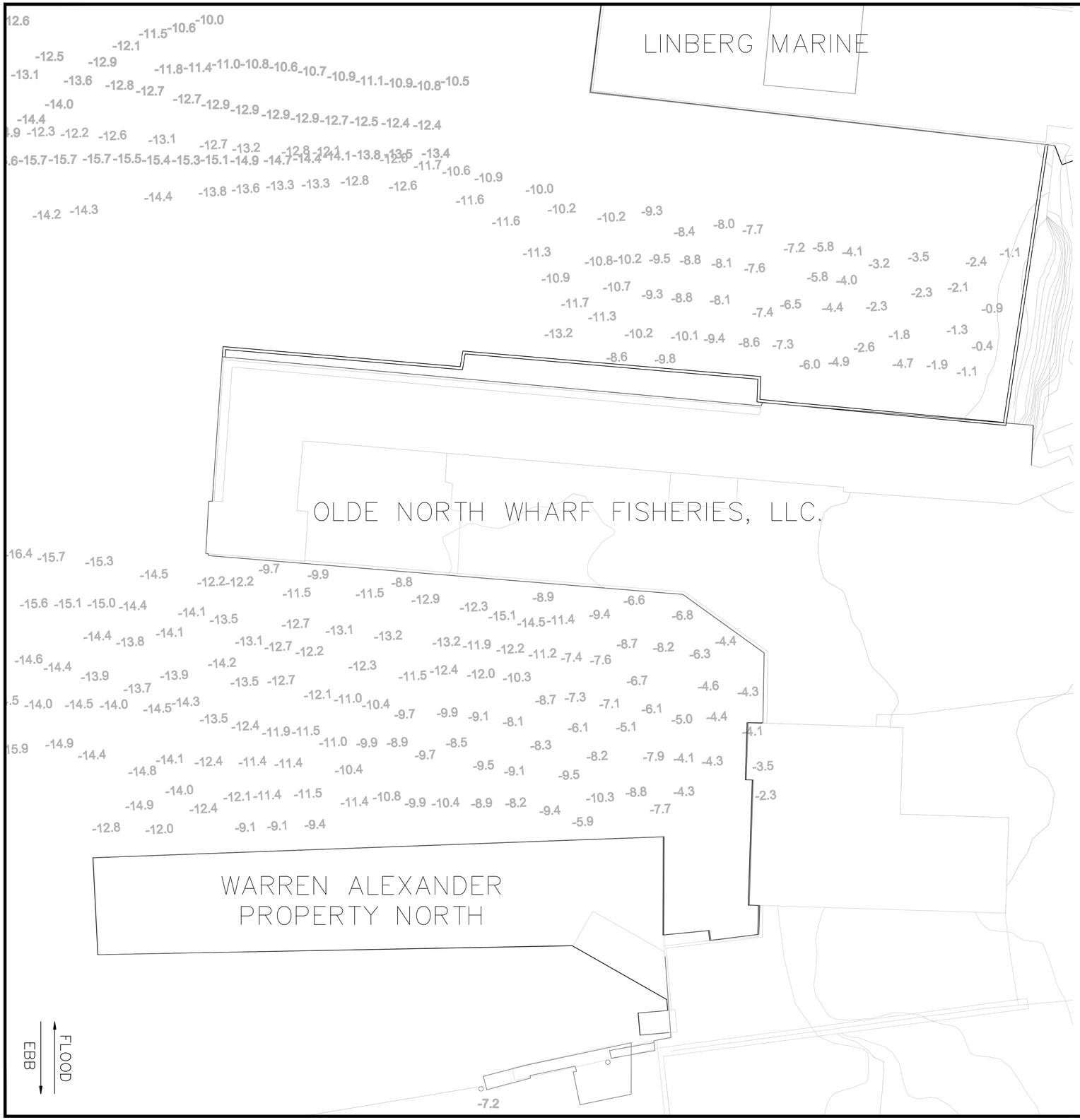
NIEMIEC MARINE DREDGE AREA- EXISTING CONDITIONS

NOT FOR CONSTRUCTION

Scale: 1"=20'

0 10 20 40 50 FEET

Date 9/5/08	Drawing No.
Proj. Mgr. JAB	
Design CW,M	
Check CM	E-7
Drawn CWM	
Job. No. 6615	
Last Rev. 10/30/08	



NOTES

1. COORDINATES SHOWN ARE IN THE STATE PLANE COORDINATE SYSTEM, MASSACHUSETTS MAINLAND ZONE 2001, REFERENCED TO THE 1983 NORTH AMERICAN DATUM.

2. HYDROGRAPHIC SURVEY IS A COMPILATION OF SURVEYS PREFORMED BETWEEN 9-11-06 AND 11-6-08.

3. HYDROGRAPHIC SURVEY DATUM IS REFERENCED TO MEAN LOWER LOW WATER (MLLW) ON THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL OCEAN SERVICE TIDAL BENCHMARK BM7584 J 1977 - SURVEY DISK SET FLUSH IN THE SURFACE OF A CONCRETE SIDEWALK ON THE SOUTH SIDE OF U.S.HIGHWAY 6 ON THE NORTH SIDE OF THE MOBIL SERVICE STATION, 4 FEET (1 M) WEST OF A FIRE HYDRANT AND 1 FOOT (0.3 M) SOUTH OF U.S. HIGHWAY 6. DATUM SEPARATIONS WERE COMPUTED BY COLER AND COLANTONIO, INC. FEBRUARY 2002 AS MLLW - 1.52 FT = NGVD29 0.0 FT. TO OBTAIN VALUES IN NGVD29, SUBTRACT 1.52 FEET FROM THE INDICATED VALUE AT ANY POINT. HORIZONTAL CONTROL CAN BE OBTAINED FROM THE ENGINEER.

4. BASE PLAN FOR THIS FIGURE OBTAINED FROM U.S. ARMY CORPS OF ENGINEERS. EXISTING CONDITIONS SHALL BE FIELD VERIFIED BY THE CONTRACTOR.

5. HORIZONTAL AND VERTICAL CONTROL HAVE BEEN PROVIDED BY THE OWNER AND HAVE NOT BEEN INDEPENDENTLY VERIFIED. THE CONTRACTOR IS RESPONSIBLE FOR FIELD VERIFICATION OF CONTROL DATA.

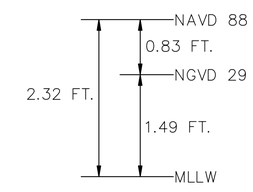
6. THE INFORMATION DEPICTED ON THIS DRAWING REPRESENTS THE RESULTS OF SURVEYS MADE ON THE DATES INDICATED ABOVE AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS AT THE TIME OF THE SURVEYS AND AT THE SOUNDING POINTS NOTED ON THE DRAWING.

7. EXISTING UTILITIES WITHIN THE SITE HAVE NOT BEEN IDENTIFIED. IDENTIFICATION AND PROTECTION OF EXISTING UTILITIES IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR.

8. LIMITS OF FEDERAL NAVIGATIONAL CHANNEL OBTAINED FROM U.S. ARMY CORPS OF ENGINEERS.

9. NO SPUDDING SHALL OCCUR IN ANY AREA DESIGNATED NO SPUD ZONE.

GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



Apex Companies, LLC.

115 BROAD STREET
SUITE 200
BOSTON MA 02110
(617) 728-0070

REVISIONS

NO.	DATE	DESCRIPTION
1.	9/05/08	PRELIM. DREDGE LAYOUT
2.	11/14/08	BID SET

THESE DRAWINGS PREPARED BY APEX FOR THIS PROJECT ARE INSTRUMENTS OF APEX'S SERVICE FOR USE SOLELY WITH RESPECT TO THIS PROJECT, AND APEX SHALL BE DEEMEND THE AUTHOR OF THE DRAWING AND SHALL RETAIN ALL COMMON LAW, STATUTORY AND OTHER RESERVED RIGHTS WITH RESPECT THERETO, INCLUDING COPYRIGHT. THE DOCUMENTS SHALL NOT BE USED ON OTHER PROJECTS, FOR ADDITIONS TO THIS PROJECT OR FOR COMPLETION OF THIS PROJECT BY OTHERS, EXCEPT BY AGREEMENT IN WRITING AND WITH APPROPRIATE COMPENSATION TO APEX.

PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE - PHASE III, PART A

PREPARED FOR:

THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

DRAWING TITLE:

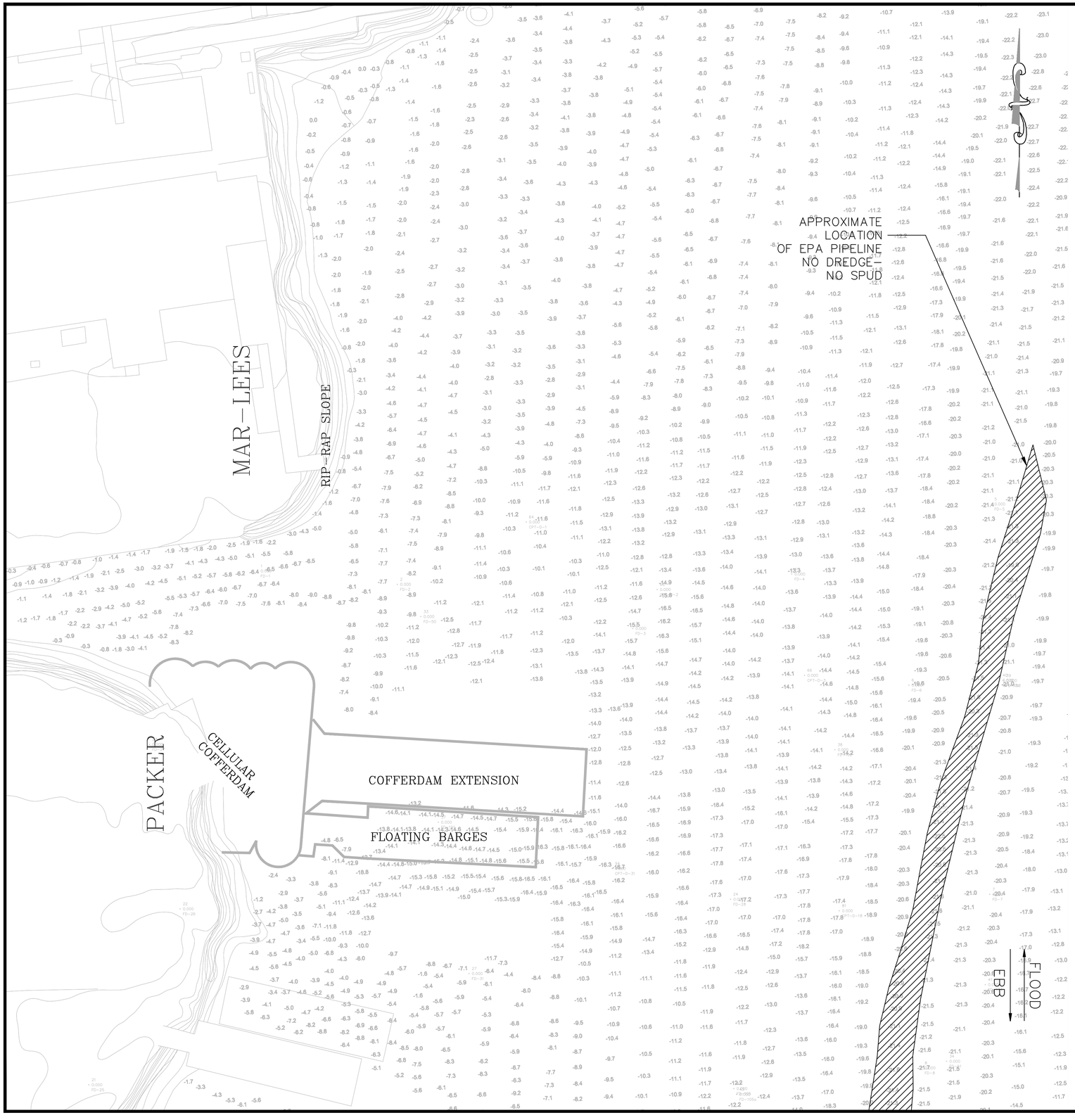
OLDE NORTH WHARF FISHERIES DREDGE AREAS- EXISTING CONDITIONS

NOT FOR CONSTRUCTION

Scale: 1"=40'

0 20 40 80 100 FEET

Date 9/5/08	Drawing No.
Proj. Mgr. JAB	
Design CWM	
Check CM	E-8
Drawn CWM	
Job. No. 6615	
Last Rev. 10/30/08	



NOTES

1. COORDINATES SHOWN ARE IN THE STATE PLANE COORDINATE SYSTEM, MASSACHUSETTS MAINLAND ZONE 2001, REFERENCED TO THE 1983 NORTH AMERICAN DATUM.

2. HYDROGRAPHIC SURVEY IS A COMPILATION OF SURVEYS PREFORMED BETWEEN 9-11-06 AND 11-6-08.

3. HYDROGRAPHIC SURVEY DATUM IS REFERENCED TO MEAN LOWER LOW WATER (MLLW) ON THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL OCEAN SERVICE TIDAL BENCHMARK BM7584 J 1977 - SURVEY DISK SET FLUSH IN THE SURFACE OF A CONCRETE SIDEWALK ON THE SOUTH SIDE OF U.S.HIGHWAY 6 ON THE NORTH SIDE OF THE MOBIL SERVICE STATION, 4 FEET (1 M) WEST OF A FIRE HYDRANT AND 1 FOOT (0.3 M) SOUTH OF U.S. HIGHWAY 6. DATUM SEPARATIONS WERE COMPUTED BY COLER AND COLANTONIO, INC. FEBRUARY 2002 AS MLLW - 1.52 FT = NGVD29 0.0 FT. TO OBTAIN VALUES IN NGVD29, SUBTRACT 1.52 FEET FROM THE INDICATED VALUE AT ANY POINT. HORIZONTAL CONTROL CAN BE OBTAINED FROM THE ENGINEER.

4. BASE PLAN FOR THIS FIGURE OBTAINED FROM U.S. ARMY CORPS OF ENGINEERS. EXISTING CONDITIONS SHALL BE FIELD VERIFIED BY THE CONTRACTOR.

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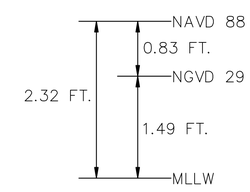
8. LIMITS OF FEDERAL NAVIGATIONAL CHANNEL OBTAINED FROM U.S. ARMY CORPS OF ENGINEERS.

9. NO SPUDDING SHALL OCCUR IN ANY AREA DESIGNATED NO SPUD ZONE.

GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



Apex Companies, LLC.

115 BROAD STREET
SUITE 200
BOSTON MA 02110
(617) 728-0070

REVISIONS

NO.	DATE	DESCRIPTION
1.	9/05/08	PRELIM. DREDGE LAYOUT
2.	11/14/08	BID SET

THESE DRAWINGS PREPARED BY APEX FOR THIS PROJECT ARE INSTRUMENTS OF APEX'S SERVICE FOR USE SOLELY WITH RESPECT TO THIS PROJECT, AND APEX SHALL BE DEEMEND THE AUTHOR OF THE DRAWING AND SHALL RETAIN ALL COMMON LAW, STATUTORY AND OTHER RESERVED RIGHTS WITH RESPECT THERETO, INCLUDING COPYRIGHT. THE DOCUMENTS SHALL NOT BE USED ON OTHER PROJECTS, FOR ADDITIONS TO THIS PROJECT OR FOR COMPLETION OF THIS PROJECT BY OTHERS, EXCEPT BY AGREEMENT IN WRITING AND WITH APPROPRIATE COMPENSATION TO APEX.

TOWN OF FAIRHAVEN MA · INCORPORATED FEB 22 1812

HARBOR DEVELOPMENT COMMISSION · NEW BEDFORD, MA

PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE - PHASE III, PART A

PREPARED FOR:

THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

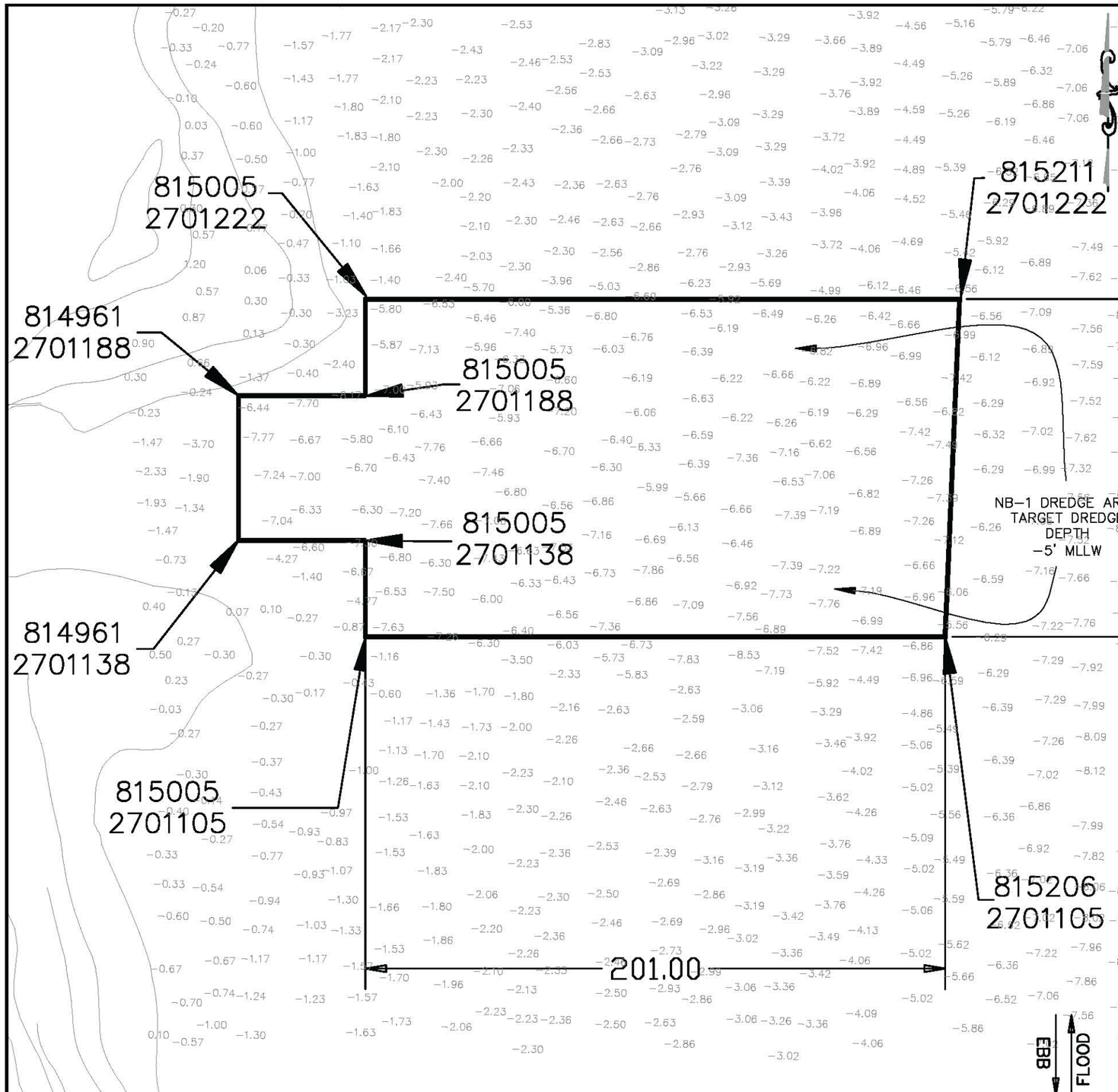
DRAWING TITLE:

PACKER FUEL & MAR-LEES DREDGE AREAS- EXISTING CONDITIONS NOT FOR CONSTRUCTION

Scale: 1"=40'

0 20 40 80 100 FEET

Date 9/5/08	Drawing No.
Proj. Mgr. JAB	
Design CWM	
Check CM	E-9
Drawn CWM	
Job. No. 6615	
Last Rev. 10/30/08	



NOTES

1. COORDINATES SHOWN ARE IN THE STATE PLANE COORDINATE SYSTEM, MASSACHUSETTS MAINLAND ZONE 2001, REFERENCED TO THE 1983 NORTH AMERICAN DATUM.

2. HYDROGRAPHIC SURVEY WAS PERFORMED BY APEX COMPANIES LLC ON 4/29/09.

3. HYDROGRAPHIC SURVEY DATUM IS REFERENCED TO MEAN LOWER LOW WATER (MLLW) ON THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL OCEAN SERVICE TIDAL BENCHMARK BM7584 J 1977 – SURVEY DISK SET FLUSH IN THE SURFACE OF A CONCRETE SIDEWALK ON THE SOUTH SIDE OF U.S.HIGHWAY 6 ON THE NORTH SIDE OF THE MOBIL SERVICE STATION, 4 FEET (1 M) WEST OF A FIRE HYDRANT AND 1 FOOT (0.3 M) SOUTH OF U.S. HIGHWAY 6. DATUM SEPARATIONS WERE COMPUTED BY COLER AND COLANTONIO, INC. JUNE 2008, AS MLLW – 1.49 FT = NGVD29 0.0 FT. TO OBTAIN VALUES IN NGVD29, SUBTRACT 1.49 FEET FROM THE INDICATED VALUE AT ANY POINT. HORIZONTAL CONTROL CAN BE OBTAINED FROM THE ENGINEER.

4. BASE PLAN FOR THIS FIGURE OBTAINED FROM U.S. ARMY CORPS OF ENGINEERS. EXISTING CONDITIONS SHALL BE FIELD VERIFIED BY THE CONTRACTOR.

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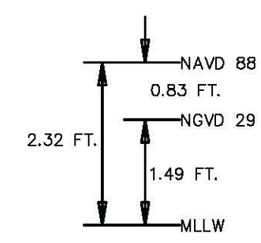
6. THE SOUNDINGS SHOWN HEREON ARE A REDUCED SELECTION OF DATA COLLECTED AT THE TIME OF THE SURVEY. THE DATA REDUCTION WAS PERFORMED USING THE SORT UTILITY WITHIN THE HYPACK SOFTWARE PACKAGE. THIS SORTING UTILITY BIASES THE SOUNDING SELECTION TOWARDS THE MINIMUM (SHOALEST) SOUNDING IN THE SAMPLING AREA.

GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



Apex Companies, LLC.

184 HIGH STREET
SUITE 402
BOSTON MA 02110
(617) 728-0070

REVISIONS

NO.	DATE	DESCRIPTION
1.	9/05/08	PRELIM. DREDGE LAYOUT
2.	11/14/08	BID SET
3.	1/16/09	RE-BID
4.	2/18/09	REV. FOOTPRINT LOCATION
5.	3/23/09	FOR CONSTRUCTION
6.	4/30/09	POST-DREDGE

THESE DRAWINGS PREPARED BY APEX FOR THIS PROJECT ARE INSTRUMENTS OF APEX'S SERVICE FOR USE SOLELY WITH RESPECT TO THIS PROJECT, AND APEX SHALL BE DEEMED THE AUTHOR OF THE DRAWING AND SHALL RETAIN ALL COMMON LAW, STATUTORY AND OTHER RESERVED RIGHTS WITH RESPECT THERETO, INCLUDING COPYRIGHT. THE DOCUMENTS SHALL NOT BE USED ON OTHER PROJECTS, FOR ADDITIONS TO THIS PROJECT OR FOR COMPLETION OF THIS PROJECT BY OTHERS, EXCEPT BY AGREEMENT IN WRITING AND WITH APPROPRIATE COMPENSATION TO APEX.

PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE – PHASE III, PART B

PREPARED FOR:

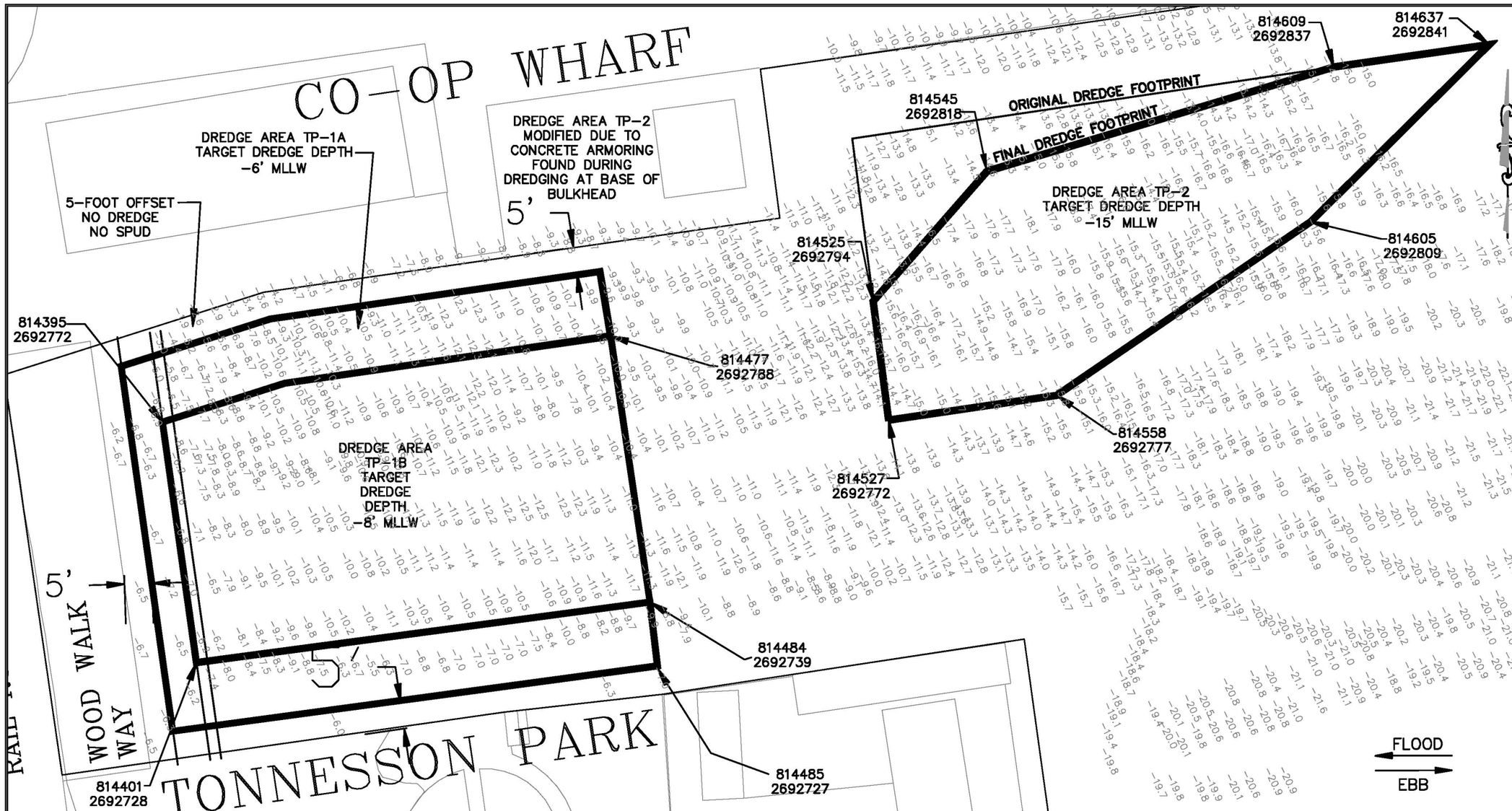
THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

DRAWING TITLE:

NEW BEDFORD ROWING FACILITY DREDGE AREA POST – DREDGE

Scale: 1"=40'
0 10 20 40 FEET

Date 9/5/08	Drawing No.
Proj. Mgr. JAB	P–1
Design GCD	
Check CM	
Drawn GCD	
Job. No. 6615	
Last Rev. 4/30/09	



NOTES

1. COORDINATES SHOWN ARE IN THE STATE PLANE COORDINATE SYSTEM, MASSACHUSETTS MAINLAND ZONE 2001, REFERENCED TO THE 1983 NORTH AMERICAN DATUM.

2. HYDROGRAPHIC SURVEY WAS PERFORMED BY APEX COMPANIES LLC ON 5/23/09.

3. HYDROGRAPHIC SURVEY DATUM IS REFERENCED TO MEAN LOWER LOW WATER (MLLW) ON THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL OCEAN SERVICE TIDAL BENCHMARK BM7584 J 1977 – SURVEY DISK SET FLUSH IN THE SURFACE OF A CONCRETE SIDEWALK ON THE SOUTH SIDE OF U.S.HIGHWAY 6 ON THE NORTH SIDE OF THE MOBIL SERVICE STATION, 4 FEET (1 M) WEST OF A FIRE HYDRANT AND 1 FOOT (0.3 M) SOUTH OF U.S. HIGHWAY 6. DATUM SEPARATIONS WERE COMPUTED BY COLER AND COLANTONIO, INC. JUNE 2008, AS MLLW – 1.49 FT = NGVD29 0.0 FT. TO OBTAIN VALUES IN NGVD29, SUBTRACT 1.49 FEET FROM THE INDICATED VALUE AT ANY POINT. HORIZONTAL CONTROL CAN BE OBTAINED FROM THE ENGINEER.

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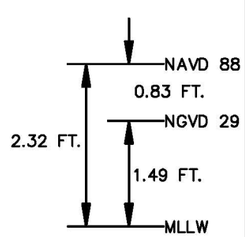
GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



Apex Companies, LLC.
184 HIGH STREET
SUITE 502
BOSTON MA 02110
(617) 728-0070

REVISIONS

NO.	DATE	DESCRIPTION
1.	9/05/08	PRELIM. DREDGE LAYOUT
2.	11/14/08	BID SET
3.	3/12/09	FOR CONSTRUCTION
4.	5/23/09	POST-DREDGE

THESE DRAWINGS PREPARED BY APEX FOR THIS PROJECT ARE INSTRUMENTS OF APEX'S SERVICE FOR USE SOLELY WITH RESPECT TO THIS PROJECT, AND APEX SHALL BE DEEMED THE AUTHOR OF THE DRAWING AND SHALL RETAIN ALL COMMON LAW, STATUTORY AND OTHER RESERVED RIGHTS WITH RESPECT THERETO, INCLUDING COPYRIGHT. THE DOCUMENTS SHALL NOT BE USED ON OTHER PROJECTS, FOR ADDITIONS TO THIS PROJECT OR FOR COMPLETION OF THIS PROJECT BY OTHERS, EXCEPT BY AGREEMENT IN WRITING AND WITH APPROPRIATE COMPENSATION TO APEX.

PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE – PHASE III, PART A

PREPARED FOR:

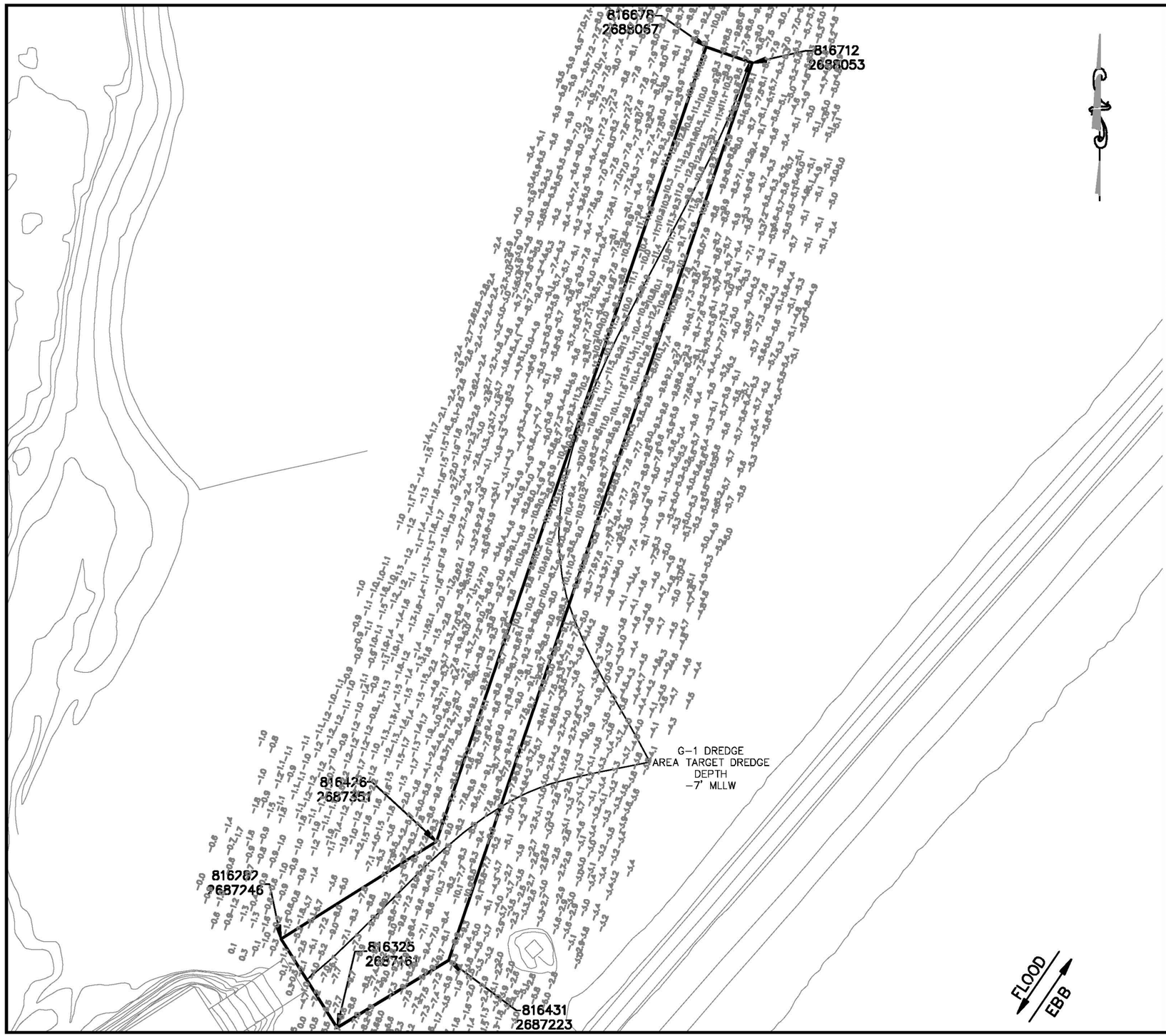
THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

DRAWING TITLE:

TONNESSON PARK DREDGE AREAS POST – DREDGE

Scale: 1"=20'
0 5 10 20 FEET

Date 9/5/08	Drawing No.
Proj. Mgr. JAB	P-1
Design GCD	
Check CM	
Drawn GCD	
Job. No. 6615	
Last Rev. 5/23/09	



NOTES

1. COORDINATES SHOWN ARE IN THE STATE PLANE COORDINATE SYSTEM, MASSACHUSETTS MAINLAND ZONE 2001, REFERENCED TO THE 1983 NORTH AMERICAN DATUM.

2. HYDROGRAPHIC SURVEY WAS PERFORMED BY APEX COMPANIES LLC ON 8/14/09.

3. HYDROGRAPHIC SURVEY DATUM IS REFERENCED TO MEAN LOWER LOW WATER (MLLW) ON THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL OCEAN SERVICE TIDAL BENCHMARK BM7584 J 1977 – SURVEY DISK SET FLUSH IN THE SURFACE OF A CONCRETE SIDEWALK ON THE SOUTH SIDE OF U.S.HIGHWAY 6 ON THE NORTH SIDE OF THE MOBIL SERVICE STATION, 4 FEET (1 M) WEST OF A FIRE HYDRANT AND 1 FOOT (0.3 M) SOUTH OF U.S. HIGHWAY 6. DATUM SEPARATIONS WERE COMPUTED BY COLER AND COLANTONIO, INC. JUNE 2008, AS MLLW – 1.49 FT = NGVD29 0.0 FT. TO OBTAIN VALUES IN NGVD29, SUBTRACT 1.49 FEET FROM THE INDICATED VALUE AT ANY POINT. HORIZONTAL CONTROL CAN BE OBTAINED FROM THE ENGINEER.

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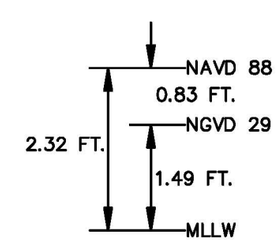
GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



Apex Companies, LLC.

184 HIGH STREET
SUITE 502
BOSTON MA 02110
(617) 728-0070

REVISIONS

NO.	DATE	DESCRIPTION
1.	9/05/08	PRELIM. DREDGE LAYOUT
2.	11/14/08	BID SET
3.	3/12/09	FOR CONSTRUCTION
4.	8/14/09	POST-DREDGE

THESE DRAWINGS PREPARED BY APEX FOR THIS PROJECT ARE INSTRUMENTS OF APEX'S SERVICE FOR USE SOLELY WITH RESPECT TO THIS PROJECT, AND APEX SHALL BE DEEMED THE AUTHOR OF THE DRAWING AND SHALL RETAIN ALL COMMON LAW, STATUTORY AND OTHER RESERVED RIGHTS WITH RESPECT THERETO, INCLUDING COPYRIGHT. THE DOCUMENTS SHALL NOT BE USED ON OTHER PROJECTS, FOR ADDITIONS TO THIS PROJECT OR FOR COMPLETION OF THIS PROJECT BY OTHERS, EXCEPT BY AGREEMENT IN WRITING AND WITH APPROPRIATE COMPENSATION TO APEX.

PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE – PHASE III, PART A

PREPARED FOR:

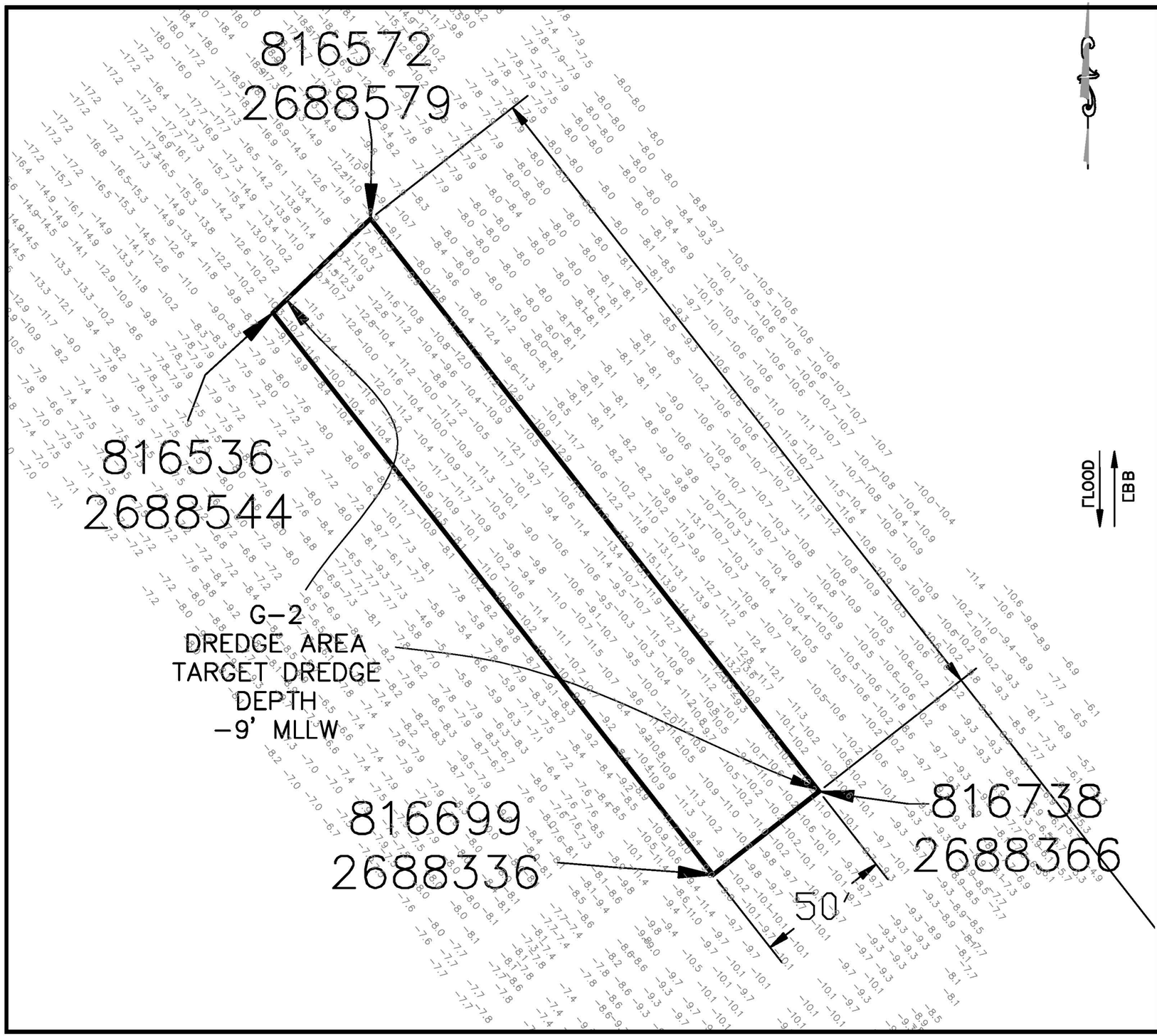
THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

DRAWING TITLE:

GIFFORD STREET BOAT RAMP DREDGE AREA POST – DREDGE

Scale: 1"=100'
0 25 50 100 FEET

Date 9/5/08	Drawing No.
Proj. Mgr. JAB	
Design CCD	
Check CM	
Drawn CCD	P-2
Job. No. 6615	
Last Rev. 8/14/09	



NOTES

1. COORDINATES SHOWN ARE IN THE STATE PLANE COORDINATE SYSTEM, MASSACHUSETTS MAINLAND ZONE 2001, REFERENCED TO THE 1983 NORTH AMERICAN DATUM.

2. HYDROGRAPHIC SURVEY WAS PERFORMED BY APEX COMPANIES LLC ON 7/28/09.

3. HYDROGRAPHIC SURVEY DATUM IS REFERENCED TO MEAN LOWER LOW WATER (MLLW) ON THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL OCEAN SERVICE TIDAL BENCHMARK BM7584 J 1977 – SURVEY DISK SET FLUSH IN THE SURFACE OF A CONCRETE SIDEWALK ON THE SOUTH SIDE OF U.S. HIGHWAY 6 ON THE NORTH SIDE OF THE MOBIL SERVICE STATION, 4 FEET (1 M) WEST OF A FIRE HYDRANT AND 1 FOOT (0.3 M) SOUTH OF U.S. HIGHWAY 6. DATUM SEPARATIONS WERE COMPUTED BY COLTR AND COLANTONIO, INC. JUNE 2008, AS MLLW – 1.49 FT = NGVD29 0.0 FT. TO OBTAIN VALUES IN NGVD29, SUBTRACT 1.49 FEET FROM THE INDICATED VALUE AT ANY POINT. HORIZONTAL CONTROL CAN BE OBTAINED FROM THE ENGINEER.

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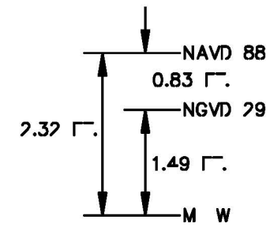
GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



Apex Companies, LLC.

184 HIGH STREET
SUITE 502
BOSTON MA 02110
(617) 728-0070

REVISIONS

NO.	DATE	DESCRIPTION
1.	9/05/08	PRELIM. DREDGE LAYOUT
2.	11/14/08	BID SET
3.	3/12/09	FOR CONSTRUCTION
4.	7/28/09	POST-DREDGE

THESE DRAWINGS PREPARED BY APEX FOR THIS PROJECT ARE INSTRUMENTS OF APEX'S SERVICE FOR USE SOLELY WITH RESPECT TO THIS PROJECT, AND APEX SHALL BE DEEMED THE AUTHOR OF THE DRAWING AND SHALL RETAIN ALL COMMON LAW, STATUTORY AND OTHER RESERVED RIGHTS WITH RESPECT THERETO, INCLUDING COPYRIGHT. THE DOCUMENTS SHALL NOT BE USED ON OTHER PROJECTS, FOR ADDITIONS TO THIS PROJECT OR FOR COMPLETION OF THIS PROJECT BY OTHERS, EXCEPT BY AGREEMENT IN WRITING AND WITH APPROPRIATE COMPENSATION TO APEX.

PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE – PHASE III, PART A

PREPARED FOR:

THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

DRAWING TITLE:

GIFFORD STREET EXTENSION G-2 DREDGE AREA POST – DREDGE

Scale: 1"=40'

0 10 20 40 FEET

Date	9/5/08
Proj. Mgr.	JAB
Design	CCD
Check	CM
Drawn	CCD
Job. No.	6615
Last Rev.	7/28/09

Drawing No.

P-2B

NOTES

1. COORDINATES SHOWN ARE IN THE STATE PLANE COORDINATE SYSTEM, MASSACHUSETTS MAINLAND ZONE 2001, REFERENCED TO THE 1983 NORTH AMERICAN DATUM.

2. HYDROGRAPHIC SURVEY WAS PERFORMED BY APEX COMPANIES LLC ON 10/14/09.

3. HYDROGRAPHIC SURVEY DATUM IS REFERENCED TO MEAN LOWER LOW WATER (MLLW) ON THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL OCEAN SERVICE TIDAL BENCHMARK BM7584 J 1977 – SURVEY DISK SET FLUSH IN THE SURFACE OF A CONCRETE SIDEWALK ON THE SOUTH SIDE OF U.S.HIGHWAY 6 ON THE NORTH SIDE OF THE MOBIL SERVICE STATION, 4 FEET (1 M) WEST OF A FIRE HYDRANT AND 1 FOOT (0.3 M) SOUTH OF U.S. HIGHWAY 6. DATUM SEPARATIONS WERE COMPUTED BY COLER AND COLANTONIO, INC. JUNE 2008, AS MLLW – 1.49 FT = NGVD29 0.0 FT. TO OBTAIN VALUES IN NGVD29, SUBTRACT 1.49 FEET FROM THE INDICATED VALUE AT ANY POINT. HORIZONTAL CONTROL CAN BE OBTAINED FROM THE ENGINEER.

4. BASE PLAN FOR THIS FIGURE OBTAINED FROM U.S. ARMY CORPS OF ENGINEERS. EXISTING CONDITIONS SHALL BE FIELD VERIFIED BY THE CONTRACTOR.

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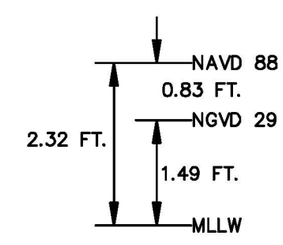
GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



Apex Companies, LLC.

184 HIGH STREET
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(617) 728-0070

REVISIONS

NO.	DATE	DESCRIPTION
1.	9/05/08	PRELIM. DREDGE LAYOUT
2.	11/14/08	BID SET
3.	3/12/09	FOR CONSTRUCTION
4.	10/14/09	POST-DREDGE

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PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE – PHASE III, PART A

PREPARED FOR:

THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

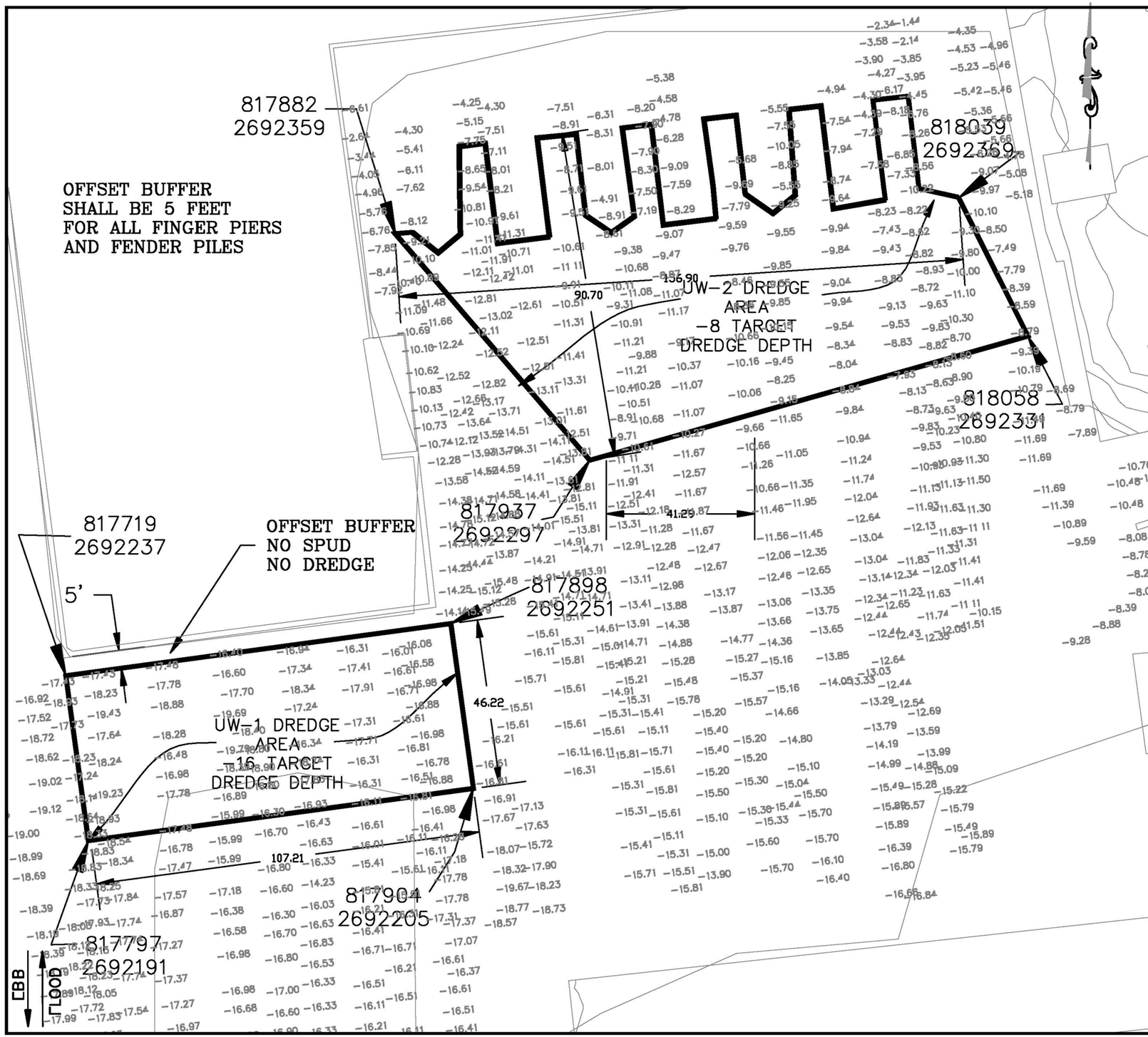
DRAWING TITLE:

SOUTH TERMINAL DREDGE AREA POST – DREDGE

Scale: 1"=50'

0 12.5 25 50 FEET

Date 9/5/08	Drawing No.
Proj. Mgr. JAB	P-3
Design CCD	
Check CM	
Drawn CCD	
Job. No. 6615	
Last Rev. 10/14/09	



NOTES

1. COORDINATES SHOWN ARE IN THE STATE PLANE COORDINATE SYSTEM, MASSACHUSETTS MAINLAND ZONE 2001, REFERENCED TO THE 1983 NORTH AMERICAN DATUM.

2. HYDROGRAPHIC SURVEY WAS PERFORMED BY APEX COMPANIES LLC ON 5/23/09.

3. HYDROGRAPHIC SURVEY DATUM IS REFERENCED TO MEAN LOWER LOW WATER (MLLW) ON THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL OCEAN SERVICE TIDAL BENCHMARK BM7584 J 1977 – SURVEY DISK SET FLUSH IN THE SURFACE OF A CONCRETE SIDEWALK ON THE SOUTH SIDE OF U.S.HIGHWAY 6 ON THE NORTH SIDE OF THE MOBIL SERVICE STATION, 4 FEET (1 M) WEST OF A FIRE HYDRANT AND 1 FOOT (0.3 M) SOUTH OF U.S. HIGHWAY 6. DATUM SEPARATIONS WERE COMPUTED BY COLER AND COLANTONIO, INC. JUNE 2008, AS MLLW – 1.49 FT = NGVD29 0.0 FT. TO OBTAIN VALUES IN NGVD29, SUBTRACT 1.49 FEET FROM THE INDICATED VALUE AT ANY POINT. HORIZONTAL CONTROL CAN BE OBTAINED FROM THE ENGINEER.

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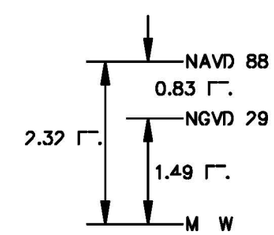
GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



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REVISIONS

NO.	DATE	DESCRIPTION
1.	9/05/08	PRELIM. DREDGE LAYOUT
2.	11/14/08	BID SET
3.	3/12/09	FOR CONSTRUCTION
4.	5/23/09	POST-DREDGE

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PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE – PHASE III, PART A

PREPARED FOR:

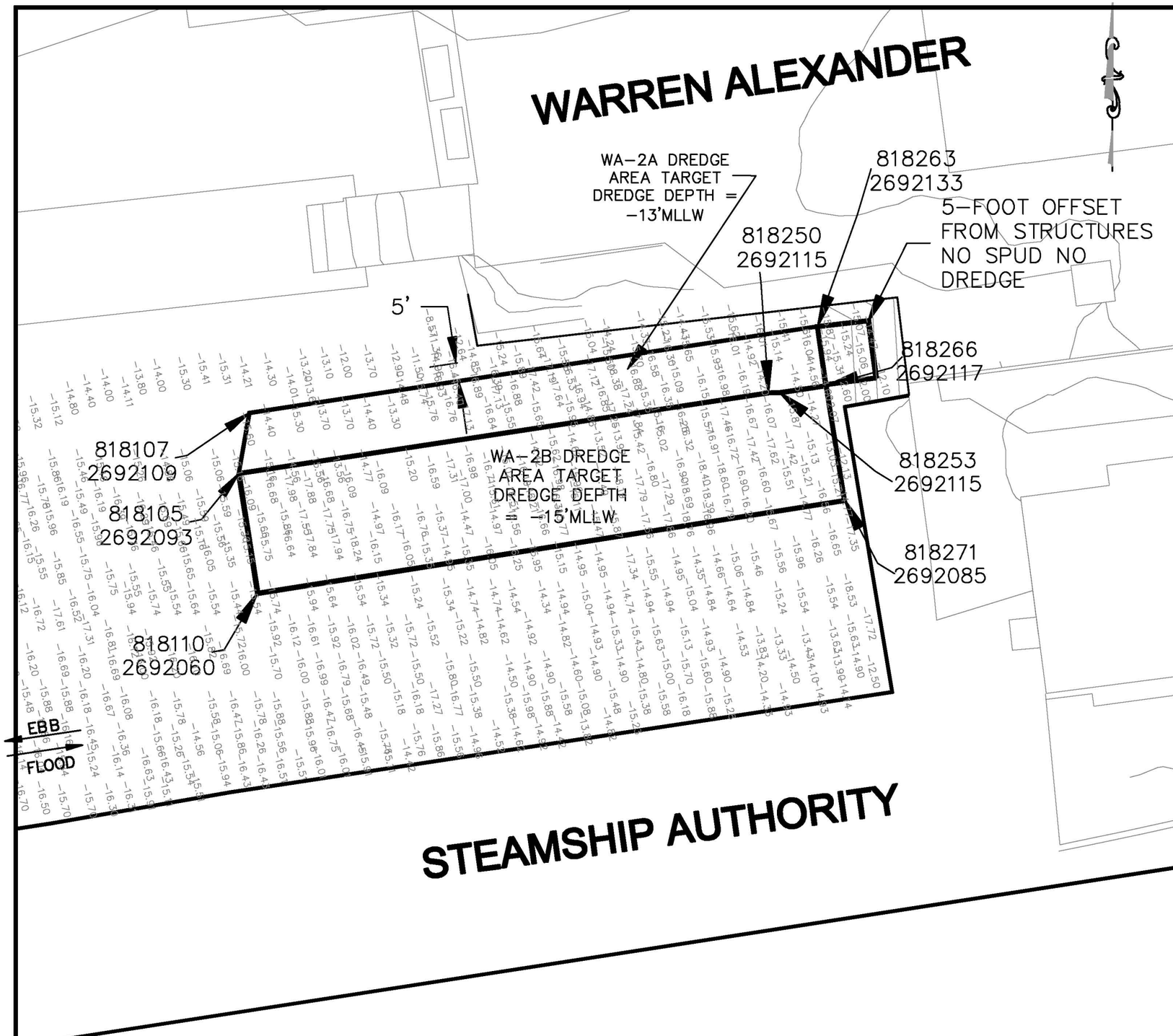
THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

DRAWING TITLE:

UNION WHARF DREDGE AREAS POST – DREDGE

Scale: 1"=30'
0 7.5 15 30 FEET

Date 9/5/08	Drawing No.
Proj. Mgr. JAB	
Design GCD	
Check CM	P-4A
Drawn GCD	
Job. No. 6615	
Last Rev. 5/23/09	



NOTES

1. COORDINATES SHOWN ARE IN THE STATE PLANE COORDINATE SYSTEM, MASSACHUSETTS MAINLAND ZONE 2001, REFERENCED TO THE 1983 NORTH AMERICAN DATUM.

2. HYDROGRAPHIC SURVEY WAS PERFORMED BY APEX COMPANIES LLC ON 7/24/09.

3. HYDROGRAPHIC SURVEY DATUM IS REFERENCED TO MEAN LOWER LOW WATER (MLLW) ON THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL OCEAN SERVICE TIDAL BENCHMARK BM7584 J 1977 – SURVEY DISK SET FLUSH IN THE SURFACE OF A CONCRETE SIDEWALK ON THE SOUTH SIDE OF U.S.HIGHWAY 6 ON THE NORTH SIDE OF THE MOBIL SERVICE STATION, 4 FEET (1 M) WEST OF A FIRE HYDRANT AND 1 FOOT (0.3 M) SOUTH OF U.S. HIGHWAY 6. DATUM SEPARATIONS WERE COMPUTED BY COLER AND COLANTONIO, INC. JUNE 2008, AS MLLW – 1.49 FT = NGVD29 0.0 FT. TO OBTAIN VALUES IN NGVD29, SUBTRACT 1.49 FEET FROM THE INDICATED VALUE AT ANY POINT. HORIZONTAL CONTROL CAN BE OBTAINED FROM THE ENGINEER.

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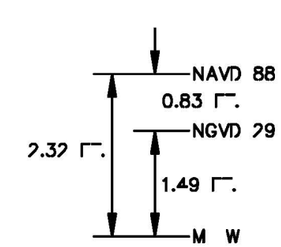
GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



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NO.	DATE	DESCRIPTION
1.	9/05/08	PRELIM. DREDGE LAYOUT
2.	11/14/08	BID SET
3.	3/12/09	FOR CONSTRUCTION
4.	7/24/09	POST-DREDGE

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PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE – PHASE III, PART A

PREPARED FOR:

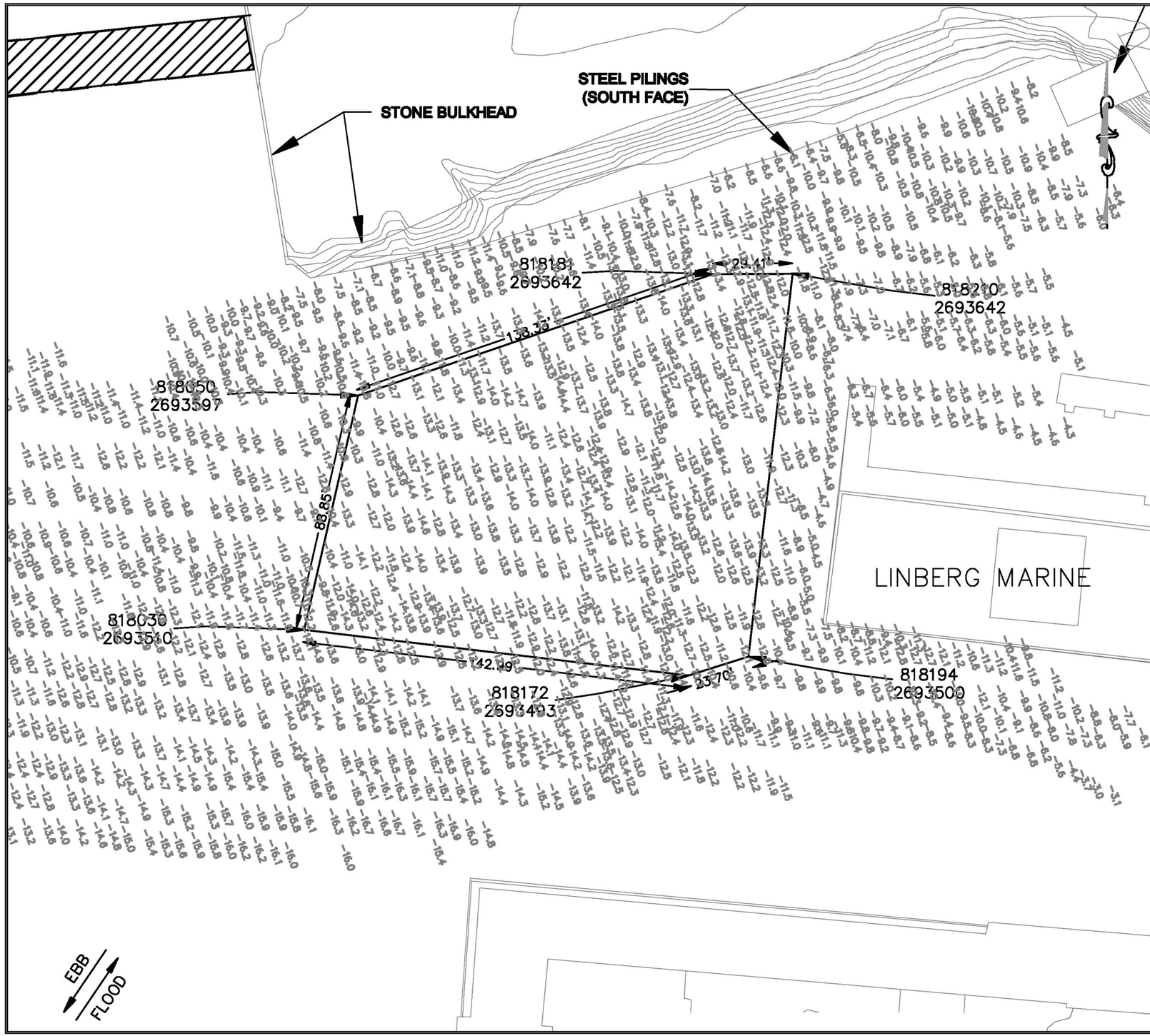
THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

DRAWING TITLE:

WARREN ALEXANDER SOUTH DREDGE AREA POST – DREDGE

Scale: 1"=30'
0 7.5 15 30 FEET

Date 9/5/08	Drawing No.
Proj. Mgr. JAB	
Design GCD	
Check CM	P-4B
Drawn GCD	
Job. No. 5615	
Last Rev. 7/24/09	



NOTES

1. COORDINATES SHOWN ARE IN THE STATE PLANE COORDINATE SYSTEM, MASSACHUSETTS MAINLAND ZONE 2001, REFERENCED TO THE 1983 NORTH AMERICAN DATUM.

2. HYDROGRAPHIC SURVEY WAS PERFORMED BY APEX COMPANIES LLC ON 6/16/09.

3. HYDROGRAPHIC SURVEY DATUM IS REFERENCED TO MEAN LOWER LOW WATER (MLLW) ON THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL OCEAN SERVICE TIDAL BENCHMARK BM7584 J 1977 – SURVEY DISK SET FLUSH IN THE SURFACE OF A CONCRETE SIDEWALK ON THE SOUTH SIDE OF U.S.HIGHWAY 6 ON THE NORTH SIDE OF THE MOBIL SERVICE STATION, 4 FEET (1 M) WEST OF A FIRE HYDRANT AND 1 FOOT (0.3 M) SOUTH OF U.S. HIGHWAY 6. DATUM SEPARATIONS WERE COMPUTED BY COLER AND COLANTONIO, INC. JUNE 2008, AS MLLW – 1.49 FT = NGVD29 0.0 FT. TO OBTAIN VALUES IN NGVD29, SUBTRACT 1.49 FEET FROM THE INDICATED VALUE AT ANY POINT. HORIZONTAL CONTROL CAN BE OBTAINED FROM THE ENGINEER.

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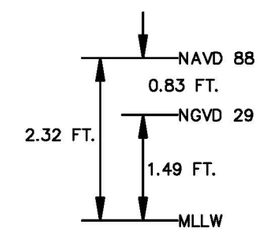
GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



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REVISIONS

NO.	DATE	DESCRIPTION
1.	9/05/08	PRELIM. DREDGE LAYOUT
2.	11/14/08	BID SET
3.	3/12/09	FOR CONSTRUCTION
4.	6/16/09	POST-DREDGE

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PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE – PHASE III, PART A

PREPARED FOR:

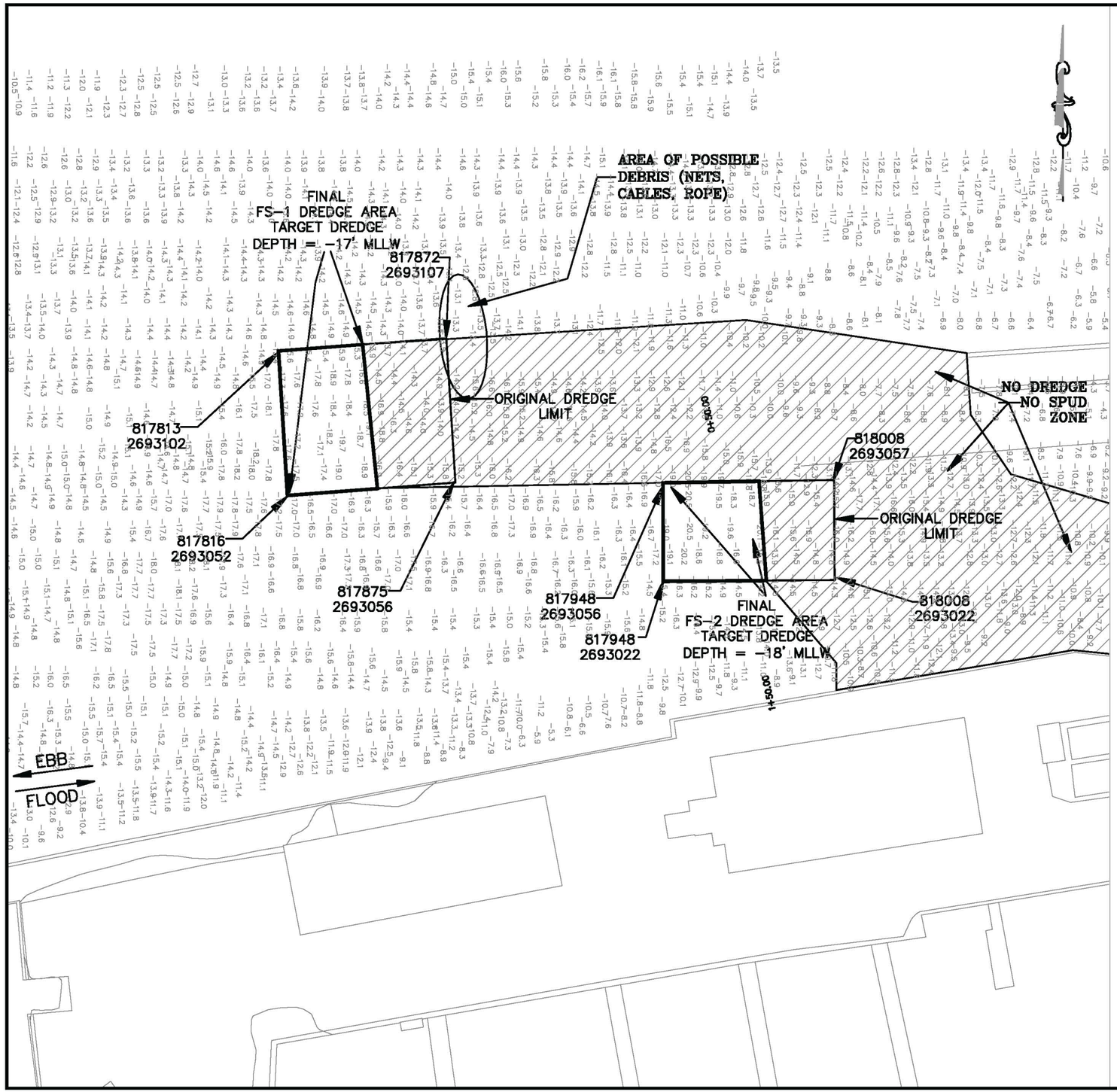
THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

DRAWING TITLE:

LINBERG MARINE DREDGE AREA POST – DREDGE

Scale: 1"=40'
0 10 20 40 FEET

Date 9/5/08	Drawing No.
Proj. Mgr. JAB	
Design GCD	
Check CM	P-5
Drawn GCD	
Job. No. 6615	
Last Rev. 6/16/09	



NOTES

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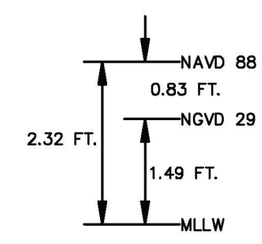
GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



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REVISIONS

NO.	DATE	DESCRIPTION
1.	9/05/08	PRELIM. DREDGE LAYOUT
2.	11/14/08	BID SET
3.	3/12/09	FOR CONSTRUCTION
4.	6/15/09	POST-DREDGE

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PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE – PHASE III, PART A

PREPARED FOR:

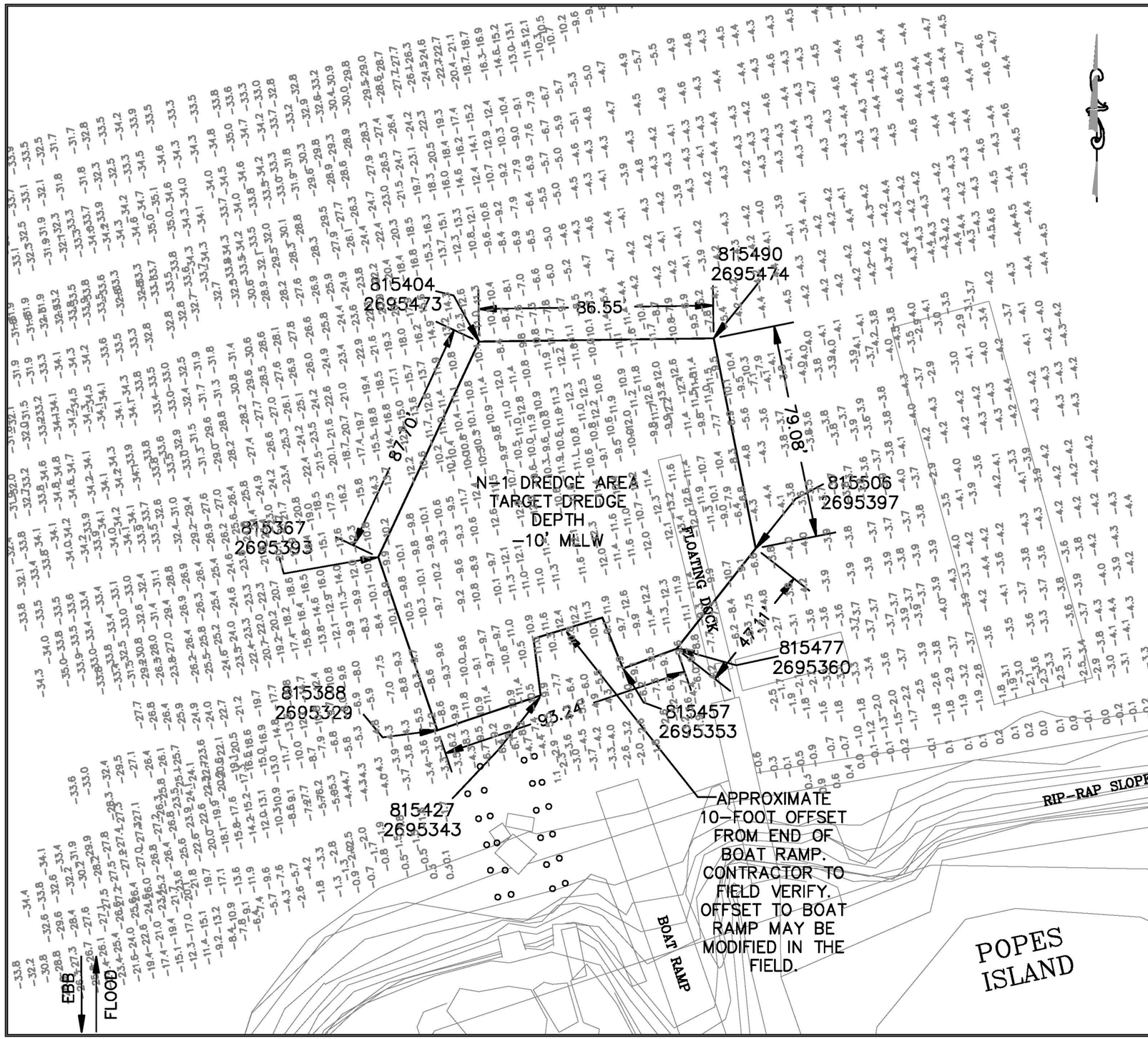
THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

DRAWING TITLE:

FAIRHAVEN SHIPYARD DREDGE AREAS POST – DREDGE

Scale: 1"=40'
0 10 20 40 FEET

Date 9/5/08	Drawing No.
Proj. Mgr. JAB	
Design GCD	
Check CM	P-6
Drawn GCD	
Job. No. 6615	
Last Rev. 6/15/09	



NOTES

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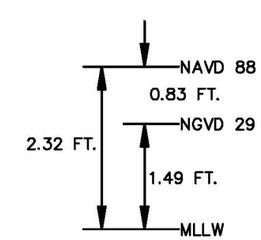
GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



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REVISIONS

NO.	DATE	DESCRIPTION
1.	9/05/08	PRELIM. DREDGE LAYOUT
2.	11/14/08	BID SET
3.	3/12/09	FOR CONSTRUCTION
4.	6/16/09	POST-DREDGE

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PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE – PHASE III, PART A

PREPARED FOR:

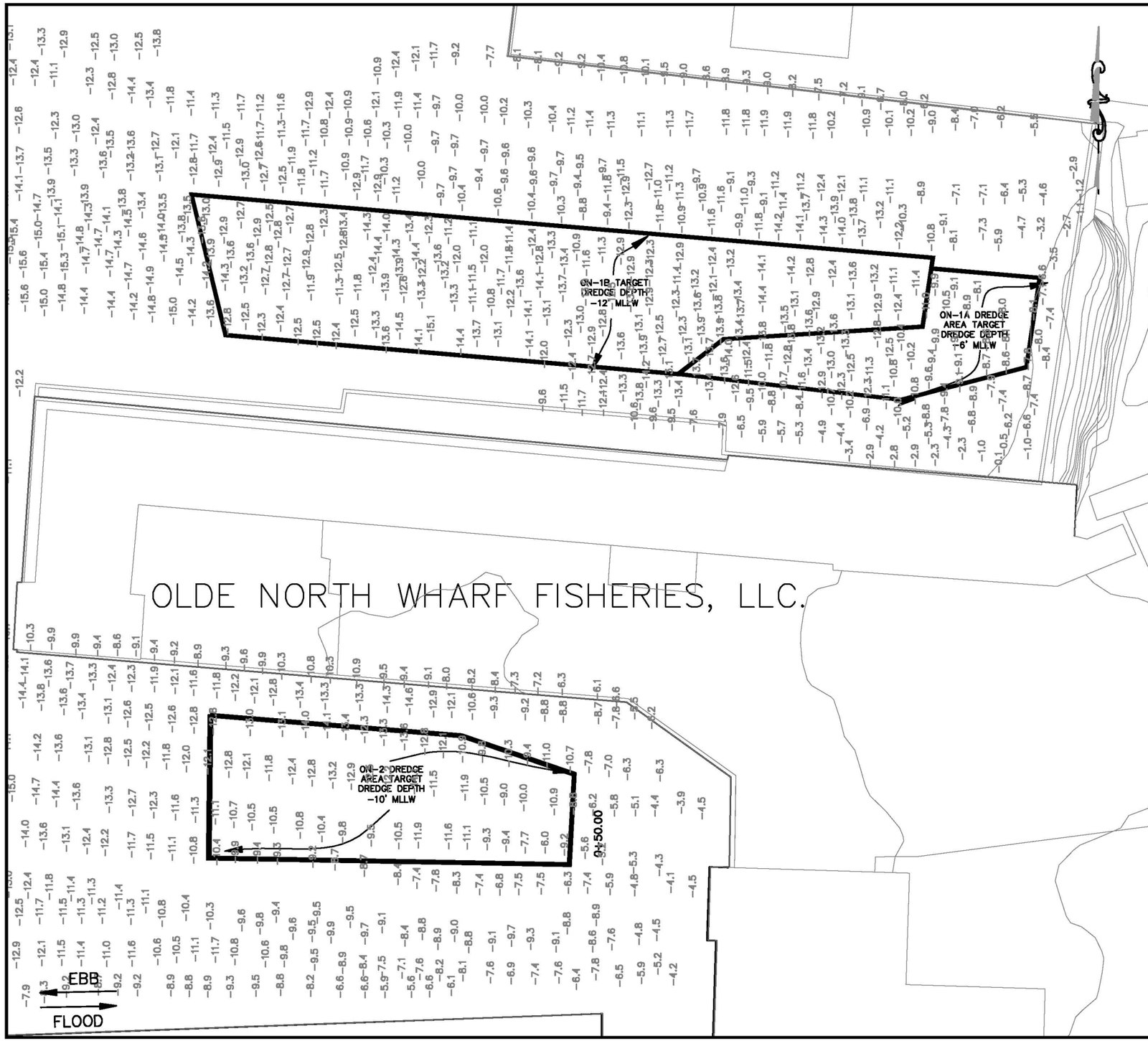
THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

DRAWING TITLE:

NIEMIEC MARINE DREDGE AREA POST – DREDGE

Scale: 1"=40'
0 10 20 40 FEET

Date 9/5/08	Drawing No.
Proj. Mgr. JAB	
Design GCD	
Check CM	
Drawn GCD	P-7
Job. No. 6615	
Last Rev. 6/16/09	



NOTES

1. COORDINATES SHOWN ARE IN THE STATE PLANE COORDINATE SYSTEM, MASSACHUSETTS MAINLAND ZONE 2001, REFERENCED TO THE 1983 NORTH AMERICAN DATUM.

2. HYDROGRAPHIC SURVEY WAS PERFORMED BY APEX COMPANIES LLC ON 7/10/09.

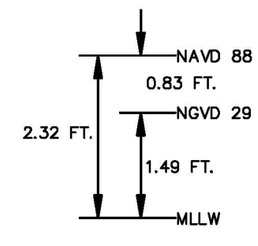
3. HYDROGRAPHIC SURVEY DATUM IS REFERENCED TO MEAN LOWER LOW WATER (MLLW) ON THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL OCEAN SERVICE TIDAL BENCHMARK BM7584 J 1977 – SURVEY DISK SET FLUSH IN THE SURFACE OF A CONCRETE SIDEWALK ON THE SOUTH SIDE OF U.S.HIGHWAY 6 ON THE NORTH SIDE OF THE MOBIL SERVICE STATION, 4 FEET (1 M) WEST OF A FIRE HYDRANT AND 1 FOOT (0.3 M) SOUTH OF U.S. HIGHWAY 6. DATUM SEPARATIONS WERE COMPUTED BY COLER AND COLANTONIO, INC. JUNE 2008, AS MLLW – 1.49 FT = NGVD29 0.0 FT. TO OBTAIN VALUES IN NGVD29, SUBTRACT 1.49 FEET FROM THE INDICATED VALUE AT ANY POINT. HORIZONTAL CONTROL CAN BE OBTAINED FROM THE ENGINEER.

4. BASE PLAN FOR THIS FIGURE OBTAINED FROM U.S. ARMY CORPS OF ENGINEERS. EXISTING CONDITIONS SHALL BE FIELD VERIFIED BY THE CONTRACTOR.

5. THE INFORMATION DEPICTED ON THIS DRAWING REPRESENTS THE RESULTS OF SURVEYS MADE ON THE DATES INDICATED ABOVE AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS AT THE TIME OF THE SURVEYS AND AT THE SOUNDING POINTS NOTED ON THE DRAWING.

6. THE SOUNDINGS SHOWN HEREON ARE A REDUCED SELECTION OF DATA COLLECTED AT THE TIME OF THE SURVEY. THE DATA REDUCTION WAS PERFORMED USING THE SORT UTILITY WITHIN THE HYPACK SOFTWARE PACKAGE. THIS SORTING UTILITY BIASES THE SOUNDING SELECTION TOWARDS THE MINIMUM (SHOALEST) SOUNDING IN THE SAMPLING AREA.

GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



Apex Companies, LLC.

184 HIGH STREET
SUITE 502
BOSTON MA 02110
(617) 728-0070

REVISIONS

NO.	DATE	DESCRIPTION
1.	9/05/08	PRELIM. DREDGE LAYOUT
2.	11/14/08	BID SET
3.	3/12/09	FOR CONSTRUCTION
4.	7/10/09	POST-DREDGE

THESE DRAWINGS PREPARED BY APEX FOR THIS PROJECT ARE INSTRUMENTS OF APEX'S SERVICE FOR USE SOLELY WITH RESPECT TO THIS PROJECT, AND APEX SHALL BE DEEMED THE AUTHOR OF THE DRAWING AND SHALL RETAIN ALL COMMON LAW, STATUTORY AND OTHER RESERVED RIGHTS WITH RESPECT THERETO, INCLUDING COPYRIGHT. THE DOCUMENTS SHALL NOT BE USED ON OTHER PROJECTS, FOR ADDITIONS TO THIS PROJECT OR FOR COMPLETION OF THIS PROJECT BY OTHERS, EXCEPT BY AGREEMENT IN WRITING AND WITH APPROPRIATE COMPENSATION TO APEX.

PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE – PHASE III, PART A

PREPARED FOR:

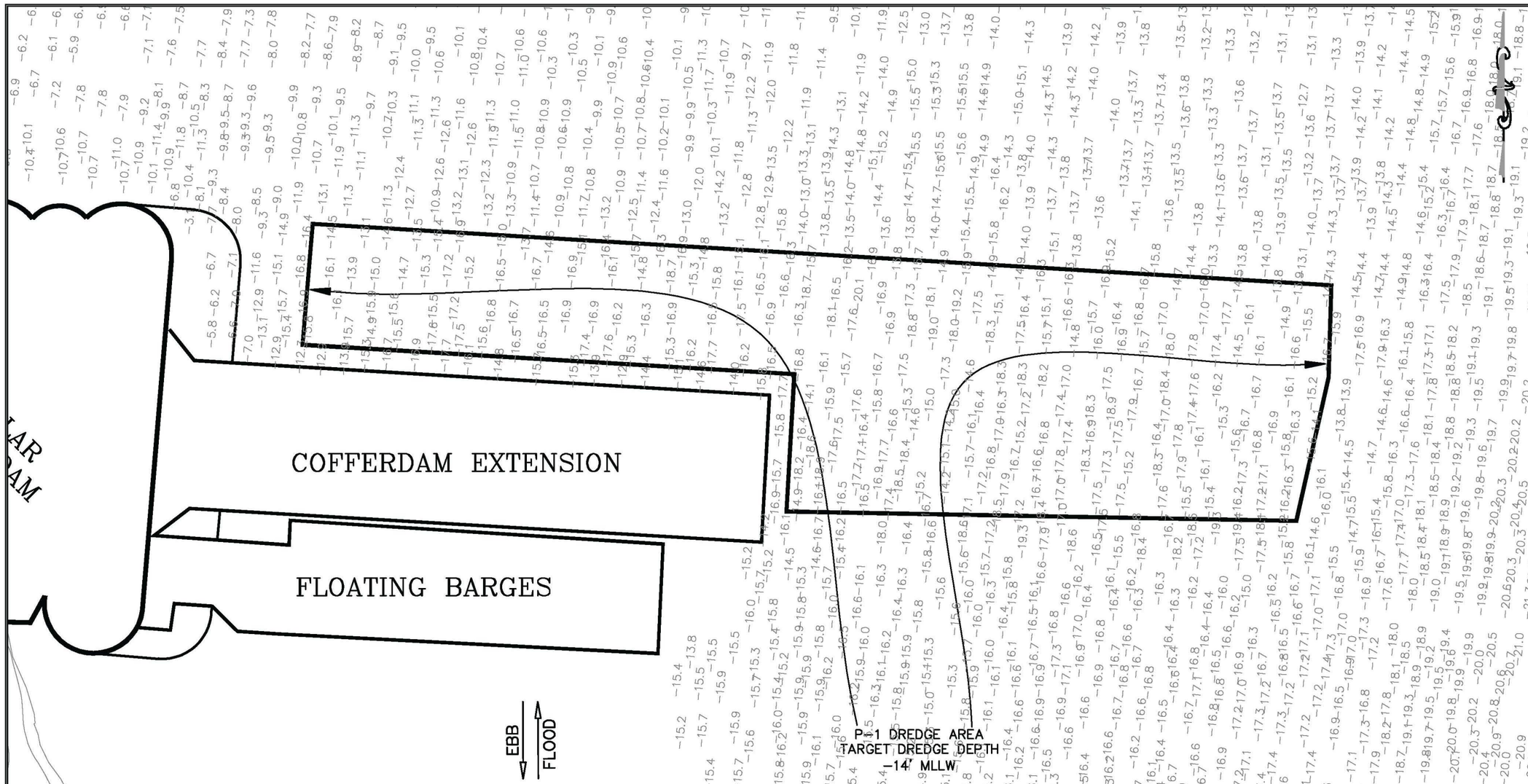
THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

DRAWING TITLE:

OLD NORTH WHARF FISHERIES DREDGE AREA POST – DREDGE

Scale: 1"=30'
0 7.5 15 30 FEET

Date 9/5/08	Drawing No.
Proj. Mgr. JAB	
Design GCD	
Check CM	P-8
Drawn GCD	
Job. No. 6615	
Last Rev. 7/10/09	



NOTES

1. COORDINATES SHOWN ARE IN THE STATE PLANE COORDINATE SYSTEM, MASSACHUSETTS MAINLAND ZONE 2001, REFERENCED TO THE 1983 NORTH AMERICAN DATUM.

2. HYDROGRAPHIC SURVEY WAS PERFORMED BY APEX COMPANIES LLC ON 10/6/09.

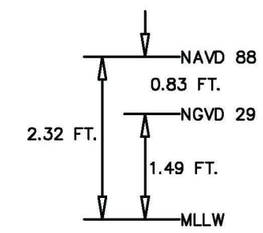
3. HYDROGRAPHIC SURVEY DATUM IS REFERENCED TO MEAN LOWER LOW WATER (MLLW) ON THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL OCEAN SERVICE TIDAL BENCHMARK BM7584 J 1977 – SURVEY DISK SET FLUSH IN THE SURFACE OF A CONCRETE SIDEWALK ON THE SOUTH SIDE OF U.S.HIGHWAY 6 ON THE NORTH SIDE OF THE MOBIL SERVICE STATION, 4 FEET (1 M) WEST OF A FIRE HYDRANT AND 1 FOOT (0.3 M) SOUTH OF U.S. HIGHWAY 6. DATUM SEPARATIONS WERE COMPUTED BY COLER AND COLANTONIO, INC. JUNE 2008, AS MLLW – 1.49 FT = NGVD29 0.0 FT. TO OBTAIN VALUES IN NGVD29, SUBTRACT 1.49 FEET FROM THE INDICATED VALUE AT ANY POINT. HORIZONTAL CONTROL CAN BE OBTAINED FROM THE ENGINEER.

4. BASE PLAN FOR THIS FIGURE OBTAINED FROM U.S. ARMY CORPS OF ENGINEERS. EXISTING CONDITIONS SHALL BE FIELD VERIFIED BY THE CONTRACTOR.

5. THE INFORMATION DEPICTED ON THIS DRAWING REPRESENTS THE RESULTS OF SURVEYS MADE ON THE DATES INDICATED ABOVE AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS AT THE TIME OF THE SURVEYS AND AT THE SOUNDING POINTS NOTED ON THE DRAWING.

6. THE SOUNDINGS SHOWN HEREON ARE A REDUCED SELECTION OF DATA COLLECTED AT THE TIME OF THE SURVEY. THE DATA REDUCTION WAS PERFORMED USING THE SORT UTILITY WITHIN THE HYPACK SOFTWARE PACKAGE. THIS SORTING UTILITY BIASES THE SOUNDING SELECTION TOWARDS THE MINIMUM (SHOALEST) SOUNDING IN THE SAMPLING AREA.

GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



Apex Companies, LLC.
184 HIGH STREET
SUITE 502
BOSTON MA 02110
(617) 728-0070

REVISIONS

NO.	DATE	DESCRIPTION
1.	9/05/08	PRELIM. DREDGE LAYOUT
2.	11/14/08	BID SET
3.	3/12/09	FOR CONSTRUCTION
4.	10/6/09	POST-DREDGE

THESE DRAWINGS PREPARED BY APEX FOR THIS PROJECT ARE INSTRUMENTS OF APEX'S SERVICE FOR USE SOLELY WITH RESPECT TO THIS PROJECT, AND APEX SHALL BE DEEMED THE AUTHOR OF THE DRAWING AND SHALL RETAIN ALL COMMON LAW, STATUTORY AND OTHER RESERVED RIGHTS WITH RESPECT THERETO, INCLUDING COPYRIGHT. THE DOCUMENTS SHALL NOT BE USED ON OTHER PROJECTS, FOR ADDITIONS TO THIS PROJECT OR FOR COMPLETION OF THIS PROJECT BY OTHERS, EXCEPT BY AGREEMENT IN WRITING AND WITH APPROPRIATE COMPENSATION TO APEX.

PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE – PHASE III, PART A

PREPARED FOR:

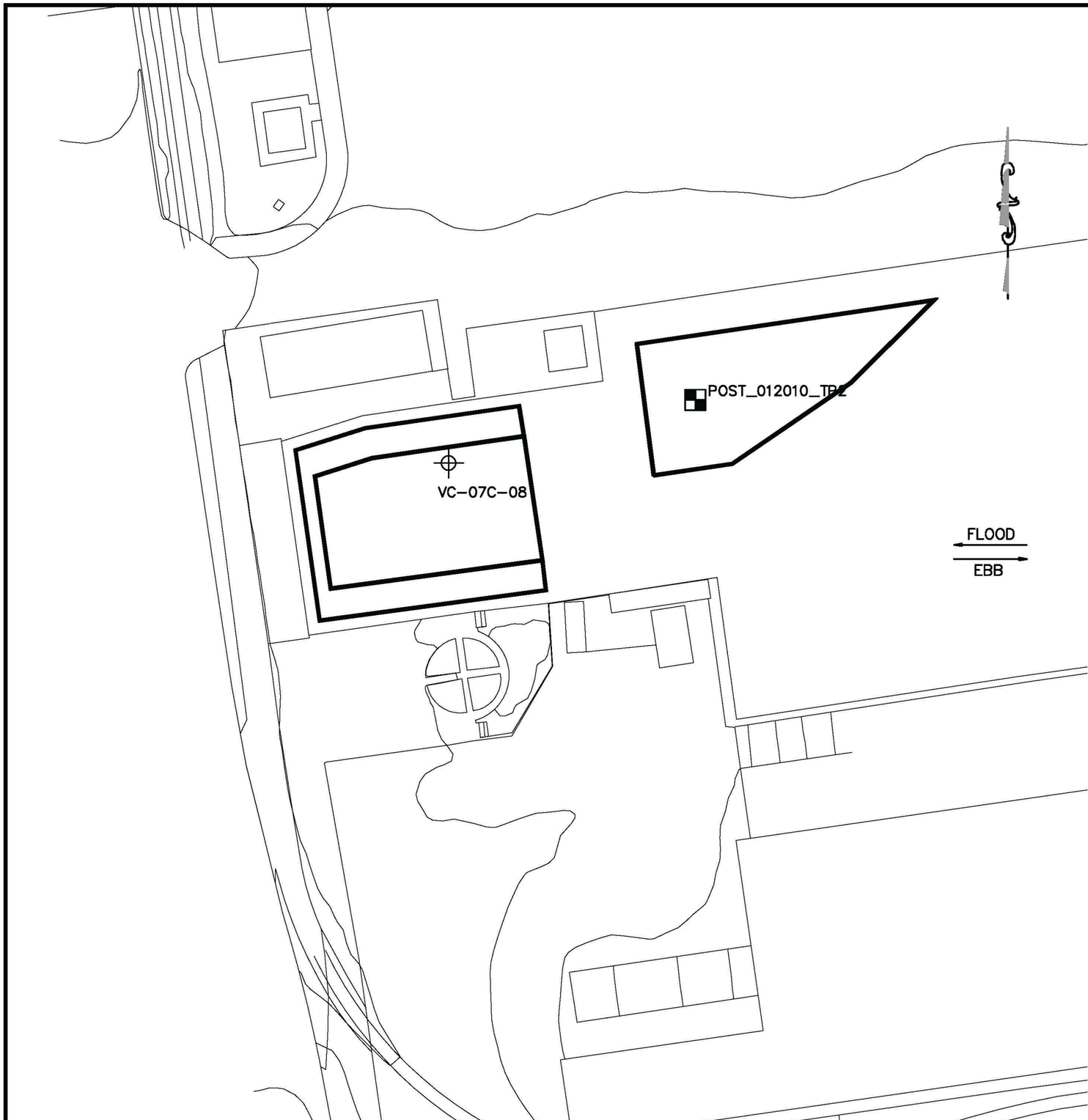
THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

DRAWING TITLE:

PACKER FUEL DREDGE AREA POST – DREDGE

Scale: 1"=40'
0 10 20 40 FEET

Date 9/5/08	Drawing No.
Proj. Mgr. JAB	
Design GCD	
Check CM	P–9
Drawn GCD	
Job. No. 6615	
Last Rev. 10/6/09	



NOTES

1. COORDINATES SHOWN ARE IN THE STATE PLANE COORDINATE SYSTEM, MASSACHUSETTS MAINLAND ZONE 2001, REFERENCED TO THE 1983 NORTH AMERICAN DATUM.

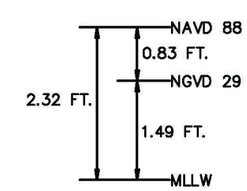
2. BASE PLAN FOR THIS FIGURE OBTAINED FROM U.S. ARMY CORPS OF ENGINEERS. EXISTING CONDITIONS SHALL BE FIELD VERIFIED BY THE CONTRACTOR.

3. HORIZONTAL AND VERTICAL CONTROL HAVE BEEN PROVIDED BY THE OWNER AND HAVE NOT BEEN INDEPENDENTLY VERIFIED. THE CONTRACTOR IS RESPONSIBLE FOR FIELD VERIFICATION OF CONTROL DATA.

VC-07-08 — PRE DREDGE SAMPLE LOCATION

POST_012010_G1 — POST DREDGE SAMPLE LOCATION

GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



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184 HIGH STREET
SUITE 502
BOSTON, MA. 02110
(617) 728-0070

REVISIONS

NO.	DATE	DESCRIPTION
1.	[illegible]	PRELIM. DREDGE LAYOUT
2.	11/14/08	BID SET
3.	1/16/09	RE-BID
4.	[illegible]	POST-DREDGE SAMPLES

THESE DRAWINGS PREPARED BY APEX FOR THIS PROJECT ARE INSTRUMENTS OF APEX'S SERVICE FOR USE SOLELY WITH RESPECT TO THIS PROJECT, AND APEX SHALL BE DEEMED THE AUTHOR OF THE DRAWING AND SHALL RETAIN ALL COMMON LAW, STATUTORY AND OTHER RESERVED RIGHTS WITH RESPECT THERETO, INCLUDING COPYRIGHT. THE DOCUMENTS SHALL NOT BE USED ON OTHER PROJECTS, FOR ADDITIONS TO THIS PROJECT OR FOR COMPLETION OF THIS PROJECT BY OTHERS, EXCEPT BY AGREEMENT IN WRITING AND WITH APPROPRIATE COMPENSATION TO APEX.

PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE - PHASE III, PART A & B

PREPARED FOR:

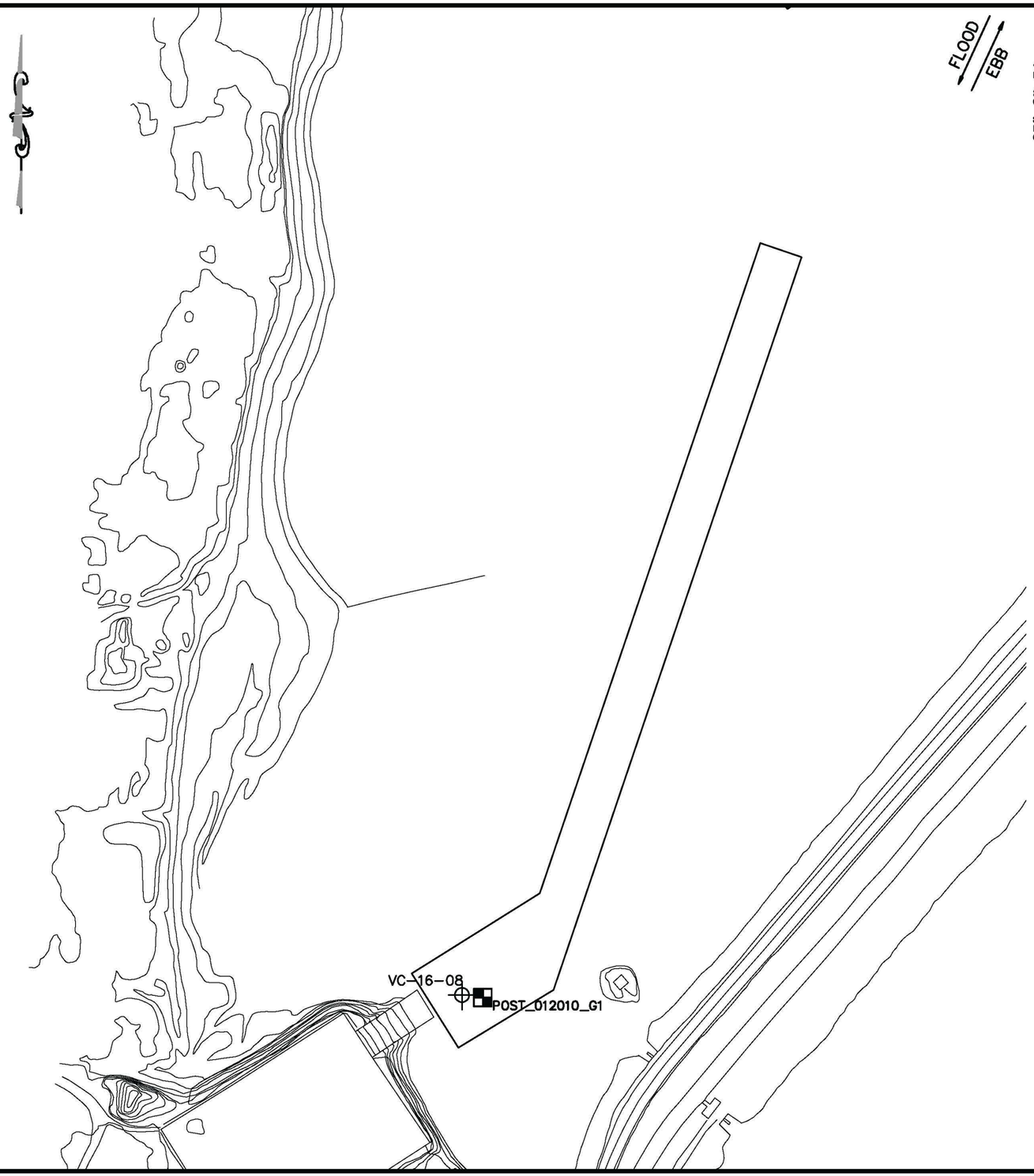
THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

DRAWING TITLE:

TONNESSON PARK DREDGE AREAS- PRE AND POST DREDGE SAMPLING LOCATIONS NOT FOR CONSTRUCTION

Scale: 0 10 20 40 50 FEET

Date 9/5/08	Drawing No.
Proj. Mgr. JAB	
Design GCD	
Check CM	V-1
Drawn GCD	
Job. No. 6615	
Last Rev. 1/22/10	



FLOOD
EBB

NOTES

1. COORDINATES SHOWN ARE IN THE STATE PLANE COORDINATE SYSTEM, MASSACHUSETTS MAINLAND ZONE 2001, REFERENCED TO THE 1983 NORTH AMERICAN DATUM.

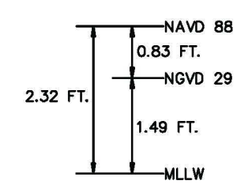
2. BASE PLAN FOR THIS FIGURE OBTAINED FROM U.S. ARMY CORPS OF ENGINEERS. EXISTING CONDITIONS SHALL BE FIELD VERIFIED BY THE CONTRACTOR.

3. HORIZONTAL AND VERTICAL CONTROL HAVE BEEN PROVIDED BY THE OWNER AND HAVE NOT BEEN INDEPENDENTLY VERIFIED. THE CONTRACTOR IS RESPONSIBLE FOR FIELD VERIFICATION OF CONTROL DATA.

VC-07-08 — PRE DREDGE SAMPLE LOCATION

POST_012010_G1 — POST DREDGE SAMPLE LOCATION

GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



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104 HIGH STREET
SUITE 602
BOSTON, MA. 02110
(617) 728-0070

REVISIONS

NO.	DATE	DESCRIPTION
1.	[illegible]	PRELIM. DREDGE LAYOUT
2.	11/14/09	BID SET
3.	1/16/09	RE-BID
4.	1/22/10	POST-DREDGE SAMPLES

THESE DRAWINGS PREPARED BY APEX FOR THIS PROJECT ARE INSTRUMENTS OF APEX'S SERVICE FOR USE SOLELY WITH RESPECT TO THIS PROJECT, AND APEX SHALL BE DEEMED THE AUTHOR OF THE DRAWING AND SHALL RETAIN ALL COMMON LAW, STATUTORY AND OTHER RESERVED RIGHTS WITH RESPECT THERETO, INCLUDING COPYRIGHT. THE DOCUMENTS SHALL NOT BE USED ON OTHER PROJECTS, FOR ADDITIONS TO THIS PROJECT OR FOR COMPLETION OF THIS PROJECT BY OTHERS, EXCEPT BY AGREEMENT IN WRITING AND WITH APPROPRIATE COMPENSATION TO APEX.

TOWN OF FAIRHAVEN MA — INCORPORATED FEB 22, 1812

NEW BEDFORD HARBOR DEVELOPMENT COMMISSION — NEW BEDFORD, MA

PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE - PHASE III, PART A & B

PREPARED FOR:

THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

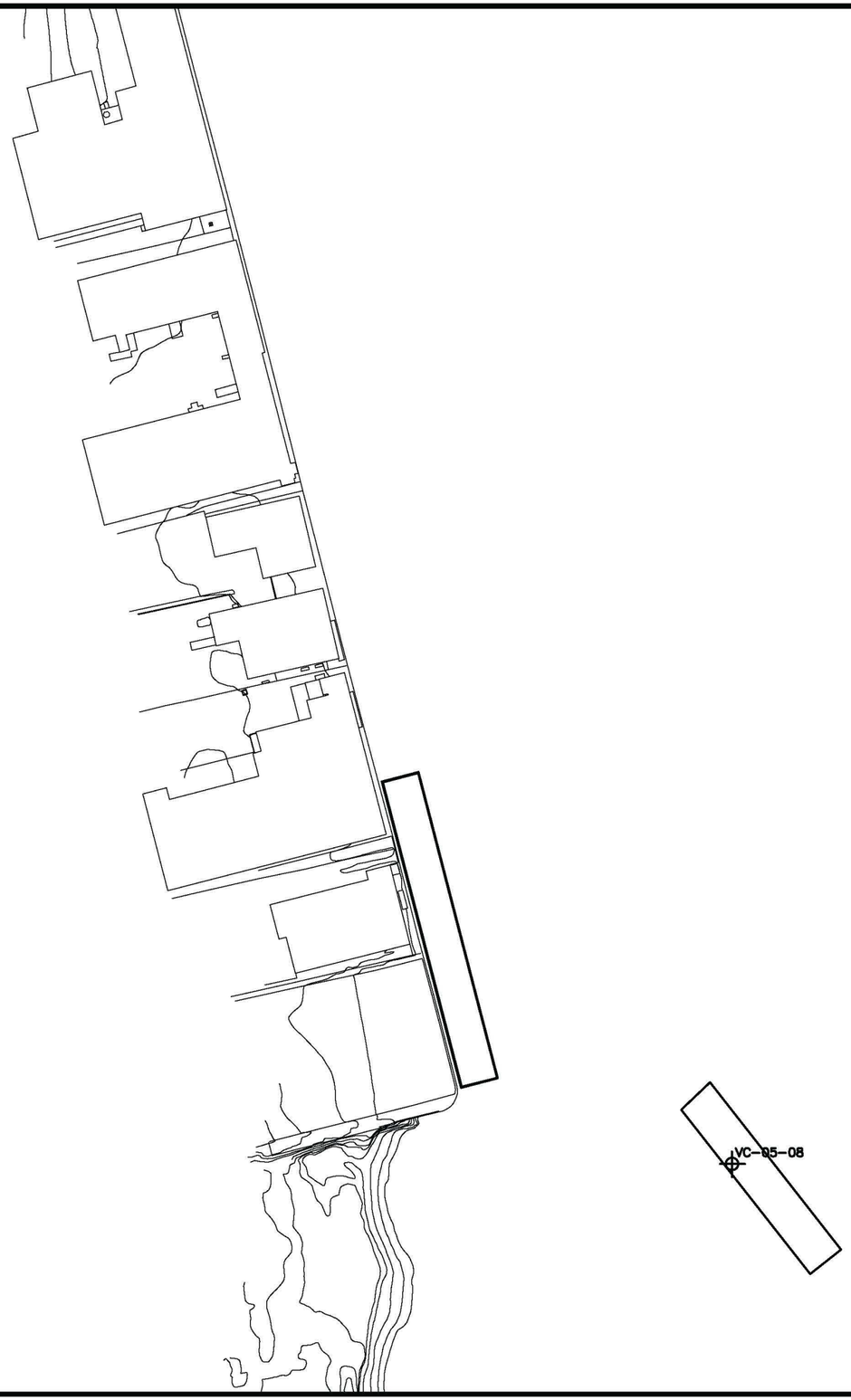
DRAWING TITLE:

GIFFORD STREET BOAT RAMP DREDGE AREA- PRE AND POST DREDGE SAMPLING LOCATIONS

NOT FOR CONSTRUCTION

Scale: 0 30 60 120 150 FEET

Date 9/5/08	Drawing No.
Proj. Mgr. JAB	
Design GCD	
Check CM	V-2
Drawn GCD	
Job. No. 6815	
Last Rev. 1/22/10	



NOTES

1. COORDINATES SHOWN ARE IN THE STATE PLANE COORDINATE SYSTEM, MASSACHUSETTS MAINLAND ZONE 2001, REFERENCED TO THE 1983 NORTH AMERICAN DATUM.

2. BASE PLAN FOR THIS FIGURE OBTAINED FROM U.S. ARMY CORPS OF ENGINEERS. EXISTING CONDITIONS SHALL BE FIELD VERIFIED BY THE CONTRACTOR.

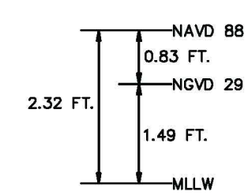
3. HORIZONTAL AND VERTICAL CONTROL HAVE BEEN PROVIDED BY THE OWNER AND HAVE NOT BEEN INDEPENDENTLY VERIFIED. THE CONTRACTOR IS RESPONSIBLE FOR FIELD VERIFICATION OF CONTROL DATA.

FLOOD
EBB

VC-07-08 — PRE DREDGE SAMPLE LOCATION

POST_012010_G1 — POST DREDGE SAMPLE LOCATION

GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



Apex Companies, LLC.
104 HIGH STREET
SUITE 502
BOSTON, MA. 02110
(617) 728-0070

REVISIONS

NO.	DATE	DESCRIPTION
1.	8/28/09	PRELIM. DREDGE LAYOUT
2.	11/14/09	BID SET
3.	1/19/09	RE-BID
4.	1/22/10	POST-DREDGE SAMPLES

THESE DRAWINGS PREPARED BY APEX FOR THIS PROJECT ARE INSTRUMENTS OF APEX'S SERVICE FOR USE SOLELY WITH RESPECT TO THIS PROJECT, AND APEX SHALL BE DEEMED THE AUTHOR OF THE DRAWING AND SHALL RETAIN ALL COMMON LAW, STATUTORY AND OTHER RESERVED RIGHTS WITH RESPECT THERETO, INCLUDING COPYRIGHT. THE DOCUMENTS SHALL NOT BE USED ON OTHER PROJECTS, FOR ADDITIONS TO THIS PROJECT OR FOR COMPLETION OF THIS PROJECT BY OTHERS, EXCEPT BY AGREEMENT IN WRITING AND WITH APPROPRIATE COMPENSATION TO APEX.

PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE - PHASE III, PART A & B

PREPARED FOR:

THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

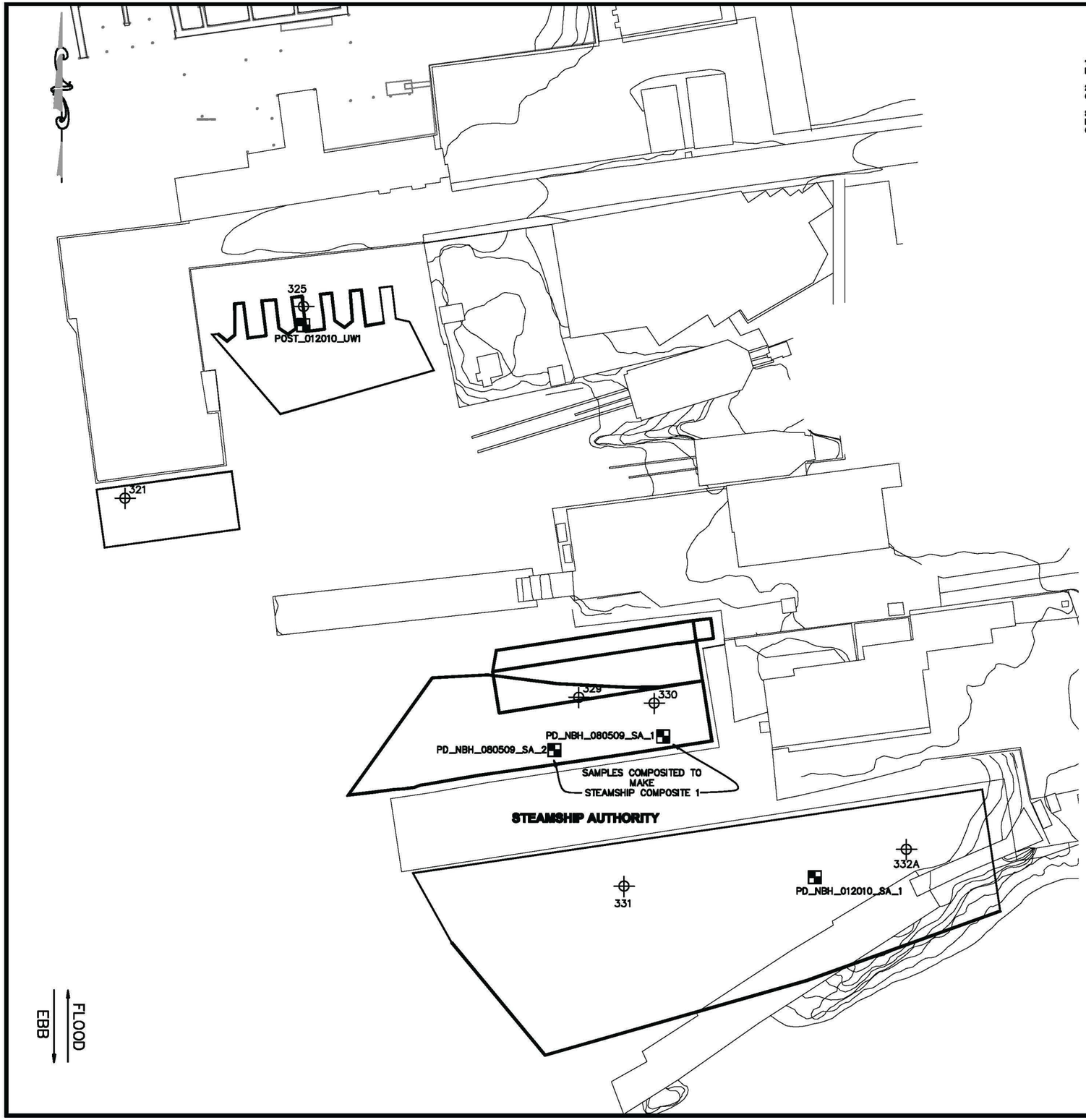
DRAWING TITLE:

SOUTH TERMINAL DREDGE AREAS- PRE AND POST DREDGE SAMPLING LOCATIONS

NOT FOR CONSTRUCTION

Scale: 0 40 80 160 200 FEET

Date 9/5/08	Drawing No.
Proj. Mgr. JAB	
Design GCD	
Check CM	V-3
Drawn GCD	
Job. No. 5615	
Last Rev. 1/22/10	



NOTES

1. COORDINATES SHOWN ARE IN THE STATE PLANE COORDINATE SYSTEM, MASSACHUSETTS MAINLAND ZONE 2001, REFERENCED TO THE 1983 NORTH AMERICAN DATUM.

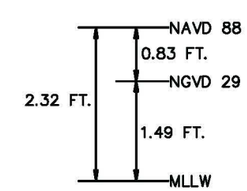
2. BASE PLAN FOR THIS FIGURE OBTAINED FROM U.S. ARMY CORPS OF ENGINEERS. EXISTING CONDITIONS SHALL BE FIELD VERIFIED BY THE CONTRACTOR.

3. HORIZONTAL AND VERTICAL CONTROL HAVE BEEN PROVIDED BY THE OWNER AND HAVE NOT BEEN INDEPENDENTLY VERIFIED. THE CONTRACTOR IS RESPONSIBLE FOR FIELD VERIFICATION OF CONTROL DATA.

VC-07-08 — PRE DREDGE SAMPLE LOCATION

POST_012010_G1 — POST DREDGE SAMPLE LOCATION

GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



Apex Companies, LLC.

184 HIGH STREET
SUITE 502
BOSTON, MA. 02110
(617) 728-0070

REVISIONS

NO.	DATE	DESCRIPTION
1.	9/05/08	PRELIM. DREDGE LAYOUT
2.	11/14/08	BID SET
3.	1/18/09	RE-BID
4.	1/22/10	POST-DREDGE SAMPLES

THESE DRAWINGS PREPARED BY APEX FOR THIS PROJECT ARE INSTRUMENTS OF APEX'S SERVICE FOR USE SOLELY WITH RESPECT TO THIS PROJECT, AND APEX SHALL BE DEEMED THE AUTHOR OF THE DRAWING AND SHALL RETAIN ALL COMMON LAW, STATUTORY AND OTHER RESERVED RIGHTS WITH RESPECT THERETO, INCLUDING COPYRIGHT. THE DOCUMENTS SHALL NOT BE USED ON OTHER PROJECTS, FOR ADDITIONS TO THIS PROJECT OR FOR COMPLETION OF THIS PROJECT BY OTHERS, EXCEPT BY AGREEMENT IN WRITING AND WITH APPROPRIATE COMPENSATION TO APEX.

PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE - PHASE III, PART A & B

PREPARED FOR:

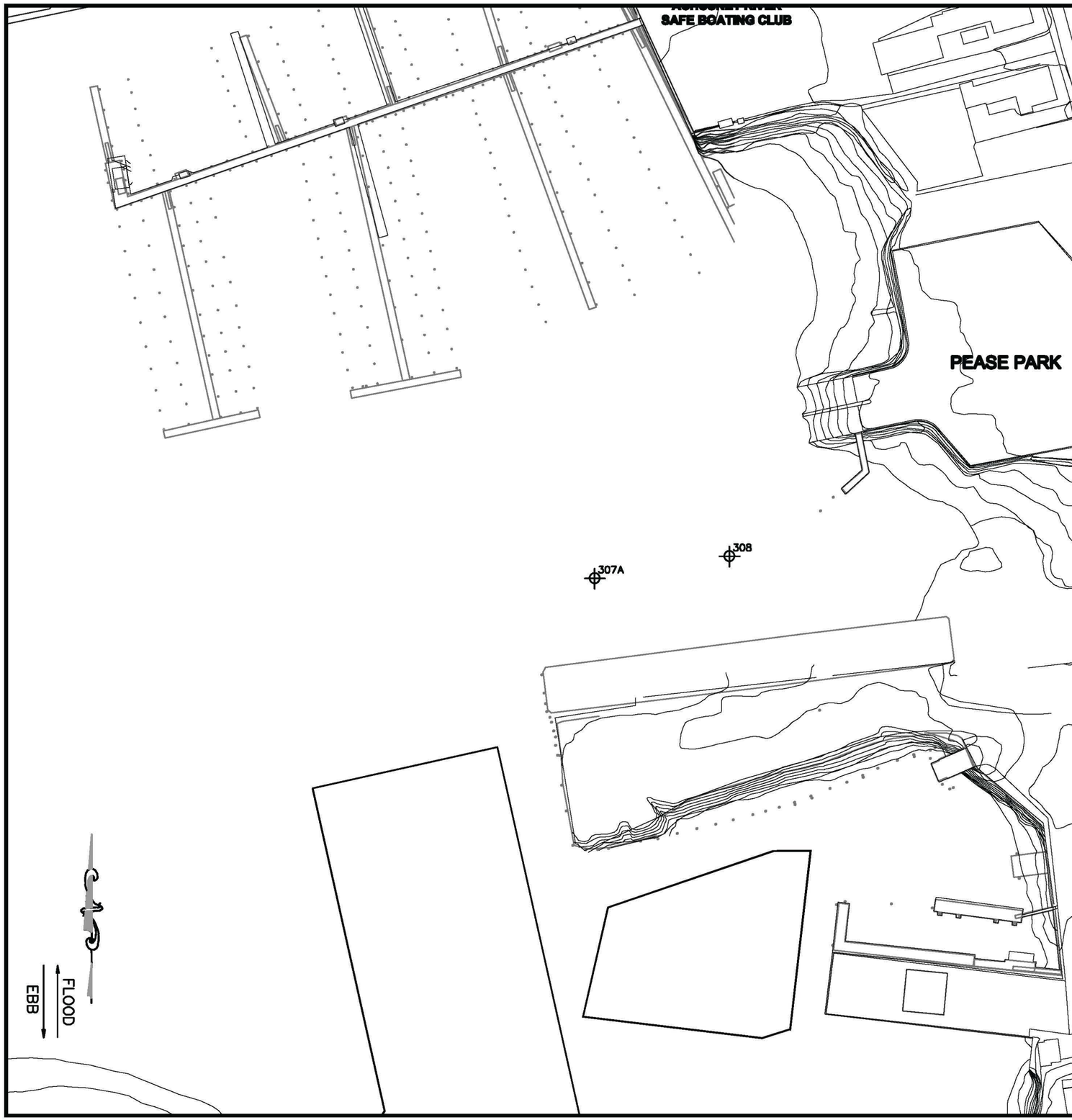
THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

DRAWING TITLE:

WARREN ALEXANDEER SOUTH AND UNION WHARF DREDGE AREAS- VIBRACORE AND BORING LOCATION SHEET NOT FOR CONSTRUCTION

Scale: 0 20 40 80 100 FEET

Date 9/5/08	Drawing No.
Proj. Mgr. JAB	
Design GCD	
Check CM	V–4
Drawn GCD	
Job. No. 6515	
Last Rev. 1/22/10	



NOTES

1. COORDINATES SHOWN ARE IN THE STATE PLANE COORDINATE SYSTEM, MASSACHUSETTS MAINLAND ZONE 2001, REFERENCED TO THE 1983 NORTH AMERICAN DATUM.

2. HYDROGRAPHIC SURVEY IS A COMPILATION OF SURVEYS PREFORMED BETWEEN 9-11-08 AND 11-3-08.

3. HYDROGRAPHIC SURVEY DATUM IS REFERENCED TO MEAN LOWER LOW WATER (MLLW) ON THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL OCEAN SERVICE TIDAL BENCHMARK BM/BM J 1977 - SURVEY DISK SET FLUSH IN THE SURFACE OF A CONCRETE SIDEWALK ON THE SOUTH SIDE OF U.S.HIGHWAY 6 ON THE NORTH SIDE OF THE MOBIL SERVICE STATION,4 FEET (1 M) WEST OF A FIRE HYDRANT AND 1 FOOT (0.3 M) SOUTH OF U.S. HIGHWAY 6. DATUM SEPARATIONS WERE COMPUTED BY COLER AND COLANTONIO, INC. FEBRUARY 2002.AS MLLW - 1.82 FT = NGVD29 0.0 FT. TO OBTAIN VALUES IN NGVD29, SUBTRACT 1.82 FEET FROM THE INDICATED VALUE AT ANY POINT. HORIZONTAL CONTROL CAN BE OBTAINED FROM THE ENGINEER.

4. BASE PLAN FOR THIS FIGURE OBTAINED FROM U.S. ARMY CORPS OF ENGINEERS. EXISTING CONDITIONS SHALL BE FIELD VERIFIED BY THE CONTRACTOR.

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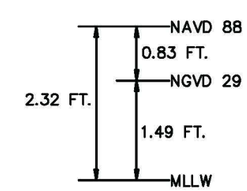
6. THE INFORMATION DEPICTED ON THIS DRAWING REPRESENTS THE RESULTS OF SURVEYS MADE ON THE DATES INDICATED ABOVE AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS AT THE TIME OF THE SURVEYS AND AT THE SOUNDING POINTS NOTED ON THE DRAWING.

312 VIBRACORE LOCATION

312 BORING LOCATION

GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



Apex Companies, LLC.

115 BROAD STREET
SUITE 300
BOSTON MA 02110
(617) 728-0070

REVISIONS

NO.	DATE	DESCRIPTION
1.	[illegible]	PRELIM. DREDGE LAYOUT
2.	11/14/08	BID SET
3.	1/[illegible]	RE-BID

THESE DRAWINGS PREPARED BY APEX FOR THIS PROJECT ARE INSTRUMENTS OF APEX'S SERVICE FOR USE SOLELY WITH RESPECT TO THIS PROJECT, AND APEX SHALL BE DEEMED THE AUTHOR OF THE DRAWING AND SHALL RETAIN ALL COMMON LAW, STATUTORY AND OTHER RESERVED RIGHTS WITH RESPECT THERETO, INCLUDING COPYRIGHT. THE DOCUMENTS SHALL NOT BE USED ON OTHER PROJECTS, FOR ADDITIONS TO THIS PROJECT OR FOR COMPLETION OF THIS PROJECT BY OTHERS, EXCEPT BY AGREEMENT IN WRITING AND WITH APPROPRIATE COMPENSATION TO APEX.

PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE - PHASE III, PART A & B

PREPARED FOR:

THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

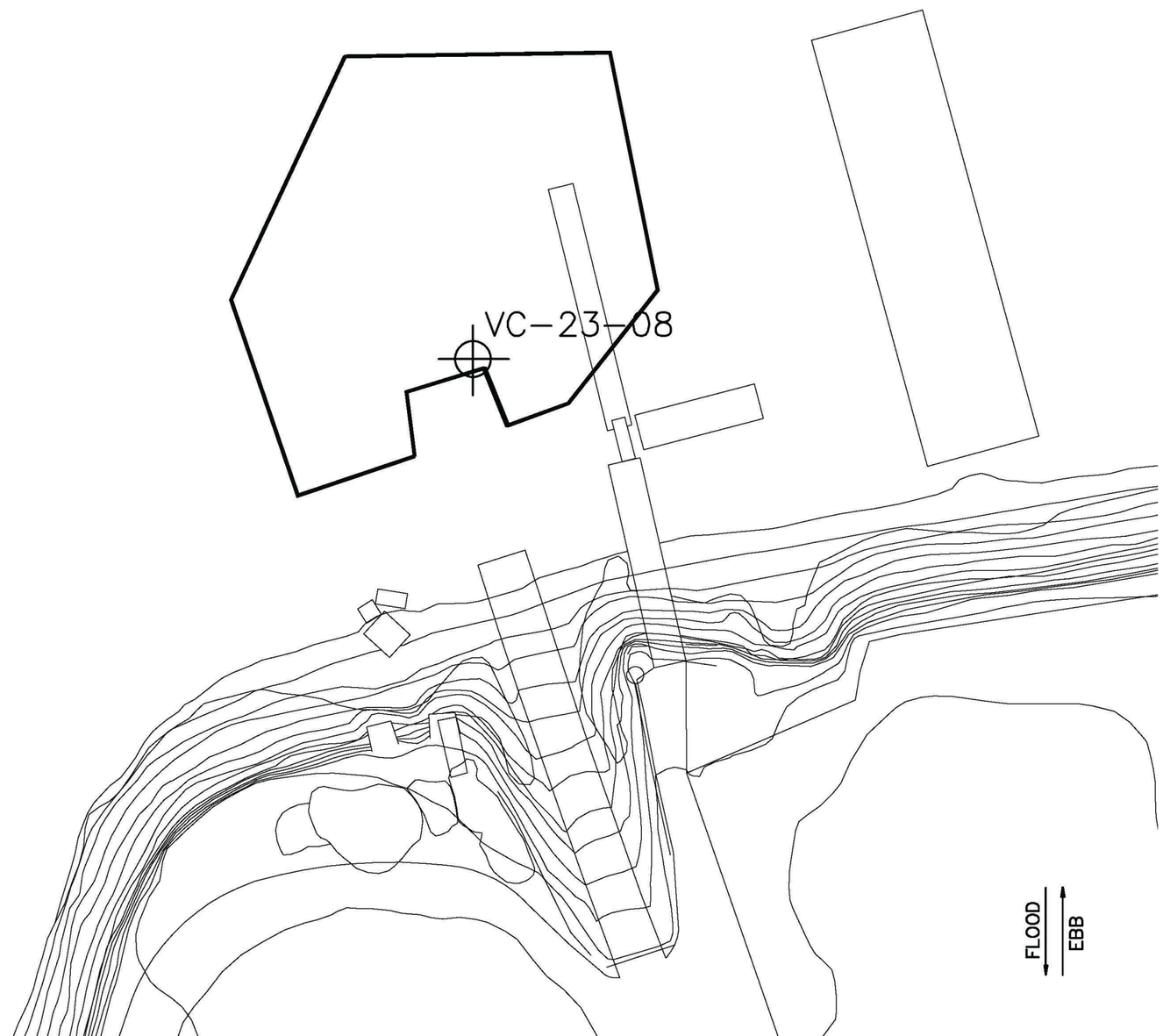
DRAWING TITLE:

LINBERG DREDGE AREAS- VIBRACORE AND BORING LOCATION SHEET

NOT FOR CONSTRUCTION

Scale: 0 20 40 80 100 FEET

Date 9/5/08	Drawing No.
Proj. Mgr. JAB	
Design GCD	
Check CM	V–5
Drawn GCD	
Job. No. 6615	
Last Rev. 10/30/08	



NOTES

1. COORDINATES SHOWN ARE IN THE STATE PLANE COORDINATE SYSTEM, MASSACHUSETTS MAINLAND ZONE 2001, REFERENCED TO THE 1983 NORTH AMERICAN DATUM.

2. HYDROGRAPHIC SURVEY IS A COMPILATION OF SURVEYS PREFORMED BETWEEN 6-11-08 AND 11-6-08.

3. HYDROGRAPHIC SURVEY DATUM IS REFERENCED TO MEAN LOWER LOW WATER (MLLW) ON THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL OCEAN SERVICE TIDAL BENCHMARK BM7684 J 1977 - SURVEY DISK SET FLUSH IN THE SURFACE OF A CONCRETE SIDEWALK ON THE SOUTH SIDE OF U.S.HIGHWAY 6 ON THE NORTH SIDE OF THE MOBIL SERVICE STATION, 4 FEET (1 M) WEST OF A FIRE HYDRANT AND 1 FOOT (0.3 M) SOUTH OF U.S. HIGHWAY 6. DATUM SEPARATIONS WERE COMPUTED BY DOLER, AND COLANTONIO, INC. FEBRUARY 2002 AS MLLW - 1.62 FT = NGVD29 0.0 FT. TO OBTAIN VALUES IN NGVD29, SUBTRACT 1.62 FEET FROM THE INDICATED VALUE AT ANY POINT. HORIZONTAL CONTROL CAN BE OBTAINED FROM THE ENGINEER.

4. BASE PLAN FOR THIS FIGURE OBTAINED FROM U.S. ARMY CORPS OF ENGINEERS. EXISTING CONDITIONS SHALL BE FIELD VERIFIED BY THE CONTRACTOR.

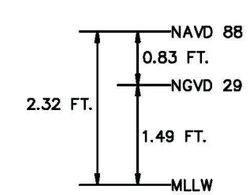
5. HORIZONTAL AND VERTICAL CONTROL HAVE BEEN PROVIDED BY THE OWNER AND HAVE NOT BEEN INDEPENDENTLY VERIFIED. THE CONTRACTOR IS RESPONSIBLE FOR FIELD VERIFICATION OF CONTROL DATA.

6. THE INFORMATION DEPICTED ON THIS DRAWING REPRESENTS THE RESULTS OF SURVEYS MADE ON THE DATES INDICATED ABOVE AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS AT THE TIME OF THE SURVEYS AND AT THE SOUNDING POINTS NOTED ON THE DRAWING.

312 VIBRACORE LOCATION

312 BORING LOCATION

GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



Apex Companies, LLC.
115 BROAD STREET
SUITE 200
BOSTON MA 02110
(617) 728-0070

REVISIONS

NO.	DATE	DESCRIPTION
1.	6/26/08	PRELIM. DREDGE LAYOUT
2.	11/14/08	BID SET
3.	1/19/09	RE-BID

THESE DRAWINGS PREPARED BY APEX FOR THIS PROJECT ARE INSTRUMENTS OF APEX'S SERVICE FOR USE SOLELY WITH RESPECT TO THIS PROJECT, AND APEX SHALL BE DEEMED THE AUTHOR OF THE DRAWING AND SHALL RETAIN ALL COMMON LAW, STATUTORY AND OTHER RESERVED RIGHTS WITH RESPECT THERETO, INCLUDING COPYRIGHT. THE DOCUMENTS SHALL NOT BE USED ON OTHER PROJECTS, FOR ADDITIONS TO THIS PROJECT OR FOR COMPLETION OF THIS PROJECT BY OTHERS, EXCEPT BY AGREEMENT IN WRITING AND WITH APPROPRIATE COMPENSATION TO APEX.

PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE - PHASE III, PART A & B

PREPARED FOR:

THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

DRAWING TITLE:

NIEMEC MARINE DREDGE AREA- VIBRACORE AND BORING LOCATION SHEET

NOT FOR CONSTRUCTION

Scale: 0 10 20 40 80 FEET

Date 9/5/08	Drawing No.
Proj. Mgr. JAB	
Design GCD	
Check CM	V-6
Drawn GCD	
Job. No. 6615	
Last Rev. 10/30/08	

NOTES

1. COORDINATES SHOWN ARE IN THE STATE PLANE COORDINATE SYSTEM, MASSACHUSETTS MAINLAND ZONE 2001, REFERENCED TO THE 1983 NORTH AMERICAN DATUM.

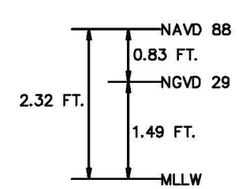
2. BASE PLAN FOR THIS FIGURE OBTAINED FROM U.S. ARMY CORPS OF ENGINEERS. EXISTING CONDITIONS SHALL BE FIELD VERIFIED BY THE CONTRACTOR.

3. HORIZONTAL AND VERTICAL CONTROL HAVE BEEN PROVIDED BY THE OWNER AND HAVE NOT BEEN INDEPENDENTLY VERIFIED. THE CONTRACTOR IS RESPONSIBLE FOR FIELD VERIFICATION OF CONTROL DATA.

VC-07-08 — PRE DREDGE SAMPLE LOCATION

POST_012010_G1 — POST DREDGE SAMPLE LOCATION

GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



Apex Companies, LLC.

184 High Street
Suite 502
Boston, MA. 02110
(617) 728-0070

REVISIONS

NO.	DATE	DESCRIPTION
1.	6/8/09	PRELIM. DREDGE LAYOUT
2.	11/14/09	BID SET
3.	1/18/10	RE-BID
4.	1/22/10	POST-DREDGE SAMPLES

THESE DRAWINGS PREPARED BY APEX FOR THIS PROJECT ARE INSTRUMENTS OF APEX'S SERVICE FOR USE SOLELY WITH RESPECT TO THIS PROJECT, AND APEX SHALL BE DEEMED THE AUTHOR OF THE DRAWING AND SHALL RETAIN ALL COMMON LAW, STATUTORY AND OTHER RESERVED RIGHTS WITH RESPECT THERETO, INCLUDING COPYRIGHT. THE DOCUMENTS SHALL NOT BE USED ON OTHER PROJECTS, FOR ADDITIONS TO THIS PROJECT OR FOR COMPLETION OF THIS PROJECT BY OTHERS, EXCEPT BY AGREEMENT IN WRITING AND WITH APPROPRIATE COMPENSATION TO APEX.

PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE - PHASE III, PART A & B

PREPARED FOR:

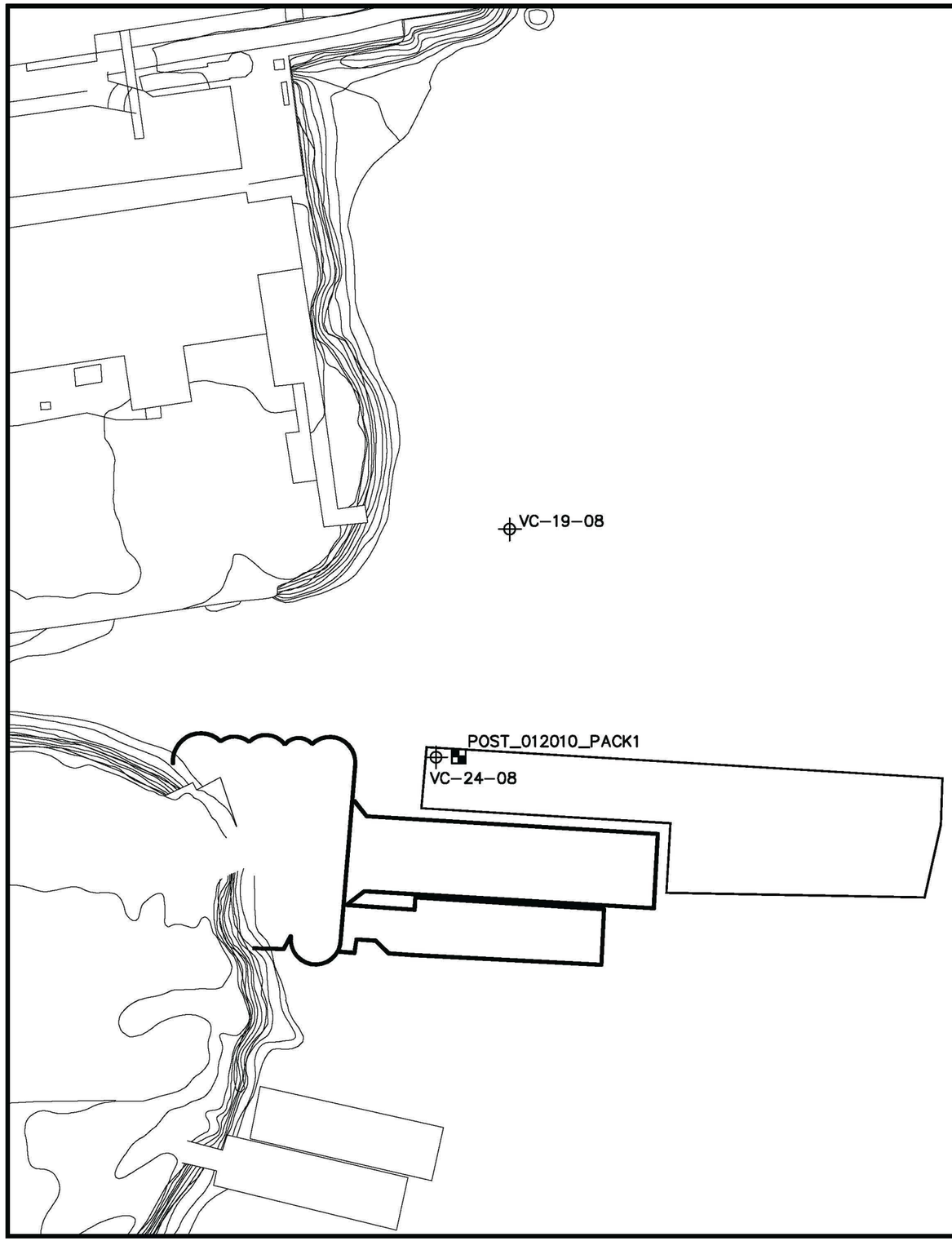
THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

DRAWING TITLE:

OLDE NORTH WHARF FISHERIES DREDGE AREAS PRE AND POST DREDGE SAMPLING LOCATIONS NOT FOR CONSTRUCTION

Scale: 0 10 20 40 50 FEET

Date 9/5/08	Drawing No.
Proj. Mgr. JAB	
Design GCD	
Check CM	V-7
Drawn GCD	
Job. No. 6615	
Last Rev. 1/22/10	



NOTES

1. COORDINATES SHOWN ARE IN THE STATE PLANE COORDINATE SYSTEM, MASSACHUSETTS MAINLAND ZONE 2001, REFERENCED TO THE 1983 NORTH AMERICAN DATUM.

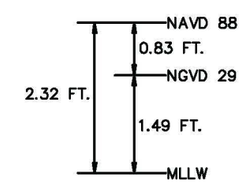
2. BASE PLAN FOR THIS FIGURE OBTAINED FROM U.S. ARMY CORPS OF ENGINEERS. EXISTING CONDITIONS SHALL BE FIELD VERIFIED BY THE CONTRACTOR.

3. HORIZONTAL AND VERTICAL CONTROL HAVE BEEN PROVIDED BY THE OWNER AND HAVE NOT BEEN INDEPENDENTLY VERIFIED. THE CONTRACTOR IS RESPONSIBLE FOR FIELD VERIFICATION OF CONTROL DATA.

VC-07-08 — PRE DREDGE SAMPLE LOCATION

POST_012010_G1 — POST DREDGE SAMPLE LOCATION

GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



EBB FLOOD

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184 HIGH STREET
SUITE 502
BOSTON, MA. 02110
(617) 728-0370

REVISIONS

NO.	DATE	DESCRIPTION
1.	6/8/09	PRELIM. DREDGE LAYOUT
2.	11/14/09	IND SET
3.	1/18/09	RE-IND
4.	1/22/10	POST-DREDGE SAMPLES

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PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE - PHASE III, PART A & B

PREPARED FOR:

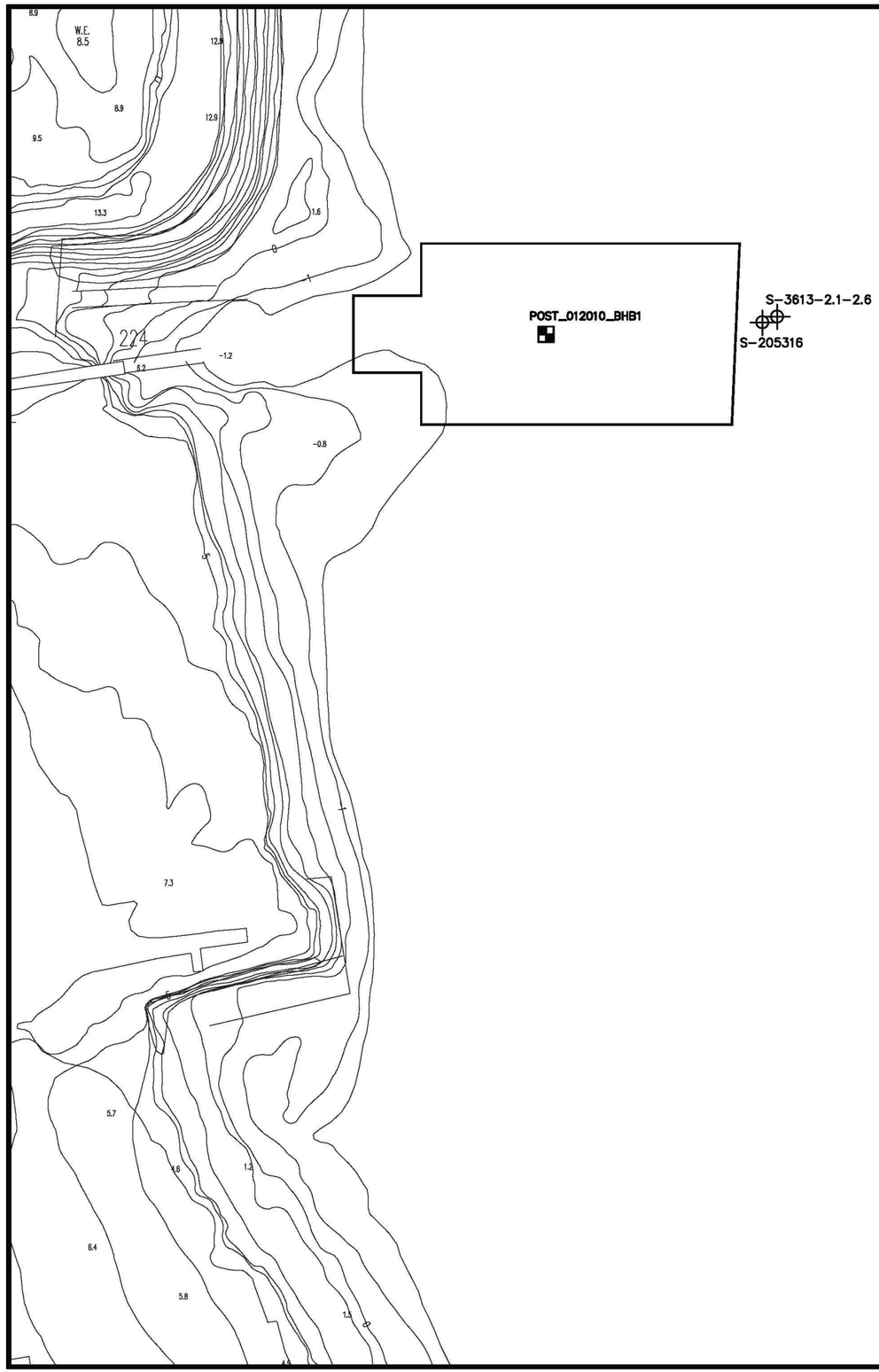
THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

DRAWING TITLE:

PACKER FUEL & MAR-LEES DREDGE AREAS PRE AND POST DREDGE SAMPLING LOCATIONS NOT FOR CONSTRUCTION

Scale: 0 20 40 80 100 FEET

Date 9/5/08	Drawing No.
Proj. Mgr. JAB	
Design GCD	
Check CM	V–8
Drawn GCD	
Job. No. 6615	
Last Rev. 1/22/10	



FLOOD
EBB

NOTES

1. COORDINATES SHOWN ARE IN THE STATE PLANE COORDINATE SYSTEM, MASSACHUSETTS MAINLAND ZONE 2001, REFERENCED TO THE 1983 NORTH AMERICAN DATUM.

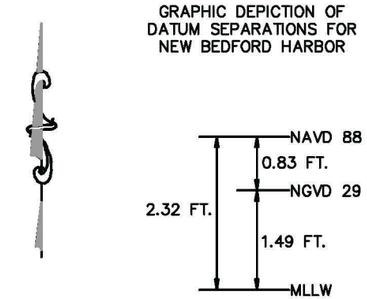
2. BASE PLAN FOR THIS FIGURE OBTAINED FROM U.S. ARMY CORPS OF ENGINEERS. EXISTING CONDITIONS SHALL BE FIELD VERIFIED BY THE CONTRACTOR.

3. HORIZONTAL AND VERTICAL CONTROL HAVE BEEN PROVIDED BY THE OWNER AND HAVE NOT BEEN INDEPENDENTLY VERIFIED. THE CONTRACTOR IS RESPONSIBLE FOR FIELD VERIFICATION OF CONTROL DATA.

VC-07-08 — PRE DREDGE SAMPLE LOCATION

POST_012010_G1 — POST DREDGE SAMPLE LOCATION

GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



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104 HIGH STREET
SUITE 202
BOSTON, MA. 02110
(617) 728-5670

REVISIONS

NO.	DATE	DESCRIPTION
1.	9/28/09	PRELIM. DREDGE LAYOUT
2.	11/14/09	BID SET
3.	1/19/09	RE-BID
4.	1/22/10	POST-DREDGE SAMPLES

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PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE - PHASE III, PART A & B

PREPARED FOR:

THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

DRAWING TITLE:

NEW BEDFORD ROWING FACILITY DREDGE AREA PRE AND POST DREDGE SAMPLING LOCATIONS NOT FOR CONSTRUCTION

Scale: 0 20 40 80 100 FEET

Date 9/5/08	Drawing No.
Proj. Mgr. JAB	
Design GCD	
Check CM	V-9
Drawn GCD	
Job. No. 6615	
Last Rev. 1/22/10	

APPENDIX A
SEDIMENT ANALYTICAL DATA

ANALYTICAL REPORT

Prepared for:
Apex Environmental, Inc.
286 Congress Street
Suite 610
Boston, MA 02210

Project:	New Bedford Harbor
ETR:	0610188
Report Date:	December 01, 2006

Certifications and Accreditations
Massachusetts MA030
Connecticut PH-0141
New Hampshire 220602
Rhode Island 64
New Jersey MA015
Maine MA030
New York 11627
Louisiana 03090
Army Corps of Engineers
Department of the Navy
Florida E87814

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375 Paramount Drive, Suite 2, Raynham, Massachusetts 02767, (508) 822-9300, Fax (508) 822-3288

Sample ID Cross Reference

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**

Lab Code: **MA00030**
ETR: **0610188**

Lab Sample ID	Client Sample ID
0610188-02	301 0-1
0610188-03	302 0-1
0610188-04	303 0-1
0610188-06	304 0-1
0610188-08	305 0-1
0610188-09	306 0-1
0610188-11	307A 0-1
0610188-13	308 0-1
0610188-15	309 0-1
0610188-16	310 0-1
0610188-18	329 0-1
0610188-19	332A 0-1
0610188-20	330 0-1

Gaps in Lab Sample IDs are indicative of samples not analyzed per client request.

CASE NARRATIVE
Alpha Woods Hole Labs

ETR: 0610188
Project: New Bedford Harbor

All analyses were performed according to Alpha Woods Hole Labs quality assurance program and documented Standard Operating Procedures (SOPs). The analytical results contained in this report were performed within holding time, and with appropriate quality control measures, except where noted. A summary of all state and federal accreditations is provided within this report. Blank correction of results is not performed in the laboratory for any parameter. Soil/sediment samples are reported on a dry weight basis unless otherwise noted. Air and sediment samples are either not certifiable under the NELAC and/or are not currently held as accredited matrices.

Sample Receipt

1. Samples were frozen upon receipt, extending the extraction holding time.

Polychlorinated Biphenyls by GC/MS

1. Several target congeners analyzed by this method co-elute with non-target congeners and are therefore reported as a co-eluting pair. Refer to the individual report forms.

2. The initial analysis of several samples had concentrations that exceeded the calibration range of the instrument. These samples were reanalyzed at dilution and both analyses are reported. Refer to the individual report forms for dilution requirements.

Extractable Petroleum Hydrocarbons by GC/FID

1. All data quality objectives were met.

The enclosed results of analyses are representative of the samples as received by the laboratory. Alpha Woods Hole Labs makes no representations or certifications as to the method of sample collection, sample identification, or transporting/handling procedures used prior to the receipt of samples by Alpha Woods Hole Labs. To the best of my knowledge, the information contained in this report is accurate and complete.

Approved by: Nancy a Rose Title: Project Manager Date: 11/30/06

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **301 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **0610188-02**
Associated Blank: **SS111506B08**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/23/06	10/27/06	11/15/06	11/28/06	79.1	5.36	2	1	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**5.4**
Cl3-BZ#18	**12**
Cl3-BZ#28/#31[1]	**68**
Cl4-BZ#44	**16**
Cl4-BZ#52	**42**
Cl4-BZ#43/#49[1]	**41**
Cl4-BZ#66	**29**
Cl5-BZ#101/#84[1]	**49**
Cl5-BZ#87	**11**
Cl7-BZ#184	0.24 U
Cl5-BZ#105	**13**
Cl5-BZ#118	**41**
Cl7-BZ#183	**1.4**
Cl6-BZ#167/#128[1]	**7.7**
Cl6-BZ#138/#163[1]	**31**
Cl6-BZ#153	**30**
Cl7-BZ#170/#190[1]	**3.0**
Cl7-BZ#180	**4.5**
Cl7-BZ#182/#187[1]	**3.4**
Cl8-BZ#195	**0.38**
Cl9-BZ#206	**0.43**
Cl10-BZ#209	0.24 U

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	82	50-125
Cl8-BZ#202-C13	81	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

11/30/06 13:03

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **302 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **0610188-03**
Associated Blank: **SS111506B08**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/23/06	10/27/06	11/15/06	11/28/06	59.4	5.63	2	1	TLW

Parameter	Result	
Cl2-BZ#5/#8[1]	**46**	
Cl3-BZ#18	**98**	
Cl3-BZ#28/#31[1]	**730**	E
Cl4-BZ#44	**140**	
Cl4-BZ#52	**320**	E
Cl4-BZ#43/#49[1]	**400**	
Cl4-BZ#66	**350**	E
Cl5-BZ#101/#84[1]	**480**	E
Cl5-BZ#87	**85**	
Cl7-BZ#184	0.30	U
Cl5-BZ#105	**110**	
Cl5-BZ#118	**440**	E
Cl7-BZ#183	**13**	
Cl6-BZ#167/#128[1]	**67**	
Cl6-BZ#138/#163[1]	**280**	
Cl6-BZ#153	**320**	E
Cl7-BZ#170/#190[1]	**28**	
Cl7-BZ#180	**42**	
Cl7-BZ#182/#187[1]	**34**	
Cl8-BZ#195	**3.7**	
Cl9-BZ#206	**4.2**	
Cl10-BZ#209	**1.7**	

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	73	50-125
Cl8-BZ#202-C13	77	50-125

N/A - Not Applicable
E - Estimated value, exceeds the upper limit of calibration.
U - The analyte was analyzed for but not detected at the sample specific level reported.

11/30/06 13:03

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **302 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **0610188-03E**
Associated Blank: **SS111506B08**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/23/06	10/27/06	11/15/06	11/28/06	59.4	5.63	2	5	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**44**
Cl3-BZ#18	**90**
Cl3-BZ#28/#31[1]	**670**
Cl4-BZ#44	**130**
Cl4-BZ#52	**290**
Cl4-BZ#43/#49[1]	**360**
Cl4-BZ#66	**310**
Cl5-BZ#101/#84[1]	**450**
Cl5-BZ#87	**81**
Cl7-BZ#184	1.5 U
Cl5-BZ#105	**100**
Cl5-BZ#118	**410**
Cl7-BZ#183	**15**
Cl6-BZ#167/#128[1]	**65**
Cl6-BZ#138/#163[1]	**270**
Cl6-BZ#153	**310**
Cl7-BZ#170/#190[1]	**26**
Cl7-BZ#180	**43**
Cl7-BZ#182/#187[1]	**38**
Cl8-BZ#195	**4.9**
Cl9-BZ#206	**5.1**
Cl10-BZ#209	**3.0**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	85	50-125
Cl8-BZ#202-C13	96	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

11/30/06 13:06

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **303 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **0610188-04**
Associated Blank: **SS111506B08**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/23/06	10/27/06	11/15/06	11/28/06	38.5	5.89	2	1	TLW

Parameter	Result	
Cl2-BZ#5/#8[1]	**82**	
Cl3-BZ#18	**160**	
Cl3-BZ#28/#31[1]	**1500**	E
Cl4-BZ#44	**230**	
Cl4-BZ#52	**580**	E
Cl4-BZ#43/#49[1]	**840**	E
Cl4-BZ#66	**680**	E
Cl5-BZ#101/#84[1]	**1000**	E
Cl5-BZ#87	**190**	
Cl7-BZ#184	0.44	U
Cl5-BZ#105	**260**	
Cl5-BZ#118	**980**	E
Cl7-BZ#183	**31**	
Cl6-BZ#167/#128[1]	**150**	
Cl6-BZ#138/#163[1]	**650**	
Cl6-BZ#153	**730**	E
Cl7-BZ#170/#190[1]	**67**	
Cl7-BZ#180	**100**	
Cl7-BZ#182/#187[1]	**82**	
Cl8-BZ#195	**11**	
Cl9-BZ#206	**11**	
Cl10-BZ#209	**4.6**	

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	82	50-125
Cl8-BZ#202-C13	84	50-125

N/A - Not Applicable
E - Estimated value, exceeds the upper limit of calibration.
U - The analyte was analyzed for but not detected at the sample specific level reported.

11/30/06 13:03

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **303 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **0610188-04E**
Associated Blank: **SS111506B08**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/23/06	10/27/06	11/15/06	11/28/06	38.5	5.89	2	5	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**81**
Cl3-BZ#18	**150**
Cl3-BZ#28/#31[1]	**1500**
Cl4-BZ#44	**230**
Cl4-BZ#52	**570**
Cl4-BZ#43/#49[1]	**820**
Cl4-BZ#66	**660**
Cl5-BZ#101/#84[1]	**1000**
Cl5-BZ#87	**220**
Cl7-BZ#184	2.2 U
Cl5-BZ#105	**260**
Cl5-BZ#118	**970**
Cl7-BZ#183	**32**
Cl6-BZ#167/#128[1]	**160**
Cl6-BZ#138/#163[1]	**650**
Cl6-BZ#153	**740**
Cl7-BZ#170/#190[1]	**67**
Cl7-BZ#180	**100**
Cl7-BZ#182/#187[1]	**84**
Cl8-BZ#195	**10**
Cl9-BZ#206	**11**
Cl10-BZ#209	**6.4**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	86	50-125
Cl8-BZ#202-C13	96	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

11/30/06 13:06

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **304 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **0610188-06**
Associated Blank: **SS111506B08**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/23/06	10/27/06	11/15/06	11/28/06	50.8	5.85	2	1	TLW

Parameter	Result	
Cl2-BZ#5/#8[1]	**52**	
Cl3-BZ#18	**170**	
Cl3-BZ#28/#31[1]	**700**	E
Cl4-BZ#44	**210**	
Cl4-BZ#52	**400**	E
Cl4-BZ#43/#49[1]	**330**	
Cl4-BZ#66	**340**	E
Cl5-BZ#101/#84[1]	**810**	E
Cl5-BZ#87	**260**	
Cl7-BZ#184	0.34	U
Cl5-BZ#105	**250**	
Cl5-BZ#118	**650**	E
Cl7-BZ#183	**20**	
Cl6-BZ#167/#128[1]	**120**	
Cl6-BZ#138/#163[1]	**520**	
Cl6-BZ#153	**410**	E
Cl7-BZ#170/#190[1]	**45**	
Cl7-BZ#180	**67**	
Cl7-BZ#182/#187[1]	**38**	
Cl8-BZ#195	**5.8**	
Cl9-BZ#206	**6.6**	
Cl10-BZ#209	**5.6**	

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	83	50-125
Cl8-BZ#202-C13	87	50-125

N/A - Not Applicable
E - Estimated value, exceeds the upper limit of calibration.
U - The analyte was analyzed for but not detected at the sample specific level reported.

11/30/06 13:03

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **304 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **0610188-06E**
Associated Blank: **SS111506B08**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/23/06	10/27/06	11/15/06	11/28/06	50.8	5.85	2	5	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**51**
Cl3-BZ#18	**160**
Cl3-BZ#28/#31[1]	**660**
Cl4-BZ#44	**200**
Cl4-BZ#52	**380**
Cl4-BZ#43/#49[1]	**320**
Cl4-BZ#66	**320**
Cl5-BZ#101/#84[1]	**780**
Cl5-BZ#87	**250**
Cl7-BZ#184	1.7 U
Cl5-BZ#105	**240**
Cl5-BZ#118	**610**
Cl7-BZ#183	**20**
Cl6-BZ#167/#128[1]	**120**
Cl6-BZ#138/#163[1]	**500**
Cl6-BZ#153	**390**
Cl7-BZ#170/#190[1]	**46**
Cl7-BZ#180	**65**
Cl7-BZ#182/#187[1]	**40**
Cl8-BZ#195	**7.9**
Cl9-BZ#206	**6.6**
Cl10-BZ#209	**3.9**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	86	50-125
Cl8-BZ#202-C13	86	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

11/30/06 13:06

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **305 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **0610188-08**
Associated Blank: **SS111506B08**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/23/06	10/27/06	11/15/06	11/28/06	38.8	5.66	2	1	TLW

Parameter	Result	
Cl2-BZ#5/#8[1]	**81**	
Cl3-BZ#18	**130**	
Cl3-BZ#28/#31[1]	**1200**	E
Cl4-BZ#44	**180**	
Cl4-BZ#52	**460**	E
Cl4-BZ#43/#49[1]	**670**	
Cl4-BZ#66	**560**	E
Cl5-BZ#101/#84[1]	**880**	E
Cl5-BZ#87	**190**	
Cl7-BZ#184	0.46	U
Cl5-BZ#105	**240**	
Cl5-BZ#118	**840**	E
Cl7-BZ#183	**28**	
Cl6-BZ#167/#128[1]	**140**	
Cl6-BZ#138/#163[1]	**580**	
Cl6-BZ#153	**630**	E
Cl7-BZ#170/#190[1]	**57**	
Cl7-BZ#180	**90**	
Cl7-BZ#182/#187[1]	**70**	
Cl8-BZ#195	**5.8**	
Cl9-BZ#206	**8.6**	
Cl10-BZ#209	**3.0**	

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	77	50-125
Cl8-BZ#202-C13	77	50-125

N/A - Not Applicable
E - Estimated value, exceeds the upper limit of calibration.
U - The analyte was analyzed for but not detected at the sample specific level reported.

375 Paramount Drive, Suite 2, Raynham, Massachusetts 02767, (508) 822-9300, Fax (508) 822-3288

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ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **305 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **0610188-08E**
Associated Blank: **SS111506B08**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/23/06	10/27/06	11/15/06	11/28/06	38.8	5.66	2	5	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**78**
Cl3-BZ#18	**130**
Cl3-BZ#28/#31[1]	**1200**
Cl4-BZ#44	**180**
Cl4-BZ#52	**450**
Cl4-BZ#43/#49[1]	**660**
Cl4-BZ#66	**540**
Cl5-BZ#101/#84[1]	**880**
Cl5-BZ#87	**190**
Cl7-BZ#184	2.3 U
Cl5-BZ#105	**230**
Cl5-BZ#118	**830**
Cl7-BZ#183	**27**
Cl6-BZ#167/#128[1]	**140**
Cl6-BZ#138/#163[1]	**580**
Cl6-BZ#153	**630**
Cl7-BZ#170/#190[1]	**59**
Cl7-BZ#180	**90**
Cl7-BZ#182/#187[1]	**73**
Cl8-BZ#195	**13**
Cl9-BZ#206	**8.3**
Cl10-BZ#209	**3.1**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	85	50-125
Cl8-BZ#202-C13	93	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

11/30/06 13:06

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **306 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **0610188-09**
Associated Blank: **SS111506B08**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/23/06	10/27/06	11/15/06	11/28/06	50.1	5.68	2	1	TLW

Parameter	Result	
Cl2-BZ#5/#8[1]	**63**	
Cl3-BZ#18	**120**	
Cl3-BZ#28/#31[1]	**1100**	E
Cl4-BZ#44	**200**	
Cl4-BZ#52	**450**	E
Cl4-BZ#43/#49[1]	**560**	E
Cl4-BZ#66	**620**	E
Cl5-BZ#101/#84[1]	**820**	E
Cl5-BZ#87	**180**	
Cl7-BZ#184	0.35	U
Cl5-BZ#105	**230**	
Cl5-BZ#118	**770**	E
Cl7-BZ#183	**24**	
Cl6-BZ#167/#128[1]	**120**	
Cl6-BZ#138/#163[1]	**520**	
Cl6-BZ#153	**530**	E
Cl7-BZ#170/#190[1]	**54**	
Cl7-BZ#180	**79**	
Cl7-BZ#182/#187[1]	**59**	
Cl8-BZ#195	**6.7**	
Cl9-BZ#206	**7.3**	
Cl10-BZ#209	**4.0**	

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	81	50-125
Cl8-BZ#202-C13	87	50-125

N/A - Not Applicable
E - Estimated value, exceeds the upper limit of calibration.
U - The analyte was analyzed for but not detected at the sample specific level reported.

375 Paramount Drive, Suite 2, Raynham, Massachusetts 02767, (508) 822-9300, Fax (508) 822-3288

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ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **306 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **0610188-09E**
Associated Blank: **SS111506B08**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/23/06	10/27/06	11/15/06	11/28/06	50.1	5.68	2	5	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**62**
Cl3-BZ#18	**130**
Cl3-BZ#28/#31[1]	**1100**
Cl4-BZ#44	**210**
Cl4-BZ#52	**450**
Cl4-BZ#43/#49[1]	**570**
Cl4-BZ#66	**620**
Cl5-BZ#101/#84[1]	**840**
Cl5-BZ#87	**180**
Cl7-BZ#184	1.8 U
Cl5-BZ#105	**220**
Cl5-BZ#118	**760**
Cl7-BZ#183	**26**
Cl6-BZ#167/#128[1]	**130**
Cl6-BZ#138/#163[1]	**520**
Cl6-BZ#153	**540**
Cl7-BZ#170/#190[1]	**51**
Cl7-BZ#180	**80**
Cl7-BZ#182/#187[1]	**60**
Cl8-BZ#195	**6.8**
Cl9-BZ#206	**5.6**
Cl10-BZ#209	**4.8**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	89	50-125
Cl8-BZ#202-C13	97	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

11/30/06 13:06

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **307A 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **0610188-11**
Associated Blank: **SS111506B08**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/23/06	10/27/06	11/15/06	11/28/06	57.7	5.60	2	1	TLW

Parameter	Result	
Cl2-BZ#5/#8[1]	**87**	
Cl3-BZ#18	**300**	E
Cl3-BZ#28/#31[1]	**1500**	E
Cl4-BZ#44	**370**	E
Cl4-BZ#52	**570**	E
Cl4-BZ#43/#49[1]	**620**	E
Cl4-BZ#66	**740**	E
Cl5-BZ#101/#84[1]	**920**	E
Cl5-BZ#87	**270**	E
Cl7-BZ#184	0.31	U
Cl5-BZ#105	**290**	E
Cl5-BZ#118	**760**	E
Cl7-BZ#183	**29**	
Cl6-BZ#167/#128[1]	**130**	
Cl6-BZ#138/#163[1]	**540**	E
Cl6-BZ#153	**460**	E
Cl7-BZ#170/#190[1]	**54**	
Cl7-BZ#180	**100**	
Cl7-BZ#182/#187[1]	**66**	
Cl8-BZ#195	**9.2**	
Cl9-BZ#206	**19**	
Cl10-BZ#209	**3.8**	

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	81	50-125
Cl8-BZ#202-C13	86	50-125

N/A - Not Applicable
E - Estimated value, exceeds the upper limit of calibration.
U - The analyte was analyzed for but not detected at the sample specific level reported.

11/30/06 13:04

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **307A 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **0610188-11E**
Associated Blank: **SS111506B08**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/23/06	10/27/06	11/15/06	11/28/06	57.7	5.60	2	5	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**82**
Cl3-BZ#18	**280**
Cl3-BZ#28/#31[1]	**1400**
Cl4-BZ#44	**360**
Cl4-BZ#52	**550**
Cl4-BZ#43/#49[1]	**590**
Cl4-BZ#66	**710**
Cl5-BZ#101/#84[1]	**890**
Cl5-BZ#87	**260**
Cl7-BZ#184	1.6 U
Cl5-BZ#105	**270**
Cl5-BZ#118	**710**
Cl7-BZ#183	**29**
Cl6-BZ#167/#128[1]	**120**
Cl6-BZ#138/#163[1]	**510**
Cl6-BZ#153	**440**
Cl7-BZ#170/#190[1]	**52**
Cl7-BZ#180	**97**
Cl7-BZ#182/#187[1]	**64**
Cl8-BZ#195	**11**
Cl9-BZ#206	**18**
Cl10-BZ#209	**4.3**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	90	50-125
Cl8-BZ#202-C13	89	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

11/30/06 13:07

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **308 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **0610188-13**
Associated Blank: **SS111506B08**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/23/06	10/27/06	11/15/06	11/28/06	71.1	5.88	2	1	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**14**
Cl3-BZ#18	**33**
Cl3-BZ#28/#31[1]	**190**
Cl4-BZ#44	**39**
Cl4-BZ#52	**84**
Cl4-BZ#43/#49[1]	**94**
Cl4-BZ#66	**84**
Cl5-BZ#101/#84[1]	**120**
Cl5-BZ#87	**32**
Cl7-BZ#184	0.24 U
Cl5-BZ#105	**36**
Cl5-BZ#118	**110**
Cl7-BZ#183	**4.1**
Cl6-BZ#167/#128[1]	**20**
Cl6-BZ#138/#163[1]	**80**
Cl6-BZ#153	**80**
Cl7-BZ#170/#190[1]	**8.3**
Cl7-BZ#180	**12**
Cl7-BZ#182/#187[1]	**9.6**
Cl8-BZ#195	**1.1**
Cl9-BZ#206	**1.6**
Cl10-BZ#209	**1.1**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	86	50-125
Cl8-BZ#202-C13	90	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

11/30/06 13:04

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **309 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **0610188-15**
Associated Blank: **SS111506B08**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/24/06	10/27/06	11/15/06	11/28/06	70.1	5.37	2	1	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**26**
Cl3-BZ#18	**57**
Cl3-BZ#28/#31[1]	**330**
Cl4-BZ#44	**73**
Cl4-BZ#52	**160**
Cl4-BZ#43/#49[1]	**180**
Cl4-BZ#66	**140**
Cl5-BZ#101/#84[1]	**240**
Cl5-BZ#87	**61**
Cl7-BZ#184	0.27 U
Cl5-BZ#105	**65**
Cl5-BZ#118	**200**
Cl7-BZ#183	**7.2**
Cl6-BZ#167/#128[1]	**36**
Cl6-BZ#138/#163[1]	**150**
Cl6-BZ#153	**140**
Cl7-BZ#170/#190[1]	**15**
Cl7-BZ#180	**24**
Cl7-BZ#182/#187[1]	**16**
Cl8-BZ#195	**2.4**
Cl9-BZ#206	**2.8**
Cl10-BZ#209	**2.0**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	82	50-125
Cl8-BZ#202-C13	89	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

11/30/06 13:04

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **310 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **0610188-16**
Associated Blank: **SS111506B08**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/24/06	10/27/06	11/15/06	11/28/06	73.3	5.75	2	1	TLW

Parameter	Result	
Cl2-BZ#5/#8[1]	**85**	
Cl3-BZ#18	**260**	E
Cl3-BZ#28/#31[1]	**1100**	E
Cl4-BZ#44	**280**	E
Cl4-BZ#52	**420**	E
Cl4-BZ#43/#49[1]	**420**	E
Cl4-BZ#66	**460**	E
Cl5-BZ#101/#84[1]	**700**	E
Cl5-BZ#87	**220**	E
Cl7-BZ#184	0.24	U
Cl5-BZ#105	**210**	E
Cl5-BZ#118	**530**	E
Cl7-BZ#183	**19**	
Cl6-BZ#167/#128[1]	**98**	
Cl6-BZ#138/#163[1]	**420**	E
Cl6-BZ#153	**350**	E
Cl7-BZ#170/#190[1]	**42**	
Cl7-BZ#180	**65**	
Cl7-BZ#182/#187[1]	**46**	
Cl8-BZ#195	**6.3**	
Cl9-BZ#206	**5.4**	
Cl10-BZ#209	**2.8**	

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	81	50-125
Cl8-BZ#202-C13	84	50-125

N/A - Not Applicable
E - Estimated value, exceeds the upper limit of calibration.
U - The analyte was analyzed for but not detected at the sample specific level reported.

11/30/06 13:05

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **310 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **0610188-16E**
Associated Blank: **SS111506B08**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/24/06	10/27/06	11/15/06	11/28/06	73.3	5.75	2	5	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**86**
Cl3-BZ#18	**260**
Cl3-BZ#28/#31[1]	**1100**
Cl4-BZ#44	**290**
Cl4-BZ#52	**420**
Cl4-BZ#43/#49[1]	**420**
Cl4-BZ#66	**480**
Cl5-BZ#101/#84[1]	**730**
Cl5-BZ#87	**230**
Cl7-BZ#184	1.2 U
Cl5-BZ#105	**220**
Cl5-BZ#118	**540**
Cl7-BZ#183	**20**
Cl6-BZ#167/#128[1]	**100**
Cl6-BZ#138/#163[1]	**430**
Cl6-BZ#153	**360**
Cl7-BZ#170/#190[1]	**44**
Cl7-BZ#180	**67**
Cl7-BZ#182/#187[1]	**49**
Cl8-BZ#195	**7.6**
Cl9-BZ#206	**5.3**
Cl10-BZ#209	**3.4**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	83	50-125
Cl8-BZ#202-C13	99	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

11/30/06 13:07

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **329 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **0610188-18**
Associated Blank: **SS111506B08**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/23/06	10/27/06	11/15/06	11/28/06	48.6	5.89	2	1	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**49**
Cl3-BZ#18	**92**
Cl3-BZ#28/#31[1]	**600** E
Cl4-BZ#44	**130**
Cl4-BZ#52	**260**
Cl4-BZ#43/#49[1]	**290**
Cl4-BZ#66	**230**
Cl5-BZ#101/#84[1]	**370**
Cl5-BZ#87	**88**
Cl7-BZ#184	0.35 U
Cl5-BZ#105	**98**
Cl5-BZ#118	**310** E
Cl7-BZ#183	**18**
Cl6-BZ#167/#128[1]	**57**
Cl6-BZ#138/#163[1]	**240**
Cl6-BZ#153	**260**
Cl7-BZ#170/#190[1]	**39**
Cl7-BZ#180	**68**
Cl7-BZ#182/#187[1]	**46**
Cl8-BZ#195	**8.4**
Cl9-BZ#206	**7.5**
Cl10-BZ#209	**2.1**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	81	50-125
Cl8-BZ#202-C13	87	50-125

N/A - Not Applicable
E - Estimated value, exceeds the upper limit of calibration.
U - The analyte was analyzed for but not detected at the sample specific level reported.

11/30/06 13:05

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **329 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **0610188-18E**
Associated Blank: **SS111506B08**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/23/06	10/27/06	11/15/06	11/28/06	48.6	5.89	2	2	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**48**
Cl3-BZ#18	**87**
Cl3-BZ#28/#31[1]	**540**
Cl4-BZ#44	**120**
Cl4-BZ#52	**260**
Cl4-BZ#43/#49[1]	**290**
Cl4-BZ#66	**220**
Cl5-BZ#101/#84[1]	**370**
Cl5-BZ#87	**90**
Cl7-BZ#184	0.70 U
Cl5-BZ#105	**97**
Cl5-BZ#118	**310**
Cl7-BZ#183	**18**
Cl6-BZ#167/#128[1]	**57**
Cl6-BZ#138/#163[1]	**240**
Cl6-BZ#153	**260**
Cl7-BZ#170/#190[1]	**37**
Cl7-BZ#180	**69**
Cl7-BZ#182/#187[1]	**46**
Cl8-BZ#195	**7.3**
Cl9-BZ#206	**7.3**
Cl10-BZ#209	**1.7**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	81	50-125
Cl8-BZ#202-C13	84	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

11/30/06 13:05

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **332A 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **0610188-19**
Associated Blank: **SS111506B08**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/23/06	10/27/06	11/15/06	11/28/06	95.9	5.36	2	1	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**1.5**
Cl3-BZ#18	**2.8**
Cl3-BZ#28/#31[1]	**14**
Cl4-BZ#44	**3.9**
Cl4-BZ#52	**7.4**
Cl4-BZ#43/#49[1]	**7.5**
Cl4-BZ#66	**5.4**
Cl5-BZ#101/#84[1]	**11**
Cl5-BZ#87	**3.0**
Cl7-BZ#184	0.19 U
Cl5-BZ#105	**3.0**
Cl5-BZ#118	**8.1**
Cl7-BZ#183	**0.69**
Cl6-BZ#167/#128[1]	**1.9**
Cl6-BZ#138/#163[1]	**7.4**
Cl6-BZ#153	**7.6**
Cl7-BZ#170/#190[1]	**1.2**
Cl7-BZ#180	**2.6**
Cl7-BZ#182/#187[1]	**1.9**
Cl8-BZ#195	**0.74**
Cl9-BZ#206	0.19 U
Cl10-BZ#209	**0.30**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	68	50-125
Cl8-BZ#202-C13	74	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

11/30/06 13:05

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **330 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **0610188-20**
Associated Blank: **SS111506B08**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/23/06	10/27/06	11/15/06	11/28/06	35.3	5.77	2	1	TLW

Parameter	Result	
Cl2-BZ#5/#8[1]	**130**	
Cl3-BZ#18	**290**	
Cl3-BZ#28/#31[1]	**1400**	E
Cl4-BZ#44	**390**	
Cl4-BZ#52	**560**	E
Cl4-BZ#43/#49[1]	**600**	
Cl4-BZ#66	**590**	E
Cl5-BZ#101/#84[1]	**900**	E
Cl5-BZ#87	**250**	
Cl7-BZ#184	0.49	U
Cl5-BZ#105	**260**	
Cl5-BZ#118	**690**	E
Cl7-BZ#183	**57**	
Cl6-BZ#167/#128[1]	**140**	
Cl6-BZ#138/#163[1]	**600**	
Cl6-BZ#153	**570**	E
Cl7-BZ#170/#190[1]	**120**	
Cl7-BZ#180	**220**	
Cl7-BZ#182/#187[1]	**130**	
Cl8-BZ#195	**23**	
Cl9-BZ#206	**21**	
Cl10-BZ#209	**4.8**	

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	67	50-125
Cl8-BZ#202-C13	69	50-125

N/A - Not Applicable
E - Estimated value, exceeds the upper limit of calibration.
U - The analyte was analyzed for but not detected at the sample specific level reported.

11/30/06 13:05

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **330 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **0610188-20E**
Associated Blank: **SS111506B08**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/23/06	10/27/06	11/15/06	11/29/06	35.3	5.77	2	5	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**140**
Cl3-BZ#18	**260**
Cl3-BZ#28/#31[1]	**1300**
Cl4-BZ#44	**340**
Cl4-BZ#52	**600**
Cl4-BZ#43/#49[1]	**620**
Cl4-BZ#66	**600**
Cl5-BZ#101/#84[1]	**930**
Cl5-BZ#87	**260**
Cl7-BZ#184	2.4 U
Cl5-BZ#105	**250**
Cl5-BZ#118	**680**
Cl7-BZ#183	**56**
Cl6-BZ#167/#128[1]	**140**
Cl6-BZ#138/#163[1]	**580**
Cl6-BZ#153	**570**
Cl7-BZ#170/#190[1]	**110**
Cl7-BZ#180	**210**
Cl7-BZ#182/#187[1]	**140**
Cl8-BZ#195	**26**
Cl9-BZ#206	**22**
Cl10-BZ#209	**6.3**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	74	50-125
Cl8-BZ#202-C13	74	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

11/30/06 13:07

Blank
PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **Blank**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **SS111506B08**
Associated Blank: **N/A**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
N/A	N/A	11/15/06	11/27/06	100	5.00	2	1	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	0.40 U
Cl3-BZ#18	0.20 U
Cl3-BZ#28/#31[1]	0.40 U
Cl4-BZ#44	0.20 U
Cl4-BZ#52	0.20 U
Cl4-BZ#43/#49[1]	0.40 U
Cl4-BZ#66	0.20 U
Cl5-BZ#101/#84[1]	0.40 U
Cl5-BZ#87	0.20 U
Cl7-BZ#184	0.20 U
Cl5-BZ#105	0.20 U
Cl5-BZ#118	0.20 U
Cl7-BZ#183	0.20 U
Cl6-BZ#167/#128[1]	0.40 U
Cl6-BZ#138/#163[1]	0.40 U
Cl6-BZ#153	0.20 U
Cl7-BZ#170/#190[1]	0.40 U
Cl7-BZ#180	0.20 U
Cl7-BZ#182/#187[1]	0.40 U
Cl8-BZ#195	0.20 U
Cl9-BZ#206	0.20 U
Cl10-BZ#209	0.20 U

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	83	50-125
Cl8-BZ#202-C13	75	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

375 Paramount Drive, Suite 2, Raynham, Massachusetts 02767, (508) 822-9300, Fax (508) 822-3288

Laboratory Control Summary
PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **Laboratory Control Sample**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **See Below**
Associated Blank: **SS111506B08**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Percent Solid	Analyst
N/A	N/A	11/15/06	100	TLW

Lab ID:	SS111506B08		SS111506LCS05		SS111506LCSD05				
Parameter	**Blank Conc.**		**LCS Conc.**	**LCS % Recovery**	**LCSD Conc.**	**LCSD % Recovery**	**% RPD**	**RPD Limit**	**% Recovery Limits**
Cl2-BZ#5/#8[1]	0.40	U	6.2	78	6.4	79	2	50	40-140
Cl3-BZ#18	0.20	U	6.3	78	6.4	80	2	50	40-140
Cl3-BZ#28/#31[1]	0.40	U	12	76	12	77	1	50	40-140
Cl4-BZ#44	0.20	U	5.6	70	5.8	72	2	50	40-140
Cl4-BZ#52	0.20	U	5.8	73	5.9	74	1	50	40-140
Cl4-BZ#43/#49[1]	0.40	U	6.5	81	6.8	85	4	50	40-140
Cl4-BZ#66	0.20	U	5.2	65	6.0	75	14	50	40-140
Cl5-BZ#101/#84[1]	0.40	U	6.2	77	6.2	78	1	50	40-140
Cl5-BZ#87	0.20	U	4.8	60	4.9	61	1	50	40-140
Cl5-BZ#105	0.20	U	4.8	60	4.7	59	2	50	40-140
Cl5-BZ#118	0.20	U	5.1	63	5.0	62	2	50	40-140
Cl7-BZ#183	0.20	U	5.6	70	5.5	69	0	50	40-140
Cl6-BZ#167/#128[1]	0.40	U	11	66	10	66	1	50	40-140
Cl6-BZ#138/#163[1]	0.40	U	4.4	54	4.4	55	1	50	40-140
Cl6-BZ#153	0.20	U	5.4	68	5.4	68	0	50	40-140
Cl7-BZ#170/#190[1]	0.40	U	4.6	57	4.5	56	2	50	40-140
Cl7-BZ#180	0.20	U	6.4	80	6.6	83	4	50	40-140
Cl7-BZ#182/#187[1]	0.40	U	5.9	74	6.0	75	2	50	40-140
Cl8-BZ#195	0.20	U	5.6	69	5.4	68	2	50	40-140
Cl9-BZ#206	0.20	U	5.5	69	5.6	70	1	50	40-140
Cl10-BZ#209	0.20	U	5.5	68	5.4	68	1	50	40-140

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery		Acceptance Range (%)
Cl3-BZ#19-C13	84	86	50-125
Cl8-BZ#202-C13	82	81	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

Concentrations reported as calculated values, which includes rounding for significant figures. Percent recoveries and RPD values are calculated from the unrounded result.

11/30/06 13:08

PCB Congeners and Homologs by GC/MS-SIM Data Review Checklist

Updated 7/02

ETR #: 0610188
CLIENT: Apex

Method 680 (modified)

Extraction Date:	11/15/2006	Blank ID:	SS111506B08	LCS ID:	SS111506LCS05, LCSD05
Instrument ID:	BNA # 5	ICAL File:			
Analysis Date:	11/27/06	CCV Date & Times:			
DFTPP Date & Times:					

Review Items	N/A	Yes	No	Reason why data reportable? Narrate w/ETR.	2nd Level
A. Tune					
1. Did PFTBA meet the Tune criteria before the ICAL? Did DFTPP meet SW-846 criteria before every CCV? Did DFTPP meet Max. Sensitivity criteria before every CCV?		✓		PFTBA Date(s): *Circle tuning method(s) used (at left).*	✓
B. Initial Calibration Verification					
1. Has an Initial Calibration Checklist been completed for all ICALs? (Note any QC anomalies).		✓		Notes:	✓
2. Was the correct ICAL method used for sample quantitation? (Check *"Quant File ID" and compare w/ Method(s) above*). If wrong, data needs to be reprocessed w/ the correct Method(s) above.		✓			✓
C. Continuing Calibration Verification					
1. Has a CCV Checklist been completed for each Analytical Batch? (Note any QC anomalies).		✓		Notes:	✓
2. Were all samples injected between CCVs that were 12 hours apart *(including ending CCV)*?		✓			✓
D. Sample Results					
1. Was the correct analysis performed? Is all paperwork present? (Check ETR worksheet & comments).		✓		Client will do summation. reported NAA 22 less 1st per Tbl	✓
2. Is the header information correct? (If not, 2nd bring data package back to the Lab for corrections.)		✓			✓ Narrate corrections 11/30/06 DES
3. Sample analyses done within preparation and analytical holding time (HT)? *If No, list samples and reasons:* [Prep.=Aqu.-7 days; Soil -14 days; Analytical = 40 days] Sample(s) / Reason(s) / HT: frozen - thawed 100		✓		1. HT had expired before receipt of sample(s).-*Narrate* 2. Sample received with < 3 days left for extraction. 3. Client requested analysis after HT expired.*-*Narrate* 4. Re-extraction done after HT expired.-*Narrate* 5. Other:	✓
4. Are surrogates within 50-125% R? *If No, list Samples/Surrogates/Reasons:* Sample(s) / Surrogate(s) / Reason(s)		✓		6. Surrogate %R outside QC limits due to matrix effect. MS/MSD surr. %R demonstrated same effect.-*Narrate* 7. Surrogate %R outside QC limits due to matrix effect since re-extraction/re-analysis demonstrated the same effect. ***Report original and Narrate.*** 8. Surrogate %R outside QC limits due to obvious matrix interferences. Explain/*Narrate*: *(Analyst has confirmed w/ Section Head.)* 9. Surrogate %R outside QC limits; however, there wasn't sample left to re-extract. -*Narrate/PM notified.* 10. Surrogate %R outside QC limits; re-extraction outside HT; both sets of data are reported.-*Narrate/PM notified.* 11. Surrogate %R outside QC limits; however, at the client's request, the data were flagged and released without further investigation. *-*Narrate* 12. Surrogates diluted out.	✓
5. Is largest compound diluted to upper half of calibration range? *If no, list sample(s):* Sample(s) / Dilution(s) / Reason(s)		✓		13. At the client's request, the sample was analyzed with minimum dilution even though some compounds were outside of calibration range. *-*Narrate* 14. Largest compound diluted to acceptable concentration based on normal sample dilution volumes. 15. Sample showed matrix inhomogeneity. Duplicate analysis (or Re-extraction) was within calibration range, both analyses are reported.-*Narrate* 16. Other:	✓

* The Client must be involved in these decisions.

Extractable Petroleum Hydrocarbons by GC/FID

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **301 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **0610188-02**
Associated Blank: **ES111506B10**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Percent Solid	Sample Amount (g)	Fraction	Date Analyzed	Final Volume (ml)	Dilution Factor	Analyst
10/23/06	10/27/06	11/15/06	79.1	10.47	Aromatic	11/22/06	1	1	JBS
					Aliphatic	11/22/06	1	1	JBS

Parameter	Result
C_9-C_{18} Aliphatics [1]	3600 U
C_{19}-C_{36} Aliphatics [1]	**34000**
C_{11}-C_{22} Aromatics [1,2]	**12000**
Unadjusted C_{11}-C_{22} Aromatics [1]	**12000**

Naphthalene	600 U
2-Methylnaphthalene	600 U
Acenaphthylene	600 U
Acenaphthene	600 U
Fluorene	600 U
Phenanthrene	600 U
Anthracene	600 U
Fluoranthene	600 U
Pyrene	600 U
Benzo(a)anthracene	600 U
Chrysene	600 U
Benzo(b)fluoranthene	600 U
Benzo(k)fluoranthene	600 U
Benzo(a)pyrene	600 U
Indeno(1,2,3-cd)pyrene [3]	1200 U
Dibenzo(a,h)anthracene [3]	1200 U
Benzo(g,h,i)perylene	600 U

[1] = Range concentration excludes the concentration of any surrogate(s) and/or internal standards eluting in that range.
[2] = C11-C22 Aromatic Hydrocarbons exclude the concentration of Target PAH Analytes.
[3] = Values reported reflect their sum.

Extraction Surrogate	% Recovery	Acceptance Range (%)
5-alpha Androstane	67	40-140
ortho-Terphenyl	74	40-140
Fractionation Surrogate		
Biphenyl	85	40-140
2-Fluorobiphenyl	83	40-140

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

11/28/06 12:12

Extractable Petroleum Hydrocarbons by GC/FID

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **307A 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **0610188-11**
Associated Blank: **ES111506B10**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Percent Solid	Sample Amount (g)	Fraction	Date Analyzed	Final Volume (ml)	Dilution Factor	Analyst
10/23/06	10/27/06	11/15/06	57.7	10.43	Aromatic	11/22/06	1	1	JBS
					Aliphatic	11/22/06	1	1	JBS

Parameter	Result
C_9-C_{18} Aliphatics [1]	**300000**
C_{19}-C_{36} Aliphatics [1]	**1300000**
C_{11}-C_{22} Aromatics [1,2]	**310000**
Unadjusted C_{11}-C_{22} Aromatics [1]	**320000**

Naphthalene	830	U
2-Methylnaphthalene	830	U
Acenaphthylene	830	U
Acenaphthene	830	U
Fluorene	830	U
Phenanthrene	830	U
Anthracene	830	U
Fluoranthene	**1000**	
Pyrene	**2000**	
Benzo(a)anthracene	**990**	
Chrysene	**890**	
Benzo(b)fluoranthene	**1300**	
Benzo(k)fluoranthene	830	U
Benzo(a)pyrene	**920**	
Indeno(1,2,3-cd)pyrene [3]	1700	U
Dibenzo(a,h)anthracene [3]	1700	U
Benzo(g,h,i)perylene	830	U

[1] = Range concentration excludes the concentration of any surrogate(s) and/or internal standards eluting in that range.
[2] = C11-C22 Aromatic Hydrocarbons exclude the concentration of Target PAH Analytes.
[3] = Values reported reflect their sum.

Extraction Surrogate	% Recovery	Acceptance Range (%)
5-alpha Androstane	73	40-140
ortho-Terphenyl	69	40-140
Fractionation Surrogate		
Biphenyl	89	40-140
2-Fluorobiphenyl	86	40-140

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

11/28/06 12:12

Extractable Petroleum Hydrocarbons by GC/FID

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **309 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **0610188-15**
Associated Blank: **ES111506B10**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Percent Solid	Sample Amount (g)	Fraction	Date Analyzed	Final Volume (ml)	Dilution Factor	Analyst
10/24/06	10/27/06	11/15/06	70.1	10.92	Aromatic	11/27/06	1	1	JBS
					Aliphatic	11/27/06	1	1	JBS

Parameter	Result
C_9-C_{18} Aliphatics [1]	**48000**
C_{19}-C_{36} Aliphatics [1]	**300000**
C_{11}-C_{22} Aromatics [1,2]	**100000**
Unadjusted C_{11}-C_{22} Aromatics [1]	**110000**

Naphthalene	650	U
2-Methylnaphthalene	650	U
Acenaphthylene	650	U
Acenaphthene	650	U
Fluorene	650	U
Phenanthrene	650	U
Anthracene	650	U
Fluoranthene	**860**	
Pyrene	**1800**	
Benzo(a)anthracene	650	U
Chrysene	650	U
Benzo(b)fluoranthene	650	U
Benzo(k)fluoranthene	650	U
Benzo(a)pyrene	650	U
Indeno(1,2,3-cd)pyrene [3]	1300	U
Dibenzo(a,h)anthracene [3]	1300	U
Benzo(g,h,i)perylene	650	U

[1] = Range concentration excludes the concentration of any surrogate(s) and/or internal standards eluting in that range.
[2] = C11-C22 Aromatic Hydrocarbons exclude the concentration of Target PAH Analytes.
[3] = Values reported reflect their sum.

Extraction Surrogate	% Recovery	Acceptance Range (%)
5-alpha Androstane	77	40-140
ortho-Terphenyl	86	40-140
Fractionation Surrogate		
Biphenyl	94	40-140
2-Fluorobiphenyl	91	40-140

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

11/28/06 12:12

Extractable Petroleum Hydrocarbons by GC/FID

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **332A 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **0610188-19**
Associated Blank: **ES111506B10**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Percent Solid	Sample Amount (g)	Fraction	Date Analyzed	Final Volume (ml)	Dilution Factor	Analyst
10/23/06	10/27/06	11/15/06	95.9	10.32	Aromatic	11/22/06	1	1	JBS
					Aliphatic	11/22/06	1	1	JBS

Parameter	Result
C_9-C_{18} Aliphatics [1]	**32000**
C_{19}-C_{36} Aliphatics [1]	**26000**
C_{11}-C_{22} Aromatics [1,2]	**40000**
Unadjusted C_{11}-C_{22} Aromatics [1]	**40000**

Naphthalene	500	U
2-Methylnaphthalene	500	U
Acenaphthylene	500	U
Acenaphthene	500	U
Fluorene	500	U
Phenanthrene	500	U
Anthracene	500	U
Fluoranthene	500	U
Pyrene	500	U
Benzo(a)anthracene	500	U
Chrysene	500	U
Benzo(b)fluoranthene	500	U
Benzo(k)fluoranthene	500	U
Benzo(a)pyrene	500	U
Indeno(1,2,3-cd)pyrene [3]	1000	U
Dibenzo(a,h)anthracene [3]	1000	U
Benzo(g,h,i)perylene	500	U

[1] = Range concentration excludes the concentration of any surrogate(s) and/or internal standards eluting in that range.
[2] = C11-C22 Aromatic Hydrocarbons exclude the concentration of Target PAH Analytes.
[3] = Values reported reflect their sum.

Extraction Surrogate	% Recovery	Acceptance Range (%)
5-alpha Androstane	68	40-140
ortho-Terphenyl	66	40-140
Fractionation Surrogate		
Biphenyl	74	40-140
2-Fluorobiphenyl	72	40-140

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

11/28/06 12:12

Blank
Extractable Petroleum Hydrocarbons by GC/FID

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **Blank**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **ES111506B10**
Associated Blank: **N/A**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Percent Solid	Sample Amount (g)	Fraction	Date Analyzed	Final Volume (ml)	Dilution Factor	Analyst
N/A	N/A	11/15/06	100	10.00	Aromatic	11/22/06	1	1	JBS
					Aliphatic	11/22/06	1	1	JBS

Parameter	Result
C_9-C_{18} Aliphatics [1]	3000 U
C_{19}-C_{36} Aliphatics [1]	4000 U
C_{11}-C_{22} Aromatics [1,2]	8500 U
Unadjusted C_{11}-C_{22} Aromatics [1]	8500 U
Naphthalene	500 U
2-Methylnaphthalene	500 U
Acenaphthylene	500 U
Acenaphthene	500 U
Fluorene	500 U
Phenanthrene	500 U
Anthracene	500 U
Fluoranthene	500 U
Pyrene	500 U
Benzo(a)anthracene	500 U
Chrysene	500 U
Benzo(b)fluoranthene	500 U
Benzo(k)fluoranthene	500 U
Benzo(a)pyrene	500 U
Indeno(1,2,3-cd)pyrene [3]	1000 U
Dibenzo(a,h)anthracene [3]	1000 U
Benzo(g,h,i)perylene	500 U

[1] = Range concentration excludes the concentration of any surrogate(s) and/or internal standards eluting in that range.
[2] = C11-C22 Aromatic Hydrocarbons exclude the concentration of Target PAH Analytes.
[3] = Values reported reflect their sum.

Extraction Surrogate	% Recovery	Acceptance Range (%)
5-alpha Androstane	70	40-140
ortho-Terphenyl	74	40-140
Fractionation Surrogate		
Biphenyl	88	40-140
2-Fluorobiphenyl	86	40-140

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

11/28/06 12:13

Laboratory Control Summary
Extractable Petroleum Hydrocarbons by GC/FID

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **Laboratory Control Sample**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **See Below**
Associated Blank: **ES111506B10**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Percent Solid	Analyst
N/A	N/A	11/15/06	100	JBS

Lab ID:	ES111506B10		ES111506LCS07		ES111506LCSD07				
Parameter	**Blank Conc.**		**LCS Conc.**	**LCS % Recovery**	**LCSD Conc.**	**LCSD % Recovery**	**% RPD**	**RPD Limit**	**% Recovery Limits**
Naphthalene	500	U	5800	58	5700	57	2	25	40-140
2-Methylnaphthalene	500	U	6300	63	6200	62	2	25	40-140
Acenaphthylene	500	U	6800	68	6700	67	2	25	40-140
Acenaphthene	500	U	6900	69	6800	68	2	25	40-140
Fluorene	500	U	7400	75	7300	73	2	25	40-140
Phenanthrene	500	U	7700	77	7600	75	2	25	40-140
Anthracene	500	U	7600	76	7400	75	2	25	40-140
Fluoranthene	500	U	7600	76	7500	75	2	25	40-140
Pyrene	500	U	7900	79	7700	77	2	25	40-140
Benzo(a)anthracene	500	U	7800	78	7600	76	2	25	40-140
Chrysene	500	U	7900	79	7800	78	1	25	40-140
Benzo(b)fluoranthene	500	U	8000	80	7900	79	2	25	40-140
Benzo(k)fluoranthene	500	U	7800	78	7600	76	2	25	40-140
Benzo(a)pyrene	500	U	8100	81	8000	80	1	25	40-140
Indeno(1,2,3-cd)pyrene [3]	1000	U	16000	80	16000	79	1	25	40-140
Dibenzo(a,h)anthracene [3]	1000	U	16000	80	16000	79	1	25	40-140
Benzo(g,h,i)perylene	500	U	8100	81	8000	80	2	25	40-140
n-Nonane (C9)	500	U	3400	34	3600	36	6	25	30-140
n-Decane (C10)	500	U	4800	48	5100	51	6	25	40-140
n-Dodecane (C12)	500	U	5900	59	6300	63	7	25	40-140
n-Tetradecane (C14)	500	U	6800	68	7100	71	5	25	40-140
n-Hexadecane (C16)	500	U	7300	73	7600	76	3	25	40-140
n-Octadecane (C18)	500	U	7700	77	8000	80	3	25	40-140
n-Nonadecane (C19)	500	U	8000	80	8300	83	3	25	40-140
n-Eicosane (C20)	500	U	7900	79	8100	81	3	25	40-140
n-Docosane (C22)	500	U	7900	79	7900	79	0	25	40-140
n-Tetracosane (C24)	500	U	8000	80	8000	80	1	25	40-140
n-Hexacosane (C26)	500	U	7900	79	8000	80	1	25	40-140
n-Octacosane (C28)	500	U	7800	78	7800	78	0	25	40-140
n-Triacontane (C30)	500	U	7800	78	7800	78	0	25	40-140
n-Hexatriacontane (C36)	500	U	8400	84	8400	84	0	25	40-140

[1] = Range concentration excludes the concentration of any surrogate(s) and/or internal standards eluting in that range.
[3] = Values reported reflect their sum.

Extraction Surrogate	% Recovery		Acceptance Range (%)
5-alpha Androstane	73	76	40-140
ortho-Terphenyl	78	76	40-140
Fractionation Surrogate			
Biphenyl	85	82	40-140
2-Fluorobiphenyl	82	80	40-140

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

Concentrations reported as calculated values, which includes rounding for significant figures. Percent recoveries and RPD values are calculated from the unrounded result.

11/28/06 12:13

Laboratory Control Summary
Extractable Petroleum Hydrocarbons by GC/FID

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **Laboratory Control Sample**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **See Below**
Associated Blank: **ES111506B10**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Percent Solid	Analyst
N/A	N/A	11/15/06	100	JBS

Aliphatic Breakthrough Criteria

Lab ID:	ES111506LCS07	ES111506LCSD07	
Parameter	**LCS % Breakthrough**	**LCSD % Breakthrough**	**% Breakthrough Maximum Limit**
Naphthalene	0.1	0.1	5
2-Methylnaphthalene	0.2	0.2	5

N/A - Not Applicable

Concentrations reported as calculated values, which includes rounding for significant figures. Percent recoveries and RPD values are calculated from the unrounded result.

11/28/06 12:13

Total Metals

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: N/A SDG: N/A
Client ID: **301 0-1**
Matrix: **Sediment**
Percent Solid: **79.1**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **0610188-02**
Concentration Units: **mg/Kg**
Date Collected: **10/23/06**
Date Received: **10/27/06**

Parameter	Result	Qualifier	Reporting Limit	Dilution	Date Analyzed	Date Prepared	Analytical Method	Analyst
Arsenic	**2.4**		0.099	5	11/10/06	11/08/06	6020A	LCP
Barium	**6.2**		0.099	5	11/10/06	11/08/06	6020A	LCP
Cadmium	**0.21**		0.040	5	11/10/06	11/08/06	6020A	LCP
Chromium	**16**		0.99	5	11/10/06	11/08/06	6020A	LCP
Lead	**24**		0.099	5	11/10/06	11/08/06	6020A	LCP
Mercury	**0.19**		0.0060	1	11/09/06	11/08/06	7471A	LMR
Selenium	**0.55**		0.40	5	11/10/06	11/08/06	6020A	LCP
Silver	**0.21**		0.092	5	11/13/06	11/08/06	6020A	LMR

N/A - Not Applicable

11/13/06 15:48

Total Metals

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: N/A SDG: N/A
Client ID: **307A 0-1**
Matrix: **Sediment**
Percent Solid: **57.7**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **0610188-11**
Concentration Units: **mg/Kg**
Date Collected: **10/23/06**
Date Received: **10/27/06**

Parameter	Result	Qualifier	Reporting Limit	Dilution	Date Analyzed	Date Prepared	Analytical Method	Analyst
Arsenic	**5.9**		0.12	5	11/10/06	11/08/06	6020A	LCP
Barium	**32**		0.12	5	11/10/06	11/08/06	6020A	LCP
Cadmium	**4.4**		0.050	5	11/10/06	11/08/06	6020A	LCP
Chromium	**260**		1.2	5	11/10/06	11/08/06	6020A	LCP
Lead	**190**		0.12	5	11/10/06	11/08/06	6020A	LCP
Mercury	**0.94**		0.039	5	11/09/06	11/08/06	7471A	LMR
Selenium	**1.4**		0.50	5	11/10/06	11/08/06	6020A	LCP
Silver	**1.8**		0.12	5	11/13/06	11/08/06	6020A	LMR

N/A - Not Applicable

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Total Metals

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: N/A SDG: N/A
Client ID: **309 0-1**
Matrix: **Sediment**
Percent Solid: **70.1**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **0610188-15**
Concentration Units: **mg/Kg**
Date Collected: **10/24/06**
Date Received: **10/27/06**

Parameter	Result	Qualifier	Reporting Limit	Dilution	Date Analyzed	Date Prepared	Analytical Method	Analyst
Arsenic	**5.7**		0.11	5	11/10/06	11/08/06	6020A	LCP
Barium	**160**		0.11	5	11/10/06	11/08/06	6020A	LCP
Cadmium	**0.93**		0.045	5	11/10/06	11/08/06	6020A	LCP
Chromium	**56**		1.1	5	11/10/06	11/08/06	6020A	LCP
Lead	**360**		0.11	5	11/10/06	11/08/06	6020A	LCP
Mercury	**0.43**		0.0066	1	11/09/06	11/08/06	7471A	LMR
Selenium	**0.96**		0.45	5	11/10/06	11/08/06	6020A	LCP
Silver	**0.54**		0.11	5	11/13/06	11/08/06	6020A	LMR

N/A - Not Applicable

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Total Metals

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: **N/A** SDG: **N/A**
Client ID: **332A 0-1**
Matrix: **Sediment**
Percent Solid: **95.9**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **0610188-19**
Concentration Units: **mg/Kg**
Date Collected: **10/23/06**
Date Received: **10/27/06**

Parameter	Result	Qualifier	Reporting Limit	Dilution	Date Analyzed	Date Prepared	Analytical Method	Analyst
Arsenic	**0.90**		0.090	5	11/10/06	11/08/06	6020A	LCP
Barium	**3.0**		0.090	5	11/10/06	11/08/06	6020A	LCP
Cadmium	**0.071**		0.036	5	11/10/06	11/08/06	6020A	LCP
Chromium	**3.7**		0.90	5	11/10/06	11/08/06	6020A	LCP
Lead	**10**		0.090	5	11/10/06	11/08/06	6020A	LCP
Mercury	**0.027**		0.0051	1	11/09/06	11/08/06	7471A	LMR
Selenium	0.36	U	0.36	5	11/10/06	11/08/06	6020A	LCP
Silver	0.093	U	0.093	5	11/13/06	11/08/06	6020A	LMR

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

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Blank
Total Metals

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: **N/A** SDG: **N/A**
Client ID: **Blank**
Matrix: **Sediment**
Percent Solid: **100.0**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **MS110606B06B**
Concentration Units: **mg/Kg**
Date Collected: **N/A**
Date Received: **N/A**

Parameter	Result	Qualifier	Reporting Limit	Dilution	Date Analyzed	Date Prepared	Analytical Method	Analyst
Arsenic	0.12	U	0.12	5	11/10/06	11/08/06	6020A	LCP
Barium	0.12	U	0.12	5	11/10/06	11/08/06	6020A	LCP
Cadmium	0.050	U	0.050	5	11/10/06	11/08/06	6020A	LCP
Chromium	1.2	U	1.2	5	11/10/06	11/08/06	6020A	LCP
Lead	0.12	U	0.12	5	11/10/06	11/08/06	6020A	LCP
Selenium	0.50	U	0.50	5	11/10/06	11/08/06	6020A	LCP

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

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Blank
Total Metals

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: **N/A** SDG: **N/A**
Client ID: **Blank**
Matrix: **Sediment**
Percent Solid: **100.0**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **MS110606B05B**
Concentration Units: **mg/Kg**
Date Collected: **N/A**
Date Received: **N/A**

Parameter	Result	Qualifier	Reporting Limit	Dilution	Date Analyzed	Date Prepared	Analytical Method	Analyst
Silver	0.12	U	0.12	5	11/13/06	11/08/06	6020A	LMR

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

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Blank
Total Metals

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: **N/A** SDG: **N/A**
Client ID: **Blank**
Matrix: **Sediment**
Percent Solid: **100.0**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **MS110606B07B**
Concentration Units: **mg/Kg**
Date Collected: **N/A**
Date Received: **N/A**

Parameter	Result	Qualifier	Reporting Limit	Dilution	Date Analyzed	Date Prepared	Analytical Method	Analyst
Mercury	0.010	U	0.010	1	11/09/06	11/08/06	7471A	LMR

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

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Laboratory Control Sample - High
Total Metals

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: **N/A** SDG: **N/A**
Client ID: **Lab Control Sample High**
Matrix: **Sediment**
Percent Solid: **100.0**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **MS110606SLH03SLH**
Concentration Units: **mg/Kg**
Date Collected: **N/A**
Date Received: **N/A**

Parameter	Conc.	% Recovery	% Recovery Limits
Arsenic	200	99	80-120
Barium	200	100	80-120
Cadmium	99	99	80-120
Chromium	200	100	80-120
Lead	190	96	80-120
Selenium	200	101	80-120

N/A - Not Applicable

Concentrations reported as calculated values, which includes rounding for significant figures. Percent recoveries and RPD values are calculated from the unrounded results.

11/13/06 16:01

Laboratory Control Sample - Low
Total Metals

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: N/A SDG: N/A
Client ID: **Lab Control Sample Low**
Matrix: **Sediment**
Percent Solid: **100.0**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **MS110606SLL02SLL**
Concentration Units: **mg/Kg**
Date Collected: **N/A**
Date Received: **N/A**

Parameter	Conc.	% Recovery	% Recovery Limits
Silver	2.2	108	80-120

N/A - Not Applicable

Concentrations reported as calculated values, which includes rounding for significant figures. Percent recoveries and RPD values are calculated from the unrounded results.

11/13/06 16:02

Laboratory Control Sample
Total Metals

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: **N/A** SDG: **N/A**
Client ID: **Laboratory Control Sample**
Matrix: **Sediment**
Percent Solid: **100.0**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **MS110606SLC02SLC**
Concentration Units: **mg/Kg**
Date Collected: **N/A**
Date Received: **N/A**

Parameter	Conc.	% Recovery	% Recovery Limits
Mercury	0.48	97	80-120

N/A - Not Applicable

Concentrations reported as calculated values, which includes rounding for significant figures. Percent recoveries and RPD values are calculated from the unrounded results.

11/13/06 16:03

Inorganics

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: **N/A** SDG: **N/A**
Client ID: **301 0-1**
Matrix: **Sediment**
Percent Solid: **79.1**

Lab Code: **MA00030**
ETR: **0610188**

Lab ID: **0610188-02**
Date Collected: **10/23/06**
Date Received: **10/27/06**

Parameter	Result	Qualifier	Reporting Limit	Dilution	Date Analyzed	Unit	Analytical Method	Analyst
Total Organic Carbon (Run 1)	**0.53**		0.01	1	11/14/06	%	9060	JAD
Total Organic Carbon (Run 2)	**0.65**		0.01	1	11/14/06	%	9060	JAD
Reactive Sulfide	**2.4**		0.28	1	11/15/06	mg/Kg	Ch.7/376.2	JAD

N/A - Not Applicable

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Inorganics

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: **N/A** SDG: **N/A**
Client ID: **307A 0-1**
Matrix: **Sediment**
Percent Solid: **57.7**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **0610188-11**
Date Collected: **10/23/06**
Date Received: **10/27/06**

Parameter	Result	Qualifier	Reporting Limit	Dilution	Date Analyzed	Unit	Analytical Method	Analyst
Total Organic Carbon (Run 1)	**0.98**		0.01	1	11/14/06	%	9060	JAD
Total Organic Carbon (Run 2)	**0.86**		0.01	1	11/14/06	%	9060	JAD
Reactive Sulfide	**150**		14	50	11/15/06	mg/Kg	Ch.7/376.2	JAD

N/A - Not Applicable

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Inorganics

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: **N/A** SDG: **N/A**
Client ID: **309 0-1**
Matrix: **Sediment**
Percent Solid: **70.1**

Lab Code: **MA00030**
ETR: **0610188**

Lab ID: **0610188-15**
Date Collected: **10/24/06**
Date Received: **10/27/06**

Parameter	Result	Qualifier	Reporting Limit	Dilution	Date Analyzed	Unit	Analytical Method	Analyst
Total Organic Carbon (Run 1)	**2.0**		0.01	1	11/14/06	%	9060	JAD
Total Organic Carbon (Run 2)	**1.8**		0.01	1	11/14/06	%	9060	JAD
Reactive Sulfide	**190**		14	50	11/15/06	mg/Kg	Ch.7/376.2	JAD

N/A - Not Applicable

375 Paramount Drive, Suite 2, Raynham, Massachusetts 02767, (508) 822-9300, Fax (508) 822-3288

Inorganics

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: **N/A** SDG: **N/A**
Client ID: **332A 0-1**
Matrix: **Sediment**
Percent Solid: **95.9**

Lab Code: **MA00030**
ETR: **0610188**

Lab ID: **0610188-19**
Date Collected: **10/23/06**
Date Received: **10/27/06**

Parameter	Result	Qualifier	Reporting Limit	Dilution	Date Analyzed	Unit	Analytical Method	Analyst
Total Organic Carbon (Run 1)	**0.12**		0.01	1	11/14/06	%	9060	JAD
Total Organic Carbon (Run 2)	**0.12**		0.01	1	11/14/06	%	9060	JAD
Reactive Sulfide	**11**		1.4	5	11/15/06	mg/Kg	Ch.7/376.2	JAD

N/A - Not Applicable

375 Paramount Drive, Suite 2, Raynham, Massachusetts 02767, (508) 822-9300, Fax (508) 822-3288

Blank
Inorganics

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: **N/A** SDG: **N/A**
Client ID: **Blank**
Matrix: **Sediment**
Percent Solid: **100**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **WS111406B16**
Date Collected: **N/A**
Date Received: **N/A**

Parameter	Result	Qualifier	Reporting Limit	Dilution	Date Analyzed	Unit	Analytical Method	Analyst
Total Organic Carbon (Run 1)	0.01	U	0.01	1	11/14/06	%	9060	JAD
Total Organic Carbon (Run 2)	0.01	U	0.01	1	11/14/06	%	9060	JAD

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

375 Paramount Drive, Suite 2, Raynham, Massachusetts 02767, (508) 822-9300, Fax (508) 822-3288

Blank
Inorganics

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: **N/A** SDG: **N/A**
Client ID: **Blank**
Matrix: **Sediment**
Percent Solid: **100**

Lab Code: **MA00030**
ETR: **0610188**
Lab ID: **WS111506B23**
Date Collected: **N/A**
Date Received: **N/A**

Parameter	Result	Qualifier	Reporting Limit	Dilution	Date Analyzed	Unit	Analytical Method	Analyst
Reactive Sulfide	1.0	U	1.0	1	11/15/06	mg/Kg	Ch.7/376.2	JAD

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

375 Paramount Drive, Suite 2, Raynham, Massachusetts 02767, (508) 822-9300, Fax (508) 822-3288

Standard Reference Material 1944
Inorganics

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: **N/A** SDG: **N/A**
Client ID: **SRM 1944**
Matrix: **Sediment**
Percent Solid: **100**

Lab Code: **MA00030**
ETR: **0610188**

Lab ID: **WS111406L194404**
Date Collected: **N/A**
Date Received: **N/A**

Parameter	Conc.	% Recovery	% Recovery Limits
Total Organic Carbon (Run 1)	3.8	87	75-125
Total Organic Carbon (Run 2)	3.5	80	75-125

N/A - Not Applicable

Concentrations reported as calculated values, which includes rounding for significant figures. Percent recoveries and RPD values are calculated from the unrounded results.

12/01/06 08:12

Laboratory Control Sample
Inorganics

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: N/A SDG: N/A
Client ID: **Laboratory Control Sample**
Matrix: **Sediment**
Percent Solid: **100**

Lab Code: **MA00030**
ETR: **0610188**

Lab ID: **WS111506L07**
Date Collected: **N/A**
Date Received: **N/A**

Parameter	Conc.	% Recovery	% Recovery Limits
Reactive Sulfide	26	91	75-125

N/A - Not Applicable

Concentrations reported as calculated values, which includes rounding for significant figures. Percent recoveries and RPD values are calculated from the unrounded results.

12/01/06 08:12

CHAIN OF CUSTODY

PAGE 1 OF 4

ALPHA LAB

WESTBORO, MA TEL: 508-898-9220 FAX: 508-898-9193

RAYNHAM, MA TEL: 508-822-9300 FAX: 508-822-3288

Date Rec'd in Lab:

ALPHA Job #: 0610488

Client Information

Client: Apex Companies, LLC

Address: 115 Broad Street Suite 200, Boston, MA 02110

Phone: 617-728-0070 X-113

Fax: 617-728-0080

Email: cmyers@apexenv.com

☐ These samples have been previously analyzed by Alpha

Project Information

Project Name: NB Harbor Dredge-Phase III

Project Location: New Bedford, MA

Project #: 6591.002

Project Manager: Chet Myers

ALPHA Quote #:

Turn-Around Time

☒ Standard ☐ RUSH (only confirmed if pre-approved!)

Date Due: Time:

Report Information - Data Deliverables

☒ FAX ☒ EMAIL

☐ ADEx ☐ Add'l Deliverables

Billing Information

☐ Same as Client info PO #:

Regulatory Requirements/Report Limits

State /Fed Program | Criteria

MA MCP PRESUMPTIVE CERTAINTY --- CT REASONABLE CONFIDENCE PROTOCOLS

☐ Yes ☒ No Are MCP Analytical Methods Required?

☐ Yes ☒ No Are CT RCP (Reasonable Confidence Protocols) Required?

Other Project Specific Requirements/Comments/Detection Limits:

Min Detection Limits: As = 0.5ppm, Cd = 0.1mg/kg, Cr = 1mg/kg, Cu = 1mg/kg, Pb = 1mg/kg, Hg = 0.02ppm, Ni = 1ppm, Zn = 1ppm, PCB summation of Congeners = 0.001mg/kg, EPH = 0.01ppm, TOC = 0.1%, Reactive Sulfide = 30ppm

HOLD All Samples

SAMPLE HANDLING

Filtration: ☐ Done ☒ Not needed ☐ Lab to do

Preservation: ☐ Lab to do (Please specify below)

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials	RCRA & Metals	PCB Summation of Congeners	EPH Petroleum Hydrocarbons	TOC	Reactive Sulfide	Sample Specific Comments	TOTAL # BOTTLES
-1	301 2.5-3.5	10/23/06	330pm	SED	KVN		X					
-2	301 0-1	10/23/06	330pm	SED	KVN	X	X	X	X	X		
-3	302 0-1	10/23/06	340pm	SED	KVN		X					
-4	303 0-1	10/23/06	230pm	SED	KVN		X					
-5	303 2.5-3.5	10/23/06	2:30pm	SED	KVN		X					
-6	304 0-1	10/23/06	346pm	SED	KVN		X					
-7	304 2.5-3.5	10/23/06	346pm	SED	KVN		X					
-8	305 0-1	10/23/06	410pm	SED	KVN		X					
-9	306 0-1	10/23/06	420pm	SED	KVN		X					
-10	306 2.5-3.5	10/23/06	420pm	SED	KVN		X					

Container Type

Preservative

PLEASE ANSWER QUESTIONS ABOVE!

IS YOUR PROJECT MA MCP or CT RCP?

Relinquished By:	Date/Time	Received By:	Date/Time
	10/23/06 4pm	Sheila Murender	10-26-06 4pm
Sheila Murender	10-27-06 9:10	Paul Gilbert	10-27-06 9:10
Paul Gilbert	10-27-06 0945		10/27/06 0945

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Payment Terms. See reverse side.

FORM NO: 01-01 (rev. 10-OCT-05)

CHAIN OF CUSTODY

PAGE 2 OF 4

Date Rec'd in Lab:

ALPHA Job #: 0610188

WESTBORO, MA
TEL: 508-898-9220
FAX: 508-898-9193

RAYNHAM, MA
TEL: 508-822-9300
FAX: 508-822-3288

Client Information

Client: Apex Companies LLC
Address: 115 Broad Street, Suite 2100
Boston, MA 02110
Phone: 617-728-0070 x-113
Fax: 617-728-0080
Email: cmyers@apexenv.com
☐ These samples have been previously analyzed by Alpha

Project Information

Project Name: NB Harbor Dredge Phase III
Project Location: New Bedford, MA
Project #: 6591.002
Project Manager: Clot Myers
ALPHA Quote #:

Turn-Around Time

☒ Standard ☐ RUSH (only confirmed if pre-approved!)
Date Due: Time:

Report Information - Data Deliverables

☒ FAX ☒ EMAIL
☐ ADEx ☐ Add'l Deliverables

Billing Information

☐ Same as Client info PO #:

Regulatory Requirements/Report Limits

State /Fed Program | Criteria

MA MCP PRESUMPTIVE CERTAINTY --- CT REASONABLE CONFIDENCE PROTOCOLS

☐ Yes ☒ No Are MCP Analytical Methods Required?
☐ Yes ☒ No Are CT RCP (Reasonable Confidence Protocols) Required?

Other Project Specific Requirements/Comments/Detection Limits:
MA Detection Limits: As=0.5ppm, Cd=0.1ppm, Hg=0.02ppm, (Ni, Zn, Cr, Cu, Pb=1ppm)
PCB sum of Con.=0.001ppm, EPH=0.01ppm, TOC=0.1%, Reac Sulf.=30ppm
HOLD All Samples pending call

SAMPLE HANDLING
Filtration
☐ Done
☒ Not needed
☐ Lab to do
Preservation
☐ Lab to do
(Please specify below)

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials	RCRA 8 Metals	PCB sum of Con.	EPH Petroleum Hydrocarbons	TOC	Reactive Sulfide	Sample Specific Comments	Total # Bottles
-11	307A 0-1	10/23/06	935AM	SED	KUN	X	X	X	X	X		
-12	307A 2.5-3.5	10/23/06	935AM	SED	KUN		X					
-13	308 0-1	10/23/06	910AM	SED	KUN		X					
-14	308 2.5-3.5	10/23/06	910AM	SED	KUN		X					
-15	309 0-1	10/24/06	751AM	SED	KUN	X	X	X	X	X		
-16	310 0-1	10/24/06	826AM	SED	KUN		X					
-17	310 2.5-3.5	10/24/06	826AM	SED	KUN		X					
-18	329 0-1	10/23/06	100pm	SED	KUN		X					
-19	332A 0-1	10/23/06	1030AM	SED	KUN	X	X	X	X	X		
-20	330 0-1	10/23/06	145pm	SED	KUN		X					

Container Type
Preservative

PLEASE ANSWER QUESTIONS ABOVE!

IS YOUR PROJECT MA MCP or CT RCP?

Relinquished By:	Date/Time	Received By:	Date/Time
	10/26/06 4pm	Shelly Muranda	4/26/06 4pm
Shelly Muranda	10/27/06 9:10am	Paul Gilbert	10-27-06 9:10
Paul Gilbert	10-27-06 0945	[illegible]	10/27/06 0945

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Payment Terms. See reverse side.

FORM NO: 01-01 (rev. 10-OCT-05)

Sample Receipt Checklist

Client:	APEENV	**Receipt Date:**	10/27/06
Project:	NB Harbor Phase II	**Log-in Date:**	↓
ETR #:	0610188	**Inspection by:** wr	**Login by:** wr

ALL SECTIONS BELOW MUST BE COMPLETED

Comments / Notes

Were samples shipped? Yes, FedEx / UPS / Other:_____
(No, WHG Courier pick-up) / Hand delivered

Is bill of lading retained? Yes, Tracking #:_____
No, Unavailable / (NA)

Number of coolers received for this project delivery: 1

Indicate cooler temperature upon opening (if multiple coolers, record all temps):

Note: If all coolers are 2-6°C, use one checklist, if NOT, use separate checklists and note all samples received *above* 6°C.

Cooler 1:
Temperature(s) taken from: 4° IR Gun, 3° Temp. Blank, / NA

Were samples received on ice? (Yes) / No

Chain-of-Custody present? (Yes) / No
Complete? (Yes) / No

Custody seals present on Cooler? Yes / (No)
on Bottles? Yes / (No)
Intact? Yes / No / (NA)
Note: Affix custody seals to back of this page.

Were sample containers intact? (Yes) / No If No, list samples: →

Did VOA/VPH waters contain headspace (>5mm)? Yes / No (NA) If Yes, list samples: →

Were 5035 VOA soils, or VPH soils, *covered* with MeOH? Yes / No / (NA)
If No, list samples: →

Was a sufficient amount of sample received for each test indicated on the COC?
(Yes) / No If No, list samples: →

If chemical preservation is appropriate -
Were samples field preserved? Yes / No / (NA)
☐ C=HCl ☐ M=MeOH ☐ S=H_2SO4
☐ H=NaOH ☐ N=HNO_3 ☐ Other:_____ ☐ U= Unknown

Preservation (pH) verified at lab for *EVERY* bottle? (Not: VOA / VPH / Sulfide)
YES: <2 or >12 (CN) or NO (NA)
If No, why?:

Were samples received within hold time? (Yes) / No If No, list samples: →

Discrepancy between samples rec'd & COC ? Yes / (No) If Yes, list samples: →

Was the Project Manager notified of any other problems? Yes / No / NA

Project Manager Acknowledgement: Nancy Carson Date: 10/27/06

Sample storage refrigerator #: C3

Sample storage freezer #:_____

Cooler 2:_____ Cooler 3:_____

Cooler 4:_____ Cooler 5:_____

Cooler 6:_____ Cooler 7:_____

More:_____

Chemical preservation OK for ALL samples?

Yes / No / (N/A)

If No, list samples below:

Please use back for any additional notes!

Certificate Program Summary

Method numbers assume the most recent EPA revisions. For a complete listing of analytes for the referenced methods please contact your Alpha Woods Hole Lab Project Manager or the Quality Assurance Manager.

Connecticut Department of Public Health Certificate No. : PH-0141 - *Wastewater* (General Chemistry: 120.1, 150.1, 160.1, 160.2, 180.1, 300.0, 310.1, 335.2, 365.2, 405.1, 413.1, COD HACH 8000; Metals: 200.7, 245.1; Organics: 608, 624, 625). *Solid Waste/Soil* (General Chemistry: 1010, 9010/9014, 9045, 9056, 9060; Metals: 6010, 6020, 7041, 7471; Organics: 8081, 8082, 8260, 8270, ETPH).

Florida Department of Health Certificate No. : E87814 - Secondary NELAP Accreditation for *Wastewater* (General Chemistry: 120.1/2510B, 150.1, 160.1/SM2540C, 160.2/SM2540D, 180.1, 300.0, SM2320B, 335.2, 365.2, 413.1, 420.1, SM2540G, COD HACH 8000; Metals: 200.7, 204.2, 206.2, 239.2, 245.1, 270.2, 279.2; Organics: 608, 624, 625). *Solid and Hazardous Waste* (General Chemistry: 9010/9014, 9045, 9050, 9056, 9060, 9065; Metals: 6010, 6020, 7041, 7060, 7421, 7470, 7471, 7740, 7841; Organics: 8081, 8082, 8260, 8270).

Louisiana Department of Environmental Quality Certificate No. : 03090 - Primary NELAP Accrediting Authority for *Wastewater* (General Chemistry: 120.1/2510B, 150.1, 160.1/SM2540C, 160.2/SM2540D, 180.1, 300.0, 310.1/SM2320B, 335.2, 365.2, 376.2, 405.1, 413.1, 420.1, SM2540G, COD HACH 8000; Metals: 200.7, 204.2, 206.2, 239.2, 245.1, 270.2, 279.2; Organics: 608, 624, 625). *Solid and Hazardous Waste* (General Chemistry:1010, 1311, 9010/9014, 9045, 9056, 9060; Metals: 6010, 6020, 7041, 7060, 7191, 7421, 7470, 7471, 7740, 7841; Organics: 8081, 8082, 8260, 8270).

Maine Department of Human Services Certificate No. : MA030 - *Wastewater* (General Chemistry: 120.1/2510B, 150.1, 160.1/SM2540C, 160.2/SM2540D, 180.1, 300.0, 310.1/SM2320B, 335.2, 365.2, 405.1, 413.1, 420.1, COD HACH 8000; Metals: 200.7, 239.2, 245.1, 270.2, 279.2; Organics: 608, 624).

Massachusetts Department of Environmental Protection Certificate No. : M-MA030 - *Wastewater* (General Chemistry: 120.1/2510B, 150.1, 160.1/SM2540C, 160.2/SM2540D, 180.1, 300.0, 310.1/SM2320B, 335.2, 365.2, 405.1, 413.1, 420.1, COD HACH 8000; Metals: 200.7, 239.2, 245.1, 270.2, 279.2; Organics: 608, 624).

New Hampshire Department of Environmental Services Certificate No. : 220604 - Secondary NELAP Accreditation for *Wastewater* (General Chemistry: 120.1/2510B, 150.1, 160.1/SM2540C, 160.2/SM2540D, 180.1, 300.0, 310.1/SM2320B, 335.2, 365.2, 376.2, 405.1, 413.1, 420.1, COD HACH 8000, SM2540G; Metals: 200.7, 204.2, 206.2, 239.2, 245.1, 270.2, 279.2; Organics: 608, 624, 625).

New Jersey Department of Environmental Protection Certificate No. : MA015 - *Solid and Hazardous Waste* (General Chemistry: 1010, 1311, 3060, 7196, 9010/9014, 9045, 9056, 9060; Metals: 3010, 3015, 3020, 3050, 3051, 6010, 6020, 7041, 7060, 7131, 7191, 7211, 7421, 7470, 7471, 7520, 7740, 7761, 7841; Organics: 3510, 3545, 5030, 5035, 3620, 3630, 3640, 3660, 8081, 8082, 8100, 8260, 8270).

New York Department of Health Certificate No. : 11627 - Secondary NELAP Accreditation for *Wastewater* (Metals: 200.7, 204.2, 206.2, 239.2, 245.1, 270.2, 279.2; Organics: 608, 624, 625). *Solid and Hazardous Waste* (Metals: 6010, 7041, 7060, 7470, 7471, 7740; Organics: 8081, 8082, 8260, 8270).

Rhode Island Department of Health Certificate No. : 00064 - Chemistry: *Organic and Inorganic in Surface Water, Wastewater/Sewage and Soil* (Method numbers not specified with certificate.)

U.S. Army Corps of Engineers - General Chemistry: 9010/9014, 9071/418.1, 9060; Organics: 8081, 8082, 8260, 8270, 8270-SIM; Metals: 6010, 6020, 7000.

Department of the Navy - General Chemistry: 9010/9014, 9060; Organics: 8081, 8082, 8015-mod, 8260, 8270, 8270-SIM; Metals: 6010, 6020.

ANALYTICAL REPORT

Prepared for:
Apex Environmental, Inc.
286 Congress Street
Suite 610
Boston, MA 02210

Project:	New Bedford Harbor
ETR:	0610189
Report Date:	December 04, 2006

Certifications and Accreditations
Massachusetts MA030
Connecticut PH-0141
New Hampshire 220602
Rhode Island 64
New Jersey MA015
Maine MA030
New York 11627
Louisiana 03090
Army Corps of Engineers
Department of the Navy
Florida E87814

This report shall not be reproduced except in full, without written approval from the laboratory.

375 Paramount Drive, Suite 2, Raynham, Massachusetts 02767, (508) 822-9300, Fax (508) 822-3288

Sample ID Cross Reference

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**

Lab Code: **MA00030**
ETR: **0610189**

Lab Sample ID	Client Sample ID
0610189-01	311 0-1
0610189-03	316 0-1
0610189-04	319 0-1
0610189-05	321 0-1
0610189-06	325 0-1
0610189-07	327 0-1
0610189-08	328 0-1
0610189-09	331 0-1
0610189-10	333 0-1
0610189-11	334 0-1
0610189-12	335 0-1
0610189-13	336 0-1
0610189-14	337 0-1

Gaps in Lab Sample IDs are indicative of samples not analyzed per client request.

CASE NARRATIVE
Alpha Woods Hole Labs

ETR: 0610189
Project: New Bedford Harbor

All analyses were performed according to Alpha Woods Hole Labs quality assurance program and documented Standard Operating Procedures (SOPs). The analytical results contained in this report were performed within holding time, and with appropriate quality control measures, except where noted. A summary of all state and federal accreditations is provided within this report. Blank correction of results is not performed in the laboratory for any parameter. Soil/sediment samples are reported on a dry weight basis unless otherwise noted. Air and sediment samples are either not certifiable under the NELAC and/or are not currently held as accredited matrices.

Sample Receipt

1. Samples were frozen upon receipt, extending the extraction holding time.

Polychlorinated Biphenyls by GC/MS

1. Several target congeners analyzed by this method co-elute with non-target congeners and are therefore reported as a co-eluting pair. Refer to the individual report forms.
2. The initial analysis of several samples had concentrations that exceeded the calibration range of the instrument. These samples were reanalyzed at dilution and both analyses are reported. Refer to the individual report forms for dilution requirements.

Extractable Petroleum Hydrocarbons by GC/FID

1. All data quality objectives were met.

The enclosed results of analyses are representative of the samples as received by the laboratory. Alpha Woods Hole Labs makes no representations or certifications as to the method of sample collection, sample identification, or transporting/handling procedures used prior to the receipt of samples by Alpha Woods Hole Labs. To the best of my knowledge, the information contained in this report is accurate and complete.

Approved by: Nancy J. Rose Title: Project Manager Date: 12/4/06

PCB CONGENERS

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **311 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-01**
Associated Blank: **SS111506B09**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/24/06	10/27/06	11/15/06	11/29/06	65.7	5.42	2	1	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**29**
Cl3-BZ#18	**65**
Cl3-BZ#28/#31[1]	**390**
Cl4-BZ#44	**95**
Cl4-BZ#52	**170**
Cl4-BZ#43/#49[1]	**200**
Cl4-BZ#66	**190**
Cl5-BZ#101/#84[1]	**300**
Cl5-BZ#87	**78**
Cl7-BZ#184	0.28 U
Cl5-BZ#105	**81**
Cl5-BZ#118	**240** E
Cl7-BZ#183	**9.4**
Cl6-BZ#167/#128[1]	**43**
Cl6-BZ#138/#163[1]	**180**
Cl6-BZ#153	**160**
Cl7-BZ#170/#190[1]	**20**
Cl7-BZ#180	**32**
Cl7-BZ#182/#187[1]	**21**
Cl8-BZ#195	**2.5**
Cl9-BZ#206	**3.0**
Cl10-BZ#209	**1.2**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	76	50-125
Cl8-BZ#202-C13	76	50-125

N/A - Not Applicable
E - Estimated value, exceeds the upper limit of calibration.
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/01/06 14:53

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **311 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-01E**
Associated Blank: **SS111506B09**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/24/06	10/27/06	11/15/06	11/29/06	65.7	5.42	2	5	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**31**
Cl3-BZ#18	**65**
Cl3-BZ#28/#31[1]	**370**
Cl4-BZ#44	**95**
Cl4-BZ#52	**170**
Cl4-BZ#43/#49[1]	**190**
Cl4-BZ#66	**180**
Cl5-BZ#101/#84[1]	**300**
Cl5-BZ#87	**80**
Cl7-BZ#184	1.4 U
Cl5-BZ#105	**80**
Cl5-BZ#118	**230**
Cl7-BZ#183	**11**
Cl6-BZ#167/#128[1]	**44**
Cl6-BZ#138/#163[1]	**180**
Cl6-BZ#153	**160**
Cl7-BZ#170/#190[1]	**22**
Cl7-BZ#180	**35**
Cl7-BZ#182/#187[1]	**23**
Cl8-BZ#195	**3.9**
Cl9-BZ#206	**3.9**
Cl10-BZ#209	**2.3**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	88	50-125
Cl8-BZ#202-C13	88	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/01/06 14:56

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **316 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-03**
Associated Blank: **SS111506B09**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/25/06	10/27/06	11/15/06	11/29/06	62.0	5.68	2	1	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**34**
Cl3-BZ#18	**70**
Cl3-BZ#28/#31[1]	**400**
Cl4-BZ#44	**110**
Cl4-BZ#52	**210**
Cl4-BZ#43/#49[1]	**240**
Cl4-BZ#66	**200**
Cl5-BZ#101/#84[1]	**410**
Cl5-BZ#87	**100**
Cl7-BZ#184	0.28 U
Cl5-BZ#105	**100**
Cl5-BZ#118	**340** E
Cl7-BZ#183	**15**
Cl6-BZ#167/#128[1]	**62**
Cl6-BZ#138/#163[1]	**260**
Cl6-BZ#153	**260** E
Cl7-BZ#170/#190[1]	**31**
Cl7-BZ#180	**51**
Cl7-BZ#182/#187[1]	**35**
Cl8-BZ#195	**4.6**
Cl9-BZ#206	**4.9**
Cl10-BZ#209	**2.4**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	74	50-125
Cl8-BZ#202-C13	78	50-125

N/A - Not Applicable
E - Estimated value, exceeds the upper limit of calibration.
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/01/06 14:53

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **316 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-03E**
Associated Blank: **SS111506B09**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/25/06	10/27/06	11/15/06	11/29/06	62.0	5.68	2	5	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**38**
Cl3-BZ#18	**76**
Cl3-BZ#28/#31[1]	**410**
Cl4-BZ#44	**120**
Cl4-BZ#52	**220**
Cl4-BZ#43/#49[1]	**260**
Cl4-BZ#66	**210**
Cl5-BZ#101/#84[1]	**440**
Cl5-BZ#87	**110**
Cl7-BZ#184	1.4 U
Cl5-BZ#105	**110**
Cl5-BZ#118	**360**
Cl7-BZ#183	**16**
Cl6-BZ#167/#128[1]	**70**
Cl6-BZ#138/#163[1]	**290**
Cl6-BZ#153	**280**
Cl7-BZ#170/#190[1]	**34**
Cl7-BZ#180	**56**
Cl7-BZ#182/#187[1]	**39**
Cl8-BZ#195	**4.9**
Cl9-BZ#206	**5.4**
Cl10-BZ#209	**2.9**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	86	50-125
Cl8-BZ#202-C13	94	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/01/06 14:56

PCB by GC/MS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **319 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-04**
Associated Blank: **SS111506B09**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/23/06	10/27/06	11/15/06	11/29/06	76.8	5.60	2	1	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**7.4**
Cl3-BZ#18	**13**
Cl3-BZ#28/#31[1]	**64**
Cl4-BZ#44	**19**
Cl4-BZ#52	**37**
Cl4-BZ#43/#49[1]	**39**
Cl4-BZ#66	**29**
Cl5-BZ#101/#84[1]	**50**
Cl5-BZ#87	**12**
Cl7-BZ#184	0.23 U
Cl5-BZ#105	**12**
Cl5-BZ#118	**38**
Cl7-BZ#183	**1.7**
Cl6-BZ#167/#128[1]	**6.8**
Cl6-BZ#138/#163[1]	**28**
Cl6-BZ#153	**29**
Cl7-BZ#170/#190[1]	**2.9**
Cl7-BZ#180	**4.7**
Cl7-BZ#182/#187[1]	**3.6**
Cl8-BZ#195	0.23 U
Cl9-BZ#206	**0.49**
Cl10-BZ#209	**0.48**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	76	50-125
Cl8-BZ#202-C13	82	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/01/06 14:53

PCB by GC/MS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **321 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-05**
Associated Blank: **SS111506B09**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/25/06	10/27/06	11/15/06	11/29/06	63.7	5.55	2	1	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**24**
Cl3-BZ#18	**68**
Cl3-BZ#28/#31[1]	**270**
Cl4-BZ#44	**82**
Cl4-BZ#52	**120**
Cl4-BZ#43/#49[1]	**110**
Cl4-BZ#66	**140**
Cl5-BZ#101/#84[1]	**170**
Cl5-BZ#87	**45**
Cl7-BZ#184	0.28 U
Cl5-BZ#105	**46**
Cl5-BZ#118	**97**
Cl7-BZ#183	**43**
Cl6-BZ#167/#128[1]	**22**
Cl6-BZ#138/#163[1]	**180**
Cl6-BZ#153	**180**
Cl7-BZ#170/#190[1]	**77**
Cl7-BZ#180	**170**
Cl7-BZ#182/#187[1]	**96**
Cl8-BZ#195	**18**
Cl9-BZ#206	**8.8**
Cl10-BZ#209	**0.36**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	84	50-125
Cl8-BZ#202-C13	88	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

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PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **325 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-06**
Associated Blank: **SS111506B09**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/25/06	10/27/06	11/15/06	11/29/06	46.5	5.88	2	1	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**73**
Cl3-BZ#18	**150**
Cl3-BZ#28/#31[1]	**720** E
Cl4-BZ#44	**220**
Cl4-BZ#52	**370** E
Cl4-BZ#43/#49[1]	**320**
Cl4-BZ#66	**350** E
Cl5-BZ#101/#84[1]	**940** E
Cl5-BZ#87	**280**
Cl7-BZ#184	0.37 U
Cl5-BZ#105	**250**
Cl5-BZ#118	**620** E
Cl7-BZ#183	**120**
Cl6-BZ#167/#128[1]	**150**
Cl6-BZ#138/#163[1]	**810** E
Cl6-BZ#153	**870** E
Cl7-BZ#170/#190[1]	**210**
Cl7-BZ#180	**440** E
Cl7-BZ#182/#187[1]	**300**
Cl8-BZ#195	**42**
Cl9-BZ#206	**33**
Cl10-BZ#209	**9.4**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	78	50-125
Cl8-BZ#202-C13	80	50-125

N/A - Not Applicable
E - Estimated value, exceeds the upper limit of calibration.
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/01/06 16:00

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **325 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-06E**
Associated Blank: **SS111506B09**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/25/06	10/27/06	11/15/06	11/29/06	46.5	5.88	2	10	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**80**
Cl3-BZ#18	**160**
Cl3-BZ#28/#31[1]	**780**
Cl4-BZ#44	**260**
Cl4-BZ#52	**400**
Cl4-BZ#43/#49[1]	**340**
Cl4-BZ#66	**380**
Cl5-BZ#101/#84[1]	**1000**
Cl5-BZ#87	**310**
Cl7-BZ#184	3.7 U
Cl5-BZ#105	**270**
Cl5-BZ#118	**650**
Cl7-BZ#183	**130**
Cl6-BZ#167/#128[1]	**160**
Cl6-BZ#138/#163[1]	**870**
Cl6-BZ#153	**940**
Cl7-BZ#170/#190[1]	**220**
Cl7-BZ#180	**470**
Cl7-BZ#182/#187[1]	**340**
Cl8-BZ#195	**48**
Cl9-BZ#206	**34**
Cl10-BZ#209	**13**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	96	50-125
Cl8-BZ#202-C13	95	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/01/06 14:57

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **327 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-07**
Associated Blank: **SS111506B09**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/25/06	10/27/06	11/15/06	11/29/06	36.6	5.67	2	1	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**100**
Cl3-BZ#18	**180**
Cl3-BZ#28/#31[1]	**1000** E
Cl4-BZ#44	**280**
Cl4-BZ#52	**490** E
Cl4-BZ#43/#49[1]	**540**
Cl4-BZ#66	**510** E
Cl5-BZ#101/#84[1]	**810** E
Cl5-BZ#87	**190**
Cl7-BZ#184	0.48 U
Cl5-BZ#105	**210**
Cl5-BZ#118	**650** E
Cl7-BZ#183	**57**
Cl6-BZ#167/#128[1]	**120**
Cl6-BZ#138/#163[1]	**560**
Cl6-BZ#153	**610** E
Cl7-BZ#170/#190[1]	**110**
Cl7-BZ#180	**210**
Cl7-BZ#182/#187[1]	**140**
Cl8-BZ#195	**21**
Cl9-BZ#206	**16**
Cl10-BZ#209	**4.9**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	73	50-125
Cl8-BZ#202-C13	75	50-125

N/A - Not Applicable
E - Estimated value, exceeds the upper limit of calibration.
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/01/06 14:54

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **327 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-07E**
Associated Blank: **SS111506B09**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/25/06	10/27/06	11/15/06	11/29/06	36.6	5.67	2	5	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**120**
Cl3-BZ#18	**200**
Cl3-BZ#28/#31[1]	**1100**
Cl4-BZ#44	**310**
Cl4-BZ#52	**520**
Cl4-BZ#43/#49[1]	**570**
Cl4-BZ#66	**540**
Cl5-BZ#101/#84[1]	**880**
Cl5-BZ#87	**200**
Cl7-BZ#184	2.4 U
Cl5-BZ#105	**230**
Cl5-BZ#118	**700**
Cl7-BZ#183	**63**
Cl6-BZ#167/#128[1]	**140**
Cl6-BZ#138/#163[1]	**610**
Cl6-BZ#153	**660**
Cl7-BZ#170/#190[1]	**110**
Cl7-BZ#180	**220**
Cl7-BZ#182/#187[1]	**160**
Cl8-BZ#195	**26**
Cl9-BZ#206	**18**
Cl10-BZ#209	**7.0**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	85	50-125
Cl8-BZ#202-C13	86	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/01/06 14:57

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **328 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-08**
Associated Blank: **SS111506B09**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/25/06	10/27/06	11/15/06	11/29/06	32.1	5.20	2	1	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**70**
Cl3-BZ#18	**130**
Cl3-BZ#28/#31[1]	**720**
Cl4-BZ#44	**170**
Cl4-BZ#52	**330**
Cl4-BZ#43/#49[1]	**410**
Cl4-BZ#66	**300**
Cl5-BZ#101/#84[1]	**530**
Cl5-BZ#87	**96**
Cl7-BZ#184	0.60 U
Cl5-BZ#105	**120**
Cl5-BZ#118	**430**
Cl7-BZ#183	**47**
Cl6-BZ#167/#128[1]	**80**
Cl6-BZ#138/#163[1]	**390**
Cl6-BZ#153	**450**
Cl7-BZ#170/#190[1]	**82**
Cl7-BZ#180	**170**
Cl7-BZ#182/#187[1]	**120**
Cl8-BZ#195	**18**
Cl9-BZ#206	**13**
Cl10-BZ#209	**4.3**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	74	50-125
Cl8-BZ#202-C13	79	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

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PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **331 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-09**
Associated Blank: **SS111506B09**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/25/06	10/27/06	11/15/06	11/29/06	57.0	5.29	2	1	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**1.5**
Cl3-BZ#18	**2.7**
Cl3-BZ#28/#31[1]	**14**
Cl4-BZ#44	**4.0**
Cl4-BZ#52	**7.6**
Cl4-BZ#43/#49[1]	**8.7**
Cl4-BZ#66	**6.0**
Cl5-BZ#101/#84[1]	**12**
Cl5-BZ#87	**2.3**
Cl7-BZ#184	0.33 U
Cl5-BZ#105	**2.7**
Cl5-BZ#118	**9.2**
Cl7-BZ#183	**1.6**
Cl6-BZ#167/#128[1]	**3.0**
Cl6-BZ#138/#163[1]	**8.4**
Cl6-BZ#153	**10**
Cl7-BZ#170/#190[1]	**1.7**
Cl7-BZ#180	**3.9**
Cl7-BZ#182/#187[1]	**2.8**
Cl8-BZ#195	0.33 U
Cl9-BZ#206	0.33 U
Cl10-BZ#209	0.33 U

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	82	50-125
Cl8-BZ#202-C13	76	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

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PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **333 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-10**
Associated Blank: **SS111506B09**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/24/06	10/27/06	11/15/06	11/29/06	54.3	5.78	2	1	TLW

Parameter	Result	
Cl2-BZ#5/#8[1]	**220**	
Cl3-BZ#18	**610**	E
Cl3-BZ#28/#31[1]	**2400**	E
Cl4-BZ#44	**590**	E
Cl4-BZ#52	**880**	E
Cl4-BZ#43/#49[1]	**900**	E
Cl4-BZ#66	**910**	E
Cl5-BZ#101/#84[1]	**1100**	E
Cl5-BZ#87	**400**	E
Cl7-BZ#184	0.32	U
Cl5-BZ#105	**360**	E
Cl5-BZ#118	**840**	E
Cl7-BZ#183	**28**	
Cl6-BZ#167/#128[1]	**150**	
Cl6-BZ#138/#163[1]	**640**	E
Cl6-BZ#153	**500**	E
Cl7-BZ#170/#190[1]	**61**	
Cl7-BZ#180	**94**	
Cl7-BZ#182/#187[1]	**56**	
Cl8-BZ#195	**5.6**	
Cl9-BZ#206	**8.3**	
Cl10-BZ#209	**2.9**	

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	80	50-125
Cl8-BZ#202-C13	82	50-125

N/A - Not Applicable
E - Estimated value, exceeds the upper limit of calibration.
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/01/06 14:55

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **333 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-10E**
Associated Blank: **SS111506B09**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/24/06	10/27/06	11/15/06	11/29/06	54.3	5.78	2	10	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**190**
Cl3-BZ#18	**560**
Cl3-BZ#28/#31[1]	**2200**
Cl4-BZ#44	**570**
Cl4-BZ#52	**840**
Cl4-BZ#43/#49[1]	**850**
Cl4-BZ#66	**850**
Cl5-BZ#101/#84[1]	**1100**
Cl5-BZ#87	**380**
Cl7-BZ#184	3.2 U
Cl5-BZ#105	**350**
Cl5-BZ#118	**790**
Cl7-BZ#183	**32**
Cl6-BZ#167/#128[1]	**150**
Cl6-BZ#138/#163[1]	**620**
Cl6-BZ#153	**490**
Cl7-BZ#170/#190[1]	**64**
Cl7-BZ#180	**94**
Cl7-BZ#182/#187[1]	**64**
Cl8-BZ#195	**7.2**
Cl9-BZ#206	**8.7**
Cl10-BZ#209	**4.4**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	91	50-125
Cl8-BZ#202-C13	97	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/01/06 16:09

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **334 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-11**
Associated Blank: **SS111506B09**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/24/06	10/27/06	11/15/06	11/29/06	50.7	5.40	2	1	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**40**
Cl3-BZ#18	**93**
Cl3-BZ#28/#31[1]	**550**
Cl4-BZ#44	**120**
Cl4-BZ#52	**280**
Cl4-BZ#43/#49[1]	**310**
Cl4-BZ#66	**220**
Cl5-BZ#101/#84[1]	**360**
Cl5-BZ#87	**85**
Cl7-BZ#184	0.36 U
Cl5-BZ#105	**87**
Cl5-BZ#118	**290**
Cl7-BZ#183	**11**
Cl6-BZ#167/#128[1]	**50**
Cl6-BZ#138/#163[1]	**210**
Cl6-BZ#153	**220**
Cl7-BZ#170/#190[1]	**20**
Cl7-BZ#180	**33**
Cl7-BZ#182/#187[1]	**25**
Cl8-BZ#195	**2.5**
Cl9-BZ#206	**3.6**
Cl10-BZ#209	**1.8**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	78	50-125
Cl8-BZ#202-C13	81	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/01/06 14:55

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **335 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-12**
Associated Blank: **SS111506B09**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/24/06	10/27/06	11/15/06	11/29/06	64.3	5.39	2	1	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**57**
Cl3-BZ#18	**160**
Cl3-BZ#28/#31[1]	**640** E
Cl4-BZ#44	**190**
Cl4-BZ#52	**370** E
Cl4-BZ#43/#49[1]	**320**
Cl4-BZ#66	**270** E
Cl5-BZ#101/#84[1]	**580** E
Cl5-BZ#87	**180**
Cl7-BZ#184	0.29 U
Cl5-BZ#105	**160**
Cl5-BZ#118	**440** E
Cl7-BZ#183	**15**
Cl6-BZ#167/#128[1]	**84**
Cl6-BZ#138/#163[1]	**340**
Cl6-BZ#153	**290** E
Cl7-BZ#170/#190[1]	**31**
Cl7-BZ#180	**50**
Cl7-BZ#182/#187[1]	**31**
Cl8-BZ#195	**3.5**
Cl9-BZ#206	**4.6**
Cl10-BZ#209	**2.2**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	75	50-125
Cl8-BZ#202-C13	85	50-125

N/A - Not Applicable
E - Estimated value, exceeds the upper limit of calibration.
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/01/06 14:55

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **335 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-12E**
Associated Blank: **SS111506B09**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/24/06	10/27/06	11/15/06	11/29/06	64.3	5.39	2	5	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**53**
Cl3-BZ#18	**150**
Cl3-BZ#28/#31[1]	**600**
Cl4-BZ#44	**180**
Cl4-BZ#52	**350**
Cl4-BZ#43/#49[1]	**300**
Cl4-BZ#66	**260**
Cl5-BZ#101/#84[1]	**560**
Cl5-BZ#87	**170**
Cl7-BZ#184	1.4 U
Cl5-BZ#105	**160**
Cl5-BZ#118	**430**
Cl7-BZ#183	**14**
Cl6-BZ#167/#128[1]	**81**
Cl6-BZ#138/#163[1]	**330**
Cl6-BZ#153	**280**
Cl7-BZ#170/#190[1]	**33**
Cl7-BZ#180	**50**
Cl7-BZ#182/#187[1]	**31**
Cl8-BZ#195	**7.8**
Cl9-BZ#206	**3.9**
Cl10-BZ#209	1.4 U

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	81	50-125
Cl8-BZ#202-C13	82	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/01/06 14:57

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **336 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-13**
Associated Blank: **SS111506B09**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/24/06	10/27/06	11/15/06	11/29/06	56.4	5.81	2	1	TLW

Parameter	Result	
Cl2-BZ#5/#8[1]	**73**	
Cl3-BZ#18	**170**	
Cl3-BZ#28/#31[1]	**800**	E
Cl4-BZ#44	**290**	E
Cl4-BZ#52	**640**	E
Cl4-BZ#43/#49[1]	**510**	E
Cl4-BZ#66	**320**	E
Cl5-BZ#101/#84[1]	**1000**	E
Cl5-BZ#87	**350**	E
Cl7-BZ#184	0.31	U
Cl5-BZ#105	**310**	E
Cl5-BZ#118	**820**	E
Cl7-BZ#183	**28**	
Cl6-BZ#167/#128[1]	**170**	
Cl6-BZ#138/#163[1]	**700**	E
Cl6-BZ#153	**540**	E
Cl7-BZ#170/#190[1]	**65**	
Cl7-BZ#180	**92**	
Cl7-BZ#182/#187[1]	**51**	
Cl8-BZ#195	**6.5**	
Cl9-BZ#206	**6.8**	
Cl10-BZ#209	**4.3**	

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	75	50-125
Cl8-BZ#202-C13	81	50-125

N/A - Not Applicable
E - Estimated value, exceeds the upper limit of calibration.
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/01/06 14:56

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **336 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-13E**
Associated Blank: **SS111506B09**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/24/06	10/27/06	11/15/06	11/30/06	56.4	5.81	2	10	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**71**
Cl3-BZ#18	**160**
Cl3-BZ#28/#31[1]	**760**
Cl4-BZ#44	**300**
Cl4-BZ#52	**630**
Cl4-BZ#43/#49[1]	**500**
Cl4-BZ#66	**320**
Cl5-BZ#101/#84[1]	**1100**
Cl5-BZ#87	**360**
Cl7-BZ#184	3.0 U
Cl5-BZ#105	**320**
Cl5-BZ#118	**820**
Cl7-BZ#183	**30**
Cl6-BZ#167/#128[1]	**180**
Cl6-BZ#138/#163[1]	**710**
Cl6-BZ#153	**560**
Cl7-BZ#170/#190[1]	**66**
Cl7-BZ#180	**97**
Cl7-BZ#182/#187[1]	**55**
Cl8-BZ#195	**9.2**
Cl9-BZ#206	**7.9**
Cl10-BZ#209	3.0 U

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	96	50-125
Cl8-BZ#202-C13	92	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/01/06 14:58

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **337 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-14**
Associated Blank: **SS111506B09**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/24/06	10/27/06	11/15/06	11/29/06	41.0	5.72	2	1	TLW

Parameter	Result	
Cl2-BZ#5/#8[1]	**600**	
Cl3-BZ#18	**1500**	E
Cl3-BZ#28/#31[1]	**7900**	E
Cl4-BZ#44	**1800**	E
Cl4-BZ#52	**2400**	E
Cl4-BZ#43/#49[1]	**2900**	E
Cl4-BZ#66	**3500**	E
Cl5-BZ#101/#84[1]	**3400**	E
Cl5-BZ#87	**1200**	E
Cl7-BZ#184	0.43	U
Cl5-BZ#105	**1200**	E
Cl5-BZ#118	**2700**	E
Cl7-BZ#183	**89**	
Cl6-BZ#167/#128[1]	**460**	
Cl6-BZ#138/#163[1]	**1900**	E
Cl6-BZ#153	**1500**	E
Cl7-BZ#170/#190[1]	**210**	
Cl7-BZ#180	**310**	
Cl7-BZ#182/#187[1]	**180**	
Cl8-BZ#195	**24**	
Cl9-BZ#206	**25**	
Cl10-BZ#209	**6.3**	

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	79	50-125
Cl8-BZ#202-C13	83	50-125

N/A - Not Applicable
E - Estimated value, exceeds the upper limit of calibration.
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/01/06 14:56

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **337 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-14E**
Associated Blank: **SS111506B09**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
10/24/06	10/27/06	11/15/06	11/30/06	41.0	5.72	2	20	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**680**
Cl3-BZ#18	**1700**
Cl3-BZ#28/#31[1]	**9300**
Cl4-BZ#44	**2100**
Cl4-BZ#52	**2900**
Cl4-BZ#43/#49[1]	**3400**
Cl4-BZ#66	**4000**
Cl5-BZ#101/#84[1]	**4000**
Cl5-BZ#87	**1300**
Cl7-BZ#184	8.5 U
Cl5-BZ#105	**1200**
Cl5-BZ#118	**2900**
Cl7-BZ#183	**96**
Cl6-BZ#167/#128[1]	**480**
Cl6-BZ#138/#163[1]	**2000**
Cl6-BZ#153	**1600**
Cl7-BZ#170/#190[1]	**220**
Cl7-BZ#180	**330**
Cl7-BZ#182/#187[1]	**210**
Cl8-BZ#195	**30**
Cl9-BZ#206	**28**
Cl10-BZ#209	8.5 U

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	96	50-125
Cl8-BZ#202-C13	101	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/01/06 15:33

Blank
PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **Blank**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **SS111506B09**
Associated Blank: **N/A**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
N/A	N/A	11/15/06	11/29/06	100	5.00	2	1	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	0.40 U
Cl3-BZ#18	0.20 U
Cl3-BZ#28/#31[1]	0.40 U
Cl4-BZ#44	0.20 U
Cl4-BZ#52	0.20 U
Cl4-BZ#43/#49[1]	0.40 U
Cl4-BZ#66	0.20 U
Cl5-BZ#101/#84[1]	0.40 U
Cl5-BZ#87	0.20 U
Cl7-BZ#184	0.20 U
Cl5-BZ#105	0.20 U
Cl5-BZ#118	0.20 U
Cl7-BZ#183	0.20 U
Cl6-BZ#167/#128[1]	0.40 U
Cl6-BZ#138/#163[1]	0.40 U
Cl6-BZ#153	0.20 U
Cl7-BZ#170/#190[1]	0.40 U
Cl7-BZ#180	0.20 U
Cl7-BZ#182/#187[1]	0.40 U
Cl8-BZ#195	0.20 U
Cl9-BZ#206	0.20 U
Cl10-BZ#209	0.20 U

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	86	50-125
Cl8-BZ#202-C13	90	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

375 Paramount Drive, Suite 2, Raynham, Massachusetts 02767, (508) 822-9300, Fax (508) 822-3288

Laboratory Control Summary
PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **Laboratory Control Sample**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **See Below**
Associated Blank: **SS111506B09**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Percent Solid	Analyst
N/A	N/A	11/15/06	100	TLW

Lab ID:	SS111506B09		SS111506LCS06		SS111506LCSD06				
Parameter	**Blank Conc.**		**LCS Conc.**	**LCS % Recovery**	**LCSD Conc.**	**LCSD % Recovery**	**% RPD**	**RPD Limit**	**% Recovery Limits**
Cl2-BZ#5/#8[1]	0.40	U	4.8	60	4.5	56	6	50	40-140
Cl3-BZ#18	0.20	U	5.0	62	5.0	62	0	50	40-140
Cl3-BZ#28/#31[1]	0.40	U	9.9	62	9.5	59	4	50	40-140
Cl4-BZ#44	0.20	U	4.9	61	4.9	61	1	50	40-140
Cl4-BZ#52	0.20	U	5.0	62	4.9	61	1	50	40-140
Cl4-BZ#43/#49[1]	0.40	U	5.5	69	5.8	72	5	50	40-140
Cl4-BZ#66	0.20	U	5.7	71	5.5	68	4	50	40-140
Cl5-BZ#101/#84[1]	0.40	U	5.8	72	6.0	74	3	50	40-140
Cl5-BZ#87	0.20	U	5.0	62	5.0	63	1	50	40-140
Cl5-BZ#105	0.20	U	5.7	71	5.8	72	1	50	40-140
Cl5-BZ#118	0.20	U	5.4	67	5.3	67	0	50	40-140
Cl7-BZ#183	0.20	U	5.9	74	6.2	77	5	50	40-140
Cl6-BZ#167/#128[1]	0.40	U	12	72	13	80	11	50	40-140
Cl6-BZ#138/#163[1]	0.40	U	5.1	64	5.3	66	3	50	40-140
Cl6-BZ#153	0.20	U	5.9	73	6.1	76	3	50	40-140
Cl7-BZ#170/#190[1]	0.40	U	5.1	63	5.6	70	10	50	40-140
Cl7-BZ#180	0.20	U	5.6	70	6.3	79	12	50	40-140
Cl7-BZ#182/#187[1]	0.40	U	6.3	78	6.7	84	7	50	40-140
Cl8-BZ#195	0.20	U	5.7	72	6.3	78	9	50	40-140
Cl9-BZ#206	0.20	U	6.0	74	6.6	82	10	50	40-140
Cl10-BZ#209	0.20	U	6.0	76	6.5	82	8	50	40-140

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery		Acceptance Range (%)
Cl3-BZ#19-C13	75	73	50-125
Cl8-BZ#202-C13	73	81	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

Concentrations reported as calculated values, which includes rounding for significant figures. Percent recoveries and RPD values are calculated from the unrounded result.

12/01/06 14:59

EXTRACTABLE PETROLEUM HYDROCARBONS (EPH)

Extractable Petroleum Hydrocarbons by GC/FID

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **325 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-06**
Associated Blank: **ES111506B10**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Percent Solid	Sample Amount (g)	Fraction	Date Analyzed	Final Volume (ml)	Dilution Factor	Analyst
10/25/06	10/27/06	11/15/06	46.5	10.70	Aromatic	11/22/06	1	1	JBS
					Aliphatic	11/22/06	1	1	JBS

Parameter	Result
C_9-C_{18} Aliphatics [1]	**880000**
C_{19}-C_{36} Aliphatics [1]	**2200000**
C_{11}-C_{22} Aromatics [1,2]	**1000000**
Unadjusted C_{11}-C_{22} Aromatics [1]	**1100000**

Naphthalene	1000 U
2-Methylnaphthalene	1000 U
Acenaphthylene	1000 U
Acenaphthene	1000 U
Fluorene	1000 U
Phenanthrene	**2400**
Anthracene	**1200**
Fluoranthene	**8500**
Pyrene	**10000**
Benzo(a)anthracene	**5700**
Chrysene	**5200**
Benzo(b)fluoranthene	**5600**
Benzo(k)fluoranthene	**2400**
Benzo(a)pyrene	**4100**
Indeno(1,2,3-cd)pyrene [3]	**3700**
Dibenzo(a,h)anthracene [3]	**3700**
Benzo(g,h,i)perylene	**2800**

[1] = Range concentration excludes the concentration of any surrogate(s) and/or internal standards eluting in that range.
[2] = C11-C22 Aromatic Hydrocarbons exclude the concentration of Target PAH Analytes.
[3] = Values reported reflect their sum.

Extraction Surrogate	% Recovery	Acceptance Range (%)
5-alpha Androstane	68	40-140
ortho-Terphenyl	66	40-140
Fractionation Surrogate		
Biphenyl	92	40-140
2-Fluorobiphenyl	88	40-140

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

11/28/06 12:12

Extractable Petroleum Hydrocarbons by GC/FID

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **327 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-07**
Associated Blank: **ES111506B10**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Percent Solid	Sample Amount (g)	Fraction	Date Analyzed	Final Volume (ml)	Dilution Factor	Analyst
10/25/06	10/27/06	11/15/06	36.6	10.83	Aromatic	11/27/06	1	1	JBS
					Aliphatic	11/27/06	1	1	JBS

Parameter	Result
C_9-C_{18} Aliphatics [1]	**1100000**
C_{19}-C_{36} Aliphatics [1]	**2300000**
C_{11}-C_{22} Aromatics [1,2]	**1000000**
Unadjusted C_{11}-C_{22} Aromatics [1]	**1000000**

Naphthalene	1300	U
2-Methylnaphthalene	1300	U
Acenaphthylene	**2100**	
Acenaphthene	1300	U
Fluorene	**1300**	
Phenanthrene	**1500**	
Anthracene	1300	U
Fluoranthene	**3900**	
Pyrene	**4800**	
Benzo(a)anthracene	**1700**	
Chrysene	**1700**	
Benzo(b)fluoranthene	**2400**	
Benzo(k)fluoranthene	1300	U
Benzo(a)pyrene	**1700**	
Indeno(1,2,3-cd)pyrene [3]	2500	U
Dibenzo(a,h)anthracene [3]	2500	U
Benzo(g,h,i)perylene	1300	U

[1] = Range concentration excludes the concentration of any surrogate(s) and/or internal standards eluting in that range.
[2] = C11-C22 Aromatic Hydrocarbons exclude the concentration of Target PAH Analytes.
[3] = Values reported reflect their sum.

Extraction Surrogate	% Recovery	Acceptance Range (%)
5-alpha Androstane	73	40-140
ortho-Terphenyl	84	40-140
Fractionation Surrogate		
Biphenyl	94	40-140
2-Fluorobiphenyl	89	40-140

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

11/28/06 12:12

Extractable Petroleum Hydrocarbons by GC/FID

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **333 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-10**
Associated Blank: **ES111506B10**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Percent Solid	Sample Amount (g)	Fraction	Date Analyzed	Final Volume (ml)	Dilution Factor	Analyst
10/24/06	10/27/06	11/15/06	54.3	10.17	Aromatic	11/27/06	1	1	JBS
					Aliphatic	11/27/06	1	1	JBS

Parameter	Result
C_9-C_{18} Aliphatics [1]	**200000**
C_{19}-C_{36} Aliphatics [1]	**830000**
C_{11}-C_{22} Aromatics [1,2]	**320000**
Unadjusted C_{11}-C_{22} Aromatics [1]	**330000**

Naphthalene	910	U
2-Methylnaphthalene	910	U
Acenaphthylene	910	U
Acenaphthene	910	U
Fluorene	910	U
Phenanthrene	910	U
Anthracene	910	U
Fluoranthene	**1800**	
Pyrene	**2700**	
Benzo(a)anthracene	**1400**	
Chrysene	**1200**	
Benzo(b)fluoranthene	**1600**	
Benzo(k)fluoranthene	910	U
Benzo(a)pyrene	**1300**	
Indeno(1,2,3-cd)pyrene [3]	1800	U
Dibenzo(a,h)anthracene [3]	1800	U
Benzo(g,h,i)perylene	910	U

[1] = Range concentration excludes the concentration of any surrogate(s) and/or internal standards eluting in that range.
[2] = C11-C22 Aromatic Hydrocarbons exclude the concentration of Target PAH Analytes.
[3] = Values reported reflect their sum.

Extraction Surrogate	% Recovery	Acceptance Range (%)
5-alpha Androstane	71	40-140
ortho-Terphenyl	76	40-140
Fractionation Surrogate		
Biphenyl	89	40-140
2-Fluorobiphenyl	85	40-140

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

11/28/06 12:12

Extractable Petroleum Hydrocarbons by GC/FID

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **335 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-12**
Associated Blank: **ES111506B10**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Percent Solid	Sample Amount (g)	Fraction	Date Analyzed	Final Volume (ml)	Dilution Factor	Analyst
10/24/06	10/27/06	11/15/06	64.3	10.54	Aromatic	11/22/06	1	1	JBS
					Aliphatic	11/22/06	1	1	JBS

Parameter	Result
C_9-C_{18} Aliphatics [1]	**150000**
C_{19}-C_{36} Aliphatics [1]	**650000**
C_{11}-C_{22} Aromatics [1,2]	**430000**
Unadjusted C_{11}-C_{22} Aromatics [1]	**520000**

Naphthalene	**800**
2-Methylnaphthalene	740 U
Acenaphthylene	740 U
Acenaphthene	**1500**
Fluorene	**2200**
Phenanthrene	**15000**
Anthracene	**4000**
Fluoranthene	**16000**
Pyrene	**16000**
Benzo(a)anthracene	**7400**
Chrysene	**7700**
Benzo(b)fluoranthene	**7900**
Benzo(k)fluoranthene	**2900**
Benzo(a)pyrene	**6000**
Indeno(1,2,3-cd)pyrene [3]	**4600**
Dibenzo(a,h)anthracene [3]	**4600**
Benzo(g,h,i)perylene	**3100**

[1] = Range concentration excludes the concentration of any surrogate(s) and/or internal standards eluting in that range.
[2] = C11-C22 Aromatic Hydrocarbons exclude the concentration of Target PAH Analytes.
[3] = Values reported reflect their sum.

Extraction Surrogate	% Recovery	Acceptance Range (%)
5-alpha Androstane	72	40-140
ortho-Terphenyl	78	40-140
Fractionation Surrogate		
Biphenyl	86	40-140
2-Fluorobiphenyl	81	40-140

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

11/28/06 12:12

Extractable Petroleum Hydrocarbons by GC/FID

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **336 0-1**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-13**
Associated Blank: **ES111506B10**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Percent Solid	Sample Amount (g)	Fraction	Date Analyzed	Final Volume (ml)	Dilution Factor	Analyst
10/24/06	10/27/06	11/15/06	56.4	10.98	Aromatic	11/22/06	1	1	JBS
					Aliphatic	11/22/06	1	1	JBS

Parameter	Result
C_9-C_{18} Aliphatics [1]	**120000**
C_{19}-C_{36} Aliphatics [1]	**870000**
C_{11}-C_{22} Aromatics [1,2]	**360000**
Unadjusted C_{11}-C_{22} Aromatics [1]	**380000**

Naphthalene	810	U
2-Methylnaphthalene	810	U
Acenaphthylene	810	U
Acenaphthene	810	U
Fluorene	810	U
Phenanthrene	**1600**	
Anthracene	810	U
Fluoranthene	**3500**	
Pyrene	**5400**	
Benzo(a)anthracene	**2000**	
Chrysene	**2400**	
Benzo(b)fluoranthene	**2900**	
Benzo(k)fluoranthene	**1100**	
Benzo(a)pyrene	**1600**	
Indeno(1,2,3-cd)pyrene [3]	1600	U
Dibenzo(a,h)anthracene [3]	1600	U
Benzo(g,h,i)perylene	**940**	

[1] = Range concentration excludes the concentration of any surrogate(s) and/or internal standards eluting in that range.
[2] = C11-C22 Aromatic Hydrocarbons exclude the concentration of Target PAH Analytes.
[3] = Values reported reflect their sum.

Extraction Surrogate	% Recovery	Acceptance Range (%)
5-alpha Androstane	72	40-140
ortho-Terphenyl	75	40-140
Fractionation Surrogate		
Biphenyl	81	40-140
2-Fluorobiphenyl	77	40-140

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

11/28/06 12:12

Blank
Extractable Petroleum Hydrocarbons by GC/FID

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **Blank**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **ES111506B10**
Associated Blank: **N/A**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Percent Solid	Sample Amount (g)	Fraction	Date Analyzed	Final Volume (ml)	Dilution Factor	Analyst
N/A	N/A	11/15/06	100	10.00	Aromatic	11/22/06	1	1	JBS
					Aliphatic	11/22/06	1	1	JBS

Parameter	Result	
C_9-C_{18} Aliphatics [1]	3000	U
C_{19}-C_{36} Aliphatics [1]	4000	U
C_{11}-C_{22} Aromatics [1,2]	8500	U
Unadjusted C_{11}-C_{22} Aromatics [1]	8500	U
Naphthalene	500	U
2-Methylnaphthalene	500	U
Acenaphthylene	500	U
Acenaphthene	500	U
Fluorene	500	U
Phenanthrene	500	U
Anthracene	500	U
Fluoranthene	500	U
Pyrene	500	U
Benzo(a)anthracene	500	U
Chrysene	500	U
Benzo(b)fluoranthene	500	U
Benzo(k)fluoranthene	500	U
Benzo(a)pyrene	500	U
Indeno(1,2,3-cd)pyrene [3]	1000	U
Dibenzo(a,h)anthracene [3]	1000	U
Benzo(g,h,i)perylene	500	U

[1] = Range concentration excludes the concentration of any surrogate(s) and/or internal standards eluting in that range.
[2] = C11-C22 Aromatic Hydrocarbons exclude the concentration of Target PAH Analytes.
[3] = Values reported reflect their sum.

Extraction Surrogate	% Recovery	Acceptance Range (%)
5-alpha Androstane	70	40-140
ortho-Terphenyl	74	40-140
Fractionation Surrogate		
Biphenyl	88	40-140
2-Fluorobiphenyl	86	40-140

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

11/28/06 12:12

Laboratory Control Summary
Extractable Petroleum Hydrocarbons by GC/FID

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **Laboratory Control Sample**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **See Below**
Associated Blank: **ES111506B10**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Percent Solid	Analyst
N/A	N/A	11/15/06	100	JBS

Lab ID:	ES111506B10		ES111506LCS07		ES111506LCSD07				
Parameter	**Blank Conc.**		**LCS Conc.**	**LCS % Recovery**	**LCSD Conc.**	**LCSD % Recovery**	**% RPD**	**RPD Limit**	**% Recovery Limits**
Naphthalene	500	U	5800	58	5700	57	2	25	40-140
2-Methylnaphthalene	500	U	6300	63	6200	62	2	25	40-140
Acenaphthylene	500	U	6800	68	6700	67	2	25	40-140
Acenaphthene	500	U	6900	69	6800	68	2	25	40-140
Fluorene	500	U	7400	75	7300	73	2	25	40-140
Phenanthrene	500	U	7700	77	7600	75	2	25	40-140
Anthracene	500	U	7600	76	7400	75	2	25	40-140
Fluoranthene	500	U	7600	76	7500	75	2	25	40-140
Pyrene	500	U	7900	79	7700	77	2	25	40-140
Benzo(a)anthracene	500	U	7800	78	7600	76	2	25	40-140
Chrysene	500	U	7900	79	7800	78	1	25	40-140
Benzo(b)fluoranthene	500	U	8000	80	7900	79	2	25	40-140
Benzo(k)fluoranthene	500	U	7800	78	7600	76	2	25	40-140
Benzo(a)pyrene	500	U	8100	81	8000	80	1	25	40-140
Indeno(1,2,3-cd)pyrene [3]	1000	U	16000	80	16000	79	1	25	40-140
Dibenzo(a,h)anthracene [3]	1000	U	16000	80	16000	79	1	25	40-140
Benzo(g,h,i)perylene	500	U	8100	81	8000	80	2	25	40-140
n-Nonane (C9)	500	U	3400	34	3600	36	6	25	30-140
n-Decane (C10)	500	U	4800	48	5100	51	6	25	40-140
n-Dodecane (C12)	500	U	5900	59	6300	63	7	25	40-140
n-Tetradecane (C14)	500	U	6800	68	7100	71	5	25	40-140
n-Hexadecane (C16)	500	U	7300	73	7600	76	3	25	40-140
n-Octadecane (C18)	500	U	7700	77	8000	80	3	25	40-140
n-Nonadecane (C19)	500	U	8000	80	8300	83	3	25	40-140
n-Eicosane (C20)	500	U	7900	79	8100	81	3	25	40-140
n-Docosane (C22)	500	U	7900	79	7900	79	0	25	40-140
n-Tetracosane (C24)	500	U	8000	80	8000	80	1	25	40-140
n-Hexacosane (C26)	500	U	7900	79	8000	80	1	25	40-140
n-Octacosane (C28)	500	U	7800	78	7800	78	0	25	40-140
n-Triacontane (C30)	500	U	7800	78	7800	78	0	25	40-140
n-Hexatriacontane (C36)	500	U	8400	84	8400	84	0	25	40-140

[1] = Range concentration excludes the concentration of any surrogate(s) and/or internal standards eluting in that range.
[3] = Values reported reflect their sum.

Extraction Surrogate	% Recovery		Acceptance Range (%)
5-alpha Androstane	73	76	40-140
ortho-Terphenyl	78	76	40-140
Fractionation Surrogate			
Biphenyl	85	82	40-140
2-Fluorobiphenyl	82	80	40-140

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

Concentrations reported as calculated values, which includes rounding for significant figures. Percent recoveries and RPD values are calculated from the unrounded result.

11/28/06 12:12

Laboratory Control Summary
Extractable Petroleum Hydrocarbons by GC/FID

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **Laboratory Control Sample**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **See Below**
Associated Blank: **ES111506B10**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Percent Solid	Analyst
N/A	N/A	11/15/06	100	JBS

Aliphatic Breakthrough Criteria

Lab ID:	ES111506LCS07	ES111506LCSD07	
Parameter	**LCS % Breakthrough**	**LCSD % Breakthrough**	**% Breakthrough Maximum Limit**
Naphthalene	0.1	0.1	5
2-Methylnaphthalene	0.2	0.2	5

N/A - Not Applicable

Concentrations reported as calculated values, which includes rounding for significant figures. Percent recoveries and RPD values are calculated from the unrounded result.

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TOTAL METALS

Total Metals

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: **N/A** SDG: **N/A**
Client ID: **325 0-1**
Matrix: **Sediment**
Percent Solid: **46.5**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-06**
Concentration Units: **mg/Kg**
Date Collected: **10/25/06**
Date Received: **10/27/06**

Parameter	Result	Qualifier	Reporting Limit	Dilution	Date Analyzed	Date Prepared	Analytical Method	Analyst
Arsenic	**20**		0.17	5	11/10/06	11/08/06	6020A	LCP
Barium	**330**		0.17	5	11/10/06	11/08/06	6020A	LCP
Cadmium	**5.1**		0.067	5	11/10/06	11/08/06	6020A	LCP
Chromium	**200**		1.7	5	11/10/06	11/08/06	6020A	LCP
Lead	**3000**		0.67	20	11/10/06	11/08/06	6020A	LCP
Mercury	**7.3**		0.20	20	11/09/06	11/08/06	7471A	LMR
Selenium	**3.0**		0.67	5	11/10/06	11/08/06	6020A	LCP
Silver	**1.2**		0.17	5	11/13/06	11/08/06	6020A	LMR

N/A - Not Applicable

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Total Metals

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: **N/A** SDG: **N/A**
Client ID: **327 0-1**
Matrix: **Sediment**
Percent Solid: **36.6**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-07**
Concentration Units: **mg/Kg**
Date Collected: **10/25/06**
Date Received: **10/27/06**

Parameter	Result	Qualifier	Reporting Limit	Dilution	Date Analyzed	Date Prepared	Analytical Method	Analyst
Arsenic	**49**		0.20	5	11/10/06	11/08/06	6020A	LCP
Barium	**83**		0.20	5	11/10/06	11/08/06	6020A	LCP
Cadmium	**3.7**		0.080	5	11/10/06	11/08/06	6020A	LCP
Chromium	**270**		2.0	5	11/10/06	11/08/06	6020A	LCP
Lead	**360**		0.20	5	11/10/06	11/08/06	6020A	LCP
Mercury	**2.0**		0.064	5	11/09/06	11/08/06	7471A	LMR
Selenium	**3.5**		0.80	5	11/10/06	11/08/06	6020A	LCP
Silver	**2.9**		0.20	5	11/13/06	11/08/06	6020A	LMR

N/A - Not Applicable

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Total Metals

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: **N/A** SDG: **N/A**
Client ID: **333 0-1**
Matrix: **Sediment**
Percent Solid: **54.3**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-10**
Concentration Units: **mg/Kg**
Date Collected: **10/24/06**
Date Received: **10/27/06**

Parameter	Result	Qualifier	Reporting Limit	Dilution	Date Analyzed	Date Prepared	Analytical Method	Analyst
Arsenic	**12**		0.14	5	11/10/06	11/08/06	6020A	LCP
Barium	**59**		0.14	5	11/10/06	11/08/06	6020A	LCP
Cadmium	**7.7**		0.058	5	11/10/06	11/08/06	6020A	LCP
Chromium	**360**		1.4	5	11/10/06	11/08/06	6020A	LCP
Lead	**270**		0.14	5	11/10/06	11/08/06	6020A	LCP
Mercury	**1.3**		0.045	5	11/09/06	11/08/06	7471A	LMR
Selenium	**2.1**		0.58	5	11/10/06	11/08/06	6020A	LCP
Silver	**1.8**		0.14	5	11/13/06	11/08/06	6020A	LMR

N/A - Not Applicable

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Total Metals

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: N/A SDG: N/A
Client ID: **335 0-1**
Matrix: **Sediment**
Percent Solid: **64.3**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-12**
Concentration Units: **mg/Kg**
Date Collected: **10/24/06**
Date Received: **10/27/06**

Parameter	Result	Qualifier	Reporting Limit	Dilution	Date Analyzed	Date Prepared	Analytical Method	Analyst
Arsenic	**19**		0.12	5	11/10/06	11/08/06	6020A	LCP
Barium	**52**		0.12	5	11/10/06	11/08/06	6020A	LCP
Cadmium	**2.3**		0.046	5	11/10/06	11/08/06	6020A	LCP
Chromium	**94**		1.2	5	11/10/06	11/08/06	6020A	LCP
Lead	**340**		0.12	5	11/10/06	11/08/06	6020A	LCP
Mercury	**0.98**		0.038	5	11/09/06	11/08/06	7471A	LMR
Selenium	**1.4**		0.46	5	11/10/06	11/08/06	6020A	LCP
Silver	**0.66**		0.11	5	11/13/06	11/08/06	6020A	LMR

N/A - Not Applicable

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Total Metals

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: **N/A** SDG: **N/A**
Client ID: **336 0-1**
Matrix: **Sediment**
Percent Solid: **56.4**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-13**
Concentration Units: **mg/Kg**
Date Collected: **10/24/06**
Date Received: **10/27/06**

Parameter	Result	Qualifier	Reporting Limit	Dilution	Date Analyzed	Date Prepared	Analytical Method	Analyst
Arsenic	**13**		0.13	5	11/10/06	11/08/06	6020A	LCP
Barium	**59**		0.13	5	11/10/06	11/08/06	6020A	LCP
Cadmium	**2.6**		0.051	5	11/10/06	11/08/06	6020A	LCP
Chromium	**200**		1.3	5	11/10/06	11/08/06	6020A	LCP
Lead	**710**		0.13	5	11/10/06	11/08/06	6020A	LCP
Mercury	**1.3**		0.043	5	11/09/06	11/08/06	7471A	LMR
Selenium	**1.9**		0.51	5	11/10/06	11/08/06	6020A	LCP
Silver	**1.6**		0.13	5	11/13/06	11/08/06	6020A	LMR

N/A - Not Applicable

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Blank
Total Metals

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: **N/A** SDG: **N/A**
Client ID: **Blank**
Matrix: **Sediment**
Percent Solid: **100.0**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **MS110606B06B**
Concentration Units: **mg/Kg**
Date Collected: **N/A**
Date Received: **N/A**

Parameter	Result	Qualifier	Reporting Limit	Dilution	Date Analyzed	Date Prepared	Analytical Method	Analyst
Arsenic	0.12	U	0.12	5	11/10/06	11/08/06	6020A	LCP
Barium	0.12	U	0.12	5	11/10/06	11/08/06	6020A	LCP
Cadmium	0.050	U	0.050	5	11/10/06	11/08/06	6020A	LCP
Chromium	1.2	U	1.2	5	11/10/06	11/08/06	6020A	LCP
Lead	0.12	U	0.12	5	11/10/06	11/08/06	6020A	LCP
Selenium	0.50	U	0.50	5	11/10/06	11/08/06	6020A	LCP

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

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Blank
Total Metals

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: **N/A** SDG: **N/A**
Client ID: **Blank**
Matrix: **Sediment**
Percent Solid: **100.0**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **MS110606B05B**
Concentration Units: **mg/Kg**
Date Collected: **N/A**
Date Received: **N/A**

Parameter	Result	Qualifier	Reporting Limit	Dilution	Date Analyzed	Date Prepared	Analytical Method	Analyst
Silver	0.12	U	0.12	5	11/13/06	11/08/06	6020A	LMR

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

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Blank
Total Metals

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: **N/A** SDG: **N/A**
Client ID: **Blank**
Matrix: **Sediment**
Percent Solid: **100.0**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **MS110606B07B**
Concentration Units: **mg/Kg**
Date Collected: **N/A**
Date Received: **N/A**

Parameter	Result	Qualifier	Reporting Limit	Dilution	Date Analyzed	Date Prepared	Analytical Method	Analyst
Mercury	0.010	U	0.010	1	11/09/06	11/08/06	7471A	LMR

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

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Laboratory Control Sample - High
Total Metals

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: **N/A** SDG: **N/A**
Client ID: **Lab Control Sample High**
Matrix: **Sediment**
Percent Solid: **100.0**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **MS110606SLH03SLH**
Concentration Units: **mg/Kg**
Date Collected: **N/A**
Date Received: **N/A**

Parameter	Conc.	% Recovery	% Recovery Limits
Arsenic	200	99	80-120
Barium	200	100	80-120
Cadmium	99	99	80-120
Chromium	200	100	80-120
Lead	190	96	80-120
Selenium	200	101	80-120

N/A - Not Applicable

Concentrations reported as calculated values, which includes rounding for significant figures. Percent recoveries and RPD values are calculated from the unrounded results.

375 Paramount Drive, Suite 2, Raynham, Massachusetts 02767, (508) 822-9300, Fax (508) 822-3288

Laboratory Control Sample - Low
Total Metals

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: **N/A** SDG: **N/A**
Client ID: **Lab Control Sample Low**
Matrix: **Sediment**
Percent Solid: **100.0**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **MS110606SLL02SLL**
Concentration Units: **mg/Kg**
Date Collected: **N/A**
Date Received: **N/A**

Parameter	Conc.	% Recovery	% Recovery Limits
Silver	2.2	108	80-120

N/A - Not Applicable

Concentrations reported as calculated values, which includes rounding for significant figures. Percent recoveries and RPD values are calculated from the unrounded results.

11/13/06 16:02

Laboratory Control Sample
Total Metals

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: **N/A** SDG: **N/A**
Client ID: **Laboratory Control Sample**
Matrix: **Sediment**
Percent Solid: **100.0**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **MS110606SLC02SLC**
Concentration Units: **mg/Kg**
Date Collected: **N/A**
Date Received: **N/A**

Parameter	Conc.	% Recovery	% Recovery Limits
Mercury	0.48	97	80-120

N/A - Not Applicable

Concentrations reported as calculated values, which includes rounding for significant figures. Percent recoveries and RPD values are calculated from the unrounded results.

11/13/06 16:03

WET CHEMISTRY

Inorganics

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: **N/A** SDG: **N/A**
Client ID: **325 0-1**
Matrix: **Sediment**
Percent Solid: **46.5**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-06**
Date Collected: **10/25/06**
Date Received: **10/27/06**

Parameter	Result	Qualifier	Reporting Limit	Dilution	Date Analyzed	Unit	Analytical Method	Analyst
Total Organic Carbon (Run 1)	**3.7**		0.01	1	11/15/06	%	9060	GJP
Total Organic Carbon (Run 2)	**3.9**		0.01	1	11/15/06	%	9060	GJP
Reactive Sulfide	**79**		6.6	25	11/15/06	mg/Kg	Ch.7/376.2	JAD

N/A - Not Applicable

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Inorganics

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: **N/A** SDG: **N/A**
Client ID: **327 0-1**
Matrix: **Sediment**
Percent Solid: **36.6**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-07**
Date Collected: **10/25/06**
Date Received: **10/27/06**

Parameter	Result	Qualifier	Reporting Limit	Dilution	Date Analyzed	Unit	Analytical Method	Analyst
Total Organic Carbon (Run 1)	**2.5**		0.01	1	11/15/06	%	9060	GJP
Total Organic Carbon (Run 2)	**2.2**		0.01	1	11/15/06	%	9060	GJP
Reactive Sulfide	**1300**		100	500	11/15/06	mg/Kg	Ch.7/376.2	JAD

N/A - Not Applicable

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Inorganics

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: **N/A** SDG: **N/A**
Client ID: **333 0-1**
Matrix: **Sediment**
Percent Solid: **54.3**

Lab Code: **MA00030**
ETR: **0610189**

Lab ID: **0610189-10**
Date Collected: **10/24/06**
Date Received: **10/27/06**

Parameter	Result	Qualifier	Reporting Limit	Dilution	Date Analyzed	Unit	Analytical Method	Analyst
Total Organic Carbon (Run 1)	**1.7**		0.01	1	11/15/06	%	9060	GJP
Total Organic Carbon (Run 2)	**2.0**		0.01	1	11/15/06	%	9060	GJP
Reactive Sulfide	**220**		14	50	11/15/06	mg/Kg	Ch.7/376.2	JAD

N/A - Not Applicable

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Inorganics

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: **N/A** SDG: **N/A**
Client ID: **335 0-1**
Matrix: **Sediment**
Percent Solid: **64.3**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-12**
Date Collected: **10/24/06**
Date Received: **10/27/06**

Parameter	Result	Qualifier	Reporting Limit	Dilution	Date Analyzed	Unit	Analytical Method	Analyst
Total Organic Carbon (Run 1)	**2.5**		0.01	1	11/15/06	%	9060	GJP
Total Organic Carbon (Run 2)	**2.7**		0.01	1	11/15/06	%	9060	GJP
Reactive Sulfide	**730**		57	200	11/15/06	mg/Kg	Ch.7/376.2	JAD

N/A - Not Applicable

375 Paramount Drive, Suite 2, Raynham, Massachusetts 02767, (508) 822-9300, Fax (508) 822-3288

Inorganics

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: **N/A** SDG: **N/A**
Client ID: **336 0-1**
Matrix: **Sediment**
Percent Solid: **56.4**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **0610189-13**
Date Collected: **10/24/06**
Date Received: **10/27/06**

Parameter	Result	Qualifier	Reporting Limit	Dilution	Date Analyzed	Unit	Analytical Method	Analyst
Total Organic Carbon (Run 1)	**1.1**		0.01	1	11/15/06	%	9060	GJP
Total Organic Carbon (Run 2)	**1.2**		0.01	1	11/15/06	%	9060	GJP
Reactive Sulfide	**390**		48	200	11/15/06	mg/Kg	Ch.7/376.2	JAD

N/A - Not Applicable

375 Paramount Drive, Suite 2, Raynham, Massachusetts 02767, (508) 822-9300, Fax (508) 822-3288

Blank
Inorganics

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: **N/A** SDG: **N/A**
Client ID: **Blank**
Matrix: **Sediment**
Percent Solid: **100**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **WS111506B23**
Date Collected: **N/A**
Date Received: **N/A**

Parameter	Result	Qualifier	Reporting Limit	Dilution	Date Analyzed	Unit	Analytical Method	Analyst
Reactive Sulfide	1.0	U	1.0	1	11/15/06	mg/Kg	Ch.7/376.2	JAD

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

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Blank
Inorganics

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: **N/A** SDG: **N/A**
Client ID: **Blank**
Matrix: **Sediment**
Percent Solid: **100**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **WS111606B08**
Date Collected: **N/A**
Date Received: **N/A**

Parameter	Result	Qualifier	Reporting Limit	Dilution	Date Analyzed	Unit	Analytical Method	Analyst
Total Organic Carbon (Run 1)	0.01	U	0.01	1	11/15/06	%	9060	GJP
Total Organic Carbon (Run 2)	0.01	U	0.01	1	11/15/06	%	9060	GJP

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

375 Paramount Drive, Suite 2, Raynham, Massachusetts 02767, (508) 822-9300, Fax (508) 822-3288

Laboratory Control Sample
Inorganics

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: **N/A** SDG: **N/A**
Client ID: **Laboratory Control Sample**
Matrix: **Sediment**
Percent Solid: **100**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **WS111506L07**
Date Collected: **N/A**
Date Received: **N/A**

Parameter	Conc.	% Recovery	% Recovery Limits
Reactive Sulfide	26	91	75-125

N/A - Not Applicable

Concentrations reported as calculated values, which includes rounding for significant figures. Percent recoveries and RPD values are calculated from the unrounded results.

12/01/06 08:33

Standard Reference Material 1944
Inorganics

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Case: **N/A** SDG: **N/A**
Client ID: **SRM 1944**
Matrix: **Sediment**
Percent Solid: **100**

Lab Code: **MA00030**
ETR: **0610189**
Lab ID: **WS111606L194401**
Date Collected: **N/A**
Date Received: **N/A**

Parameter	Conc.	% Recovery	% Recovery Limits
Total Organic Carbon (Run 1)	4.7	106	75-125
Total Organic Carbon (Run 2)	4.4	100	75-125

N/A - Not Applicable

Concentrations reported as calculated values, which includes rounding for significant figures. Percent recoveries and RPD values are calculated from the unrounded results.

12/01/06 08:33

CHAIN OF CUSTODY RECORDS

Sample Receipt Checklist

Page 1 of 1

Client:	APEENV	Receipt Date:	10/27/06
Project:	NB Harbor Phase II	Log-in Date:	
ETR #:	0610189	Inspection by: wr	Login by: W

ALL SECTIONS BELOW MUST BE COMPLETED

Were samples shipped? Yes, FedEx / UPS / Other:_____
No, WHG Courier pick-up / Hand delivered

Is bill of lading retained? Yes, Tracking #:_____
No, Unavailable / NA

Number of coolers received for this project delivery: 1

Indicate cooler temperature upon opening (if multiple coolers, record all temps):

Note: If all coolers are 2-6°C, use one checklist, if NOT, use separate checklists and note all samples received *above* 6°C.

Cooler 1:
Temperature(s) taken from: 4° IR Gun, 3° Temp. Blank, / NA

Were samples received on ice? Yes / No

Chain-of-Custody present? Yes / No
Complete? Yes / No

Custody seals present on Cooler? Yes / No
on Bottles? Yes / No
Intact? Yes / No / NA
Note: Affix custody seals to back of this page.

Were sample containers intact? Yes / No If No, list samples: →

Did VOA/VPH waters contain headspace (>5mm)? Yes / No / NA If Yes, list samples: →

Were 5035 VOA soils, or VPH soils, *covered* with MeOH? Yes / No / NA
If No, list samples: →

Was a sufficient amount of sample received for each test indicated on the COC?
Yes / No If No, list samples: →

If chemical preservation is appropriate -
Were samples field preserved? Yes / No / NA
☐ C=HCl ☐ M=MeOH ☐ S=H_2SO4
☐ H=NaOH ☐ N=HNO_3 ☐ Other:_____ ☐ U= Unknown

Preservation (pH) verified at lab for *EVERY* bottle? (Not: VOA / VPH / Sulfide)
YES: <2 or >12 (CN) or NO NA
If No, why?:

Were samples received within hold time? Yes / No If No, list samples: →

Discrepancy between samples rec'd & COC ? Yes / No If Yes, list samples: →

Was the Project Manager notified of any other problems? Yes / No / NA

Project Manager Acknowledgement: NAL Date: 10/27/06

Comments / Notes

Sample storage refrigerator #: C3

Sample storage freezer #:_____

Cooler 2:_____ Cooler 3:_____

Cooler 4:_____ Cooler 5:_____

Cooler 6:_____ Cooler 7:_____

More:_____

Chemical preservation OK for ALL samples?

Yes / No / N/A

If No, list samples below:

Please use back for any additional notes!

CHAIN OF CUSTODY

PAGE 3 OF 4

Date Rec'd in Lab:

ALPHA Job #: 0610189

ALPHA LABS
WESTBORO, MA TEL: 508-898-9220 FAX: 508-898-9193
RAYNHAM, MA TEL: 508-822-9300 FAX: 508-822-3288

Client Information

Client: Apex Companies, LLC
Address: 115 Broad Street, Suite 200
Boston, MA 02110
Phone: 617-728 0070 X-113
Fax: 617-728-0080
Email: cmyers@apexenv.com

☐ These samples have been previously analyzed by Alpha

Project Information

Project Name: NB Harbor Dredge Phase III
Project Location: New Bedford, MA
Project #: 6591.002
Project Manager: Chet Myers
ALPHA Quote #:

Turn-Around Time

☒ Standard ☐ RUSH (only confirmed if pre-approved!)

Date Due: Time:

Report Information - Data Deliverables

☒ FAX ☒ EMAIL
☐ ADEx ☐ Add'l Deliverables

Billing Information

☐ Same as Client info PO #:

Regulatory Requirements/Report Limits

State /Fed Program | Criteria

MA MCP PRESUMPTIVE CERTAINTY --- CT REASONABLE CONFIDENCE PROTOCOLS

☐ Yes ☒ No Are MCP Analytical Methods Required?
☐ Yes ☒ No Are CT RCP (Reasonable Confidence Protocols) Required?

Other Project Specific Requirements/Comments/Detection Limits:
Min detection Limits = As=0.5ppm, Cd=0.1ppm, Hg=0.02ppm/(Ni, Zn, Cr, Cu, Pb = 1ppm)
PCB sum of Cong = 0.001ppm, EPH = 0.01ppm, TOC = 0.1%, Rec Sulf. = 30ppm
HOLD All Samples

SAMPLE HANDLING
Filtration
☒ Done
☐ Not needed
☐ Lab to do
Preservation
☐ Lab to do
(Please specify below)

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials	RCRA 8 Metals	PCB Summation of Cong	EPH Pet. Hydrocarbon	TOC	Rec. Sulfide	Sample Specific Comments	TOTAL # BOTTLES
-1	311 0-1	10/24/06	1004AM	SED	KVN		X					
-2	311 2.5-3.5	10/24/06	1010AM	SED	KVN		X					
-3	316 0-1	10/25/06	1052AM	SED	KVN		X					
-4	319 0-1	10/23/06	1019AM	SED	KVN		X					
-5	321 0-1	10/25/06	823AM	SED	KVN		X					
-6	325 0-1	10/25/06	1215pm	SED	KVN	X	X	X	X	X		
-7	327 0-1	10/25/06	1144AM	SED	KVN	X	X	X	X	X		
-8	328 0-1	10/25/06	1216pm	SED	KVN		X					
-9	331 0-1	10/25/06	128pm	SED	KVN		X					
-10	333 0-1	10/24/06	1230pm	SED	KVN	X	X	X	X	X		

Container Type	
Preservative	

PLEASE ANSWER QUESTIONS ABOVE!

IS YOUR PROJECT MA MCP or CT RCP?

Relinquished By:	Date/Time	Received By:	Date/Time
[signature]	10/26/06 4pm	Shelly Miranda	10-26-06 4pm
Shelly Miranda	10-27-06 9:10pm	Paul Gilbert	10-27-06 9:10
Paul Gilbert	10-27-06 0945	[signature]	10/27/06 0945

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Payment Terms. See reverse side.

FORM NO: 01-01 (rev. 10-OCT-05)

CHAIN OF CUSTODY

PAGE 4 OF 4

Date Rec'd in Lab:

ALPHA Job #: 0610189

WESTBORO, MA
TEL: 508-898-9220
FAX: 508-898-9193

RAYNHAM, MA
TEL: 508-822-9300
FAX: 508-822-3288

Client Information

Client: Apex Companies

Address: 115 Broad St. Suite 2000, 02110

Phone: 617-728-0070

Fax: 617-728-0080

Email: cmyers@apexenv.com

☐ These samples have been previously analyzed by Alpha

Project Information

Project Name: New Bedford Harbor Pre-Case Phase III

Project Location: New Bedford, MA

Project #: 6591.002

Project Manager: Chet Myers

ALPHA Quote #:

Turn-Around Time

☒ Standard ☐ RUSH (only confirmed if pre-approved!)

Date Due: Time:

Report Information - Data Deliverables

☒ FAX ☒ EMAIL

☐ ADEx ☐ Add'l Deliverables

Billing Information

☐ Same as Client info PO #:

Regulatory Requirements/Report Limits

State /Fed Program | Criteria

MA MCP PRESUMPTIVE CERTAINTY --- CT REASONABLE CONFIDENCE PROTOCOLS

☐ Yes ☒ No Are MCP Analytical Methods Required?

☐ Yes ☒ No Are CT RCP (Reasonable Confidence Protocols) Required?

Other Project Specific Requirements/Comments/Detection Limits:

(In Detection Limits: As=0.15ppm, Hg=0.02ppm, Cd=0.1ppm, TOC=0.1%, Rec Sulf=30ppm, EPH=0.01ppm, PCB Sum of Congs=0.001 ppm, Ni, Zn, Cr, Cu, Pb=1ppm HOLD ALL Samples

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials	PCB Summation (Aroclors)	TOC	Reactive Sulfide RCRA 8 Metals	EPH (Ref Hyd)													TOTAL # BOTTLES
-11	334 0-1	10/24/06	210pm	SED	KVN	X																
-12	335 0-1	10/24/06	1200pm	SED	KVN	X	X	X	X	X												
-13	336 0-1	10/24/06	130pm	SED	KVN	X	X	X	X	X												
-14	337 0-1	10/24/06	210pm	SED	KVN	X																

SAMPLE HANDLING

Filtration
☐ Done
☐ Not needed
☐ Lab to do

Preservation
☐ Lab to do
(Please specify below)

Sample Specific Comments

Container Type																	
Preservative																	

PLEASE ANSWER QUESTIONS ABOVE!

IS YOUR PROJECT MA MCP or CT RCP?

Relinquished By:	Date/Time	Received By:	Date/Time
	10/26/06 4pm	Shelly Muender	10-26-06 4pm
Shelly Muender	10-27-06 9:10	Paul Gilbert	10-27-06 9:10
Paul Gilbert	10-27-06 0945		10/27/06 0945

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Payment Terms. See reverse side.

FORM NO: 01-01 (rev. 10-OCT-05)

Certificate Program Summary

Method numbers assume the most recent EPA revisions. For a complete listing of analytes for the referenced methods please contact your Alpha Woods Hole Lab Project Manager or the Quality Assurance Manager.

Connecticut Department of Public Health Certificate No. : PH-0141 - *Wastewater* (General Chemistry: 120.1, 150.1, 160.1, 160.2, 180.1, 300.0, 310.1, 335.2, 365.2, 405.1, 413.1, COD HACH 8000; Metals: 200.7, 245.1; Organics: 608, 624, 625). *Solid Waste/Soil* (General Chemistry: 1010, 9010/9014, 9045, 9056, 9060; Metals: 6010, 6020, 7041, 7471; Organics: 8081, 8082, 8260, 8270, ETPH).

Florida Department of Health Certificate No. : E87814 - Secondary NELAP Accreditation for *Wastewater* (General Chemistry: 120.1/2510B, 150.1, 160.1/SM2540C, 160.2/SM2540D, 180.1, 300.0, SM2320B, 335.2, 365.2, 413.1, 420.1, SM2540G, COD HACH 8000; Metals: 200.7, 204.2, 206.2, 239.2, 245.1, 270.2, 279.2; Organics: 608, 624, 625). *Solid and Hazardous Waste* (General Chemistry: 9010/9014, 9045, 9050, 9056, 9060, 9065; Metals: 6010, 6020, 7041, 7060, 7421, 7470, 7471, 7740, 7841; Organics: 8081, 8082, 8260, 8270).

Louisiana Department of Environmental Quality Certificate No. : 03090 - Primary NELAP Accrediting Authority for *Wastewater* (General Chemistry: 120.1/2510B, 150.1, 160.1/SM2540C, 160.2/SM2540D, 180.1, 300.0, 310.1/SM2320B, 335.2, 365.2, 376.2, 405.1, 413.1, 420.1, SM2540G, COD HACH 8000; Metals: 200.7, 204.2, 206.2, 239.2, 245.1, 270.2, 279.2; Organics: 608, 624, 625). *Solid and Hazardous Waste* (General Chemistry:1010, 1311, 9010/9014, 9045, 9056, 9060; Metals: 6010, 6020, 7041, 7060, 7191, 7421, 7470, 7471, 7740, 7841; Organics: 8081, 8082, 8260, 8270).

Maine Department of Human Services Certificate No. : MA030 - *Wastewater* (General Chemistry: 120.1/2510B, 150.1, 160.1/SM2540C, 160.2/SM2540D, 180.1, 300.0, 310.1/SM2320B, 335.2, 365.2, 405.1, 413.1, 420.1, COD HACH 8000; Metals: 200.7, 239.2, 245.1, 270.2, 279.2; Organics: 608, 624).

Massachusetts Department of Environmental Protection Certificate No. : M-MA030 - *Wastewater* (General Chemistry: 120.1/2510B, 150.1, 160.1/SM2540C, 160.2/SM2540D, 180.1, 300.0, 310.1/SM2320B, 335.2, 365.2, 405.1, 413.1, 420.1, COD HACH 8000; Metals: 200.7, 239.2, 245.1, 270.2, 279.2; Organics: 608, 624).

New Hampshire Department of Environmental Services Certificate No. : 220604 - Secondary NELAP Accreditation for *Wastewater* (General Chemistry: 120.1/2510B, 150.1, 160.1/SM2540C, 160.2/SM2540D, 180.1, 300.0, 310.1/SM2320B, 335.2, 365.2, 376.2, 405.1, 413.1, 420.1, COD HACH 8000, SM2540G; Metals: 200.7, 204.2, 206.2, 239.2, 245.1, 270.2, 279.2; Organics: 608, 624, 625).

New Jersey Department of Environmental Protection Certificate No. : MA015 - *Solid and Hazardous Waste* (General Chemistry: 1010, 1311, 3060, 7196, 9010/9014, 9045, 9056, 9060; Metals: 3010, 3015, 3020, 3050, 3051, 6010, 6020, 7041, 7060, 7131, 7191, 7211, 7421, 7470, 7471, 7520, 7740, 7761, 7841; Organics: 3510, 3545, 5030, 5035, 3620, 3630, 3640, 3660, 8081, 8082, 8100, 8260, 8270).

New York Department of Health Certificate No. : 11627 - Secondary NELAP Accreditation for *Wastewater* (Metals: 200.7, 204.2, 206.2, 239.2, 245.1, 270.2, 279.2; Organics: 608, 624, 625). *Solid and Hazardous Waste* (Metals: 6010, 7041, 7060, 7470, 7471, 7740; Organics: 8081, 8082, 8260, 8270).

Rhode Island Department of Health Certificate No. : 00064 - Chemistry: *Organic and Inorganic in Surface Water, Wastewater/Sewage and Soil* (Method numbers not specified with certificate.)

U.S. Army Corps of Engineers - General Chemistry: 9010/9014, 9071/418.1, 9060; Organics: 8081, 8082, 8260, 8270, 8270-SIM; Metals: 6010, 6020, 7000.

Department of the Navy - General Chemistry: 9010/9014, 9060; Organics: 8081, 8082, 8015-mod, 8260, 8270, 8270-SIM; Metals: 6010, 6020.

ANALYTICAL REPORT

Prepared for:
Apex Environmental, Inc.
286 Congress Street
Suite 610
Boston, MA 02210

Project:	New Bedford Harbor
ETR:	0611024
Report Date:	December 06, 2006

Certifications and Accreditations
Massachusetts MA030
Connecticut PH-0141
New Hampshire 220602
Rhode Island 64
New Jersey MA015
Maine MA030
New York 11627
Louisiana 03090
Army Corps of Engineers
Department of the Navy
Florida E87814

This report shall not be reproduced except in full, without written approval from the laboratory.

375 Paramount Drive, Suite 2, Raynham, Massachusetts 02767, (508) 822-9300, Fax (508) 822-3288

Sample ID Cross Reference

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**

Lab Code: **MA00030**
ETR: **0611024**

Lab Sample ID	Client Sample ID
0611024-01	501 grab
0611024-02	502 grab
0611024-03	503 grab
0611024-04	504 grab
0611024-05	505 composite
0611024-06	506 composite
0611024-07	507 composite
0611024-08	508 composite

CASE NARRATIVE
Alpha Woods Hole Labs

ETR: 0611024
Project: New Bedford Harbor

All analyses were performed according to Alpha Woods Hole Labs quality assurance program and documented Standard Operating Procedures (SOPs). The analytical results contained in this report were performed within holding time, and with appropriate quality control measures, except where noted. A summary of all state and federal accreditations is provided within this report. Blank correction of results is not performed in the laboratory for any parameter. Soil/sediment samples are reported on a dry weight basis unless otherwise noted. Air and sediment samples are either not certifiable under the NELAC and/or are not currently held as accredited matrices.

Polychlorinated Biphenyls by GC/MS

1. Several target congeners analyzed by this method co-elute with non-target congeners and are therefore reported as a co-eluting pair. Refer to the individual report forms.

2. The initial analysis of several samples had concentrations that exceeded the calibration range of the instrument. These samples were reanalyzed at dilution and both analyses are reported. Refer to the individual report forms for dilution requirements.

The enclosed results of analyses are representative of the samples as received by the laboratory. Alpha Woods Hole Labs makes no representations or certifications as to the method of sample collection, sample identification, or transporting/handling procedures used prior to the receipt of samples by Alpha Woods Hole Labs. To the best of my knowledge, the information contained in this report is accurate and complete.

Approved by: Nancy JuRose Title: Project Manager Date: 12/6/06

PCB CONGENERS

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **501 grab**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0611024**
Lab ID: **0611024-01**
Associated Blank: **SS111506B13**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
11/03/06	11/03/06	11/15/06	11/30/06	73.9	5.54	2	1	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**9.5**
Cl3-BZ#18	**25**
Cl3-BZ#28/#31[1]	**140**
Cl4-BZ#44	**32**
Cl4-BZ#52	**70**
Cl4-BZ#43/#49[1]	**75**
Cl4-BZ#66	**56**
Cl5-BZ#101/#84[1]	**100**
Cl5-BZ#87	**27**
Cl7-BZ#184	0.24 U
Cl5-BZ#105	**27**
Cl5-BZ#118	**83**
Cl7-BZ#183	**3.2**
Cl6-BZ#167/#128[1]	**16**
Cl6-BZ#138/#163[1]	**65**
Cl6-BZ#153	**62**
Cl7-BZ#170/#190[1]	**6.5**
Cl7-BZ#180	**11**
Cl7-BZ#182/#187[1]	**7.4**
Cl8-BZ#195	**0.76**
Cl9-BZ#206	**1.1**
Cl10-BZ#209	**0.34**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	77	50-125
Cl8-BZ#202-C13	80	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/04/06 15:17

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **502 grab**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0611024**
Lab ID: **0611024-02**
Associated Blank: **SS111506B13**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
11/03/06	11/03/06	11/15/06	11/30/06	80.8	5.31	2	1	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**6.0**
Cl3-BZ#18	**16**
Cl3-BZ#28/#31[1]	**77**
Cl4-BZ#44	**18**
Cl4-BZ#52	**44**
Cl4-BZ#43/#49[1]	**45**
Cl4-BZ#66	**32**
Cl5-BZ#101/#84[1]	**65**
Cl5-BZ#87	**16**
Cl7-BZ#184	0.23 U
Cl5-BZ#105	**17**
Cl5-BZ#118	**52**
Cl7-BZ#183	**2.3**
Cl6-BZ#167/#128[1]	**11**
Cl6-BZ#138/#163[1]	**42**
Cl6-BZ#153	**41**
Cl7-BZ#170/#190[1]	**4.6**
Cl7-BZ#180	**7.0**
Cl7-BZ#182/#187[1]	**5.2**
Cl8-BZ#195	**0.68**
Cl9-BZ#206	**0.76**
Cl10-BZ#209	0.23 U

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	82	50-125
Cl8-BZ#202-C13	79	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/04/06 15:17

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **503 grab**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0611024**
Lab ID: **0611024-03**
Associated Blank: **SS111506B13**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
11/03/06	11/03/06	11/15/06	11/30/06	52.0	5.66	2	1	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**38**
Cl3-BZ#18	**84**
Cl3-BZ#28/#31[1]	**560** E
Cl4-BZ#44	**100**
Cl4-BZ#52	**250**
Cl4-BZ#43/#49[1]	**310**
Cl4-BZ#66	**240**
Cl5-BZ#101/#84[1]	**380**
Cl5-BZ#87	**90**
Cl7-BZ#184	0.34 U
Cl5-BZ#105	**100**
Cl5-BZ#118	**350** E
Cl7-BZ#183	**12**
Cl6-BZ#167/#128[1]	**62**
Cl6-BZ#138/#163[1]	**250**
Cl6-BZ#153	**260**
Cl7-BZ#170/#190[1]	**26**
Cl7-BZ#180	**41**
Cl7-BZ#182/#187[1]	**31**
Cl8-BZ#195	**2.7**
Cl9-BZ#206	**4.7**
Cl10-BZ#209	**1.9**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	82	50-125
Cl8-BZ#202-C13	81	50-125

N/A - Not Applicable
E - Estimated value, exceeds the upper limit of calibration.
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/04/06 15:17

PCB by GC/MS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **503 grab**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0611024**
Lab ID: **0611024-03E**
Associated Blank: **SS111506B13**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
11/03/06	11/03/06	11/15/06	11/30/06	52.0	5.66	2	5	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**31**
Cl3-BZ#18	**78**
Cl3-BZ#28/#31[1]	**490**
Cl4-BZ#44	**96**
Cl4-BZ#52	**220**
Cl4-BZ#43/#49[1]	**270**
Cl4-BZ#66	**210**
Cl5-BZ#101/#84[1]	**340**
Cl5-BZ#87	**81**
Cl7-BZ#184	1.7 U
Cl5-BZ#105	**91**
Cl5-BZ#118	**300**
Cl7-BZ#183	**16**
Cl6-BZ#167/#128[1]	**56**
Cl6-BZ#138/#163[1]	**220**
Cl6-BZ#153	**230**
Cl7-BZ#170/#190[1]	**27**
Cl7-BZ#180	**39**
Cl7-BZ#182/#187[1]	**32**
Cl8-BZ#195	1.7 U
Cl9-BZ#206	1.7 U
Cl10-BZ#209	1.7 U

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	80	50-125
Cl8-BZ#202-C13	78	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/04/06 15:18

PCB by GC/MS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **504 grab**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0611024**
Lab ID: **0611024-04**
Associated Blank: **SS111506B13**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
11/03/06	11/03/06	11/15/06	11/30/06	45.9	5.35	2	1	TLW

Parameter	Result	
Cl2-BZ#5/#8[1]	**56**	
Cl3-BZ#18	**120**	
Cl3-BZ#28/#31[1]	**760**	E
Cl4-BZ#44	**150**	
Cl4-BZ#52	**340**	E
Cl4-BZ#43/#49[1]	**410**	
Cl4-BZ#66	**340**	E
Cl5-BZ#101/#84[1]	**520**	
Cl5-BZ#87	**120**	
Cl7-BZ#184	0.41	U
Cl5-BZ#105	**140**	
Cl5-BZ#118	**460**	E
Cl7-BZ#183	**18**	
Cl6-BZ#167/#128[1]	**79**	
Cl6-BZ#138/#163[1]	**330**	
Cl6-BZ#153	**340**	E
Cl7-BZ#170/#190[1]	**35**	
Cl7-BZ#180	**56**	
Cl7-BZ#182/#187[1]	**41**	
Cl8-BZ#195	**5.5**	
Cl9-BZ#206	**6.7**	
Cl10-BZ#209	**3.4**	

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	82	50-125
Cl8-BZ#202-C13	81	50-125

N/A - Not Applicable
E - Estimated value, exceeds the upper limit of calibration.
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/04/06 15:17

PCB by GC/MS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **504 grab**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0611024**
Lab ID: **0611024-04E**
Associated Blank: **SS111506B13**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
11/03/06	11/03/06	11/15/06	11/30/06	45.9	5.35	2	5	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**46**
Cl3-BZ#18	**110**
Cl3-BZ#28/#31[1]	**660**
Cl4-BZ#44	**140**
Cl4-BZ#52	**300**
Cl4-BZ#43/#49[1]	**350**
Cl4-BZ#66	**290**
Cl5-BZ#101/#84[1]	**460**
Cl5-BZ#87	**110**
Cl7-BZ#184	2.0 U
Cl5-BZ#105	**120**
Cl5-BZ#118	**390**
Cl7-BZ#183	**17**
Cl6-BZ#167/#128[1]	**73**
Cl6-BZ#138/#163[1]	**290**
Cl6-BZ#153	**300**
Cl7-BZ#170/#190[1]	**31**
Cl7-BZ#180	**50**
Cl7-BZ#182/#187[1]	**37**
Cl8-BZ#195	**4.7**
Cl9-BZ#206	**6.4**
Cl10-BZ#209	**3.3**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	79	50-125
Cl8-BZ#202-C13	78	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/04/06 15:18

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **505 composite**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0611024**
Lab ID: **0611024-05**
Associated Blank: **SS111506B13**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
11/03/06	11/03/06	11/15/06	11/30/06	41.1	5.25	2	1	TLW

Parameter	Result	
Cl2-BZ#5/#8[1]	**72**	
Cl3-BZ#18	**160**	
Cl3-BZ#28/#31[1]	**1000**	E
Cl4-BZ#44	**200**	
Cl4-BZ#52	**460**	E
Cl4-BZ#43/#49[1]	**560**	
Cl4-BZ#66	**460**	E
Cl5-BZ#101/#84[1]	**750**	E
Cl5-BZ#87	**180**	
Cl7-BZ#184	0.46	U
Cl5-BZ#105	**210**	
Cl5-BZ#118	**680**	E
Cl7-BZ#183	**24**	
Cl6-BZ#167/#128[1]	**120**	
Cl6-BZ#138/#163[1]	**490**	
Cl6-BZ#153	**510**	E
Cl7-BZ#170/#190[1]	**50**	
Cl7-BZ#180	**80**	
Cl7-BZ#182/#187[1]	**59**	
Cl8-BZ#195	**5.5**	
Cl9-BZ#206	**7.7**	
Cl10-BZ#209	**3.9**	

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	80	50-125
Cl8-BZ#202-C13	85	50-125

N/A - Not Applicable
E - Estimated value, exceeds the upper limit of calibration.
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/04/06 15:17

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **505 composite**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0611024**
Lab ID: **0611024-05E**
Associated Blank: **SS111506B13**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
11/03/06	11/03/06	11/15/06	12/02/06	41.1	5.25	2	5	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**56**
Cl3-BZ#18	**120**
Cl3-BZ#28/#31[1]	**820**
Cl4-BZ#44	**150**
Cl4-BZ#52	**360**
Cl4-BZ#43/#49[1]	**430**
Cl4-BZ#66	**370**
Cl5-BZ#101/#84[1]	**600**
Cl5-BZ#87	**150**
Cl7-BZ#184	2.3 U
Cl5-BZ#105	**180**
Cl5-BZ#118	**560**
Cl7-BZ#183	**21**
Cl6-BZ#167/#128[1]	**110**
Cl6-BZ#138/#163[1]	**420**
Cl6-BZ#153	**420**
Cl7-BZ#170/#190[1]	**47**
Cl7-BZ#180	**72**
Cl7-BZ#182/#187[1]	**52**
Cl8-BZ#195	**5.6**
Cl9-BZ#206	**7.7**
Cl10-BZ#209	**3.5**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	76	50-125
Cl8-BZ#202-C13	73	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/04/06 15:18

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **506 composite**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0611024**
Lab ID: **0611024-06**
Associated Blank: **SS111506B13**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
11/03/06	11/03/06	11/15/06	11/30/06	44.1	5.37	2	1	TLW

Parameter	Result	
Cl2-BZ#5/#8[1]	**69**	
Cl3-BZ#18	**150**	
Cl3-BZ#28/#31[1]	**1100**	E
Cl4-BZ#44	**180**	
Cl4-BZ#52	**480**	E
Cl4-BZ#43/#49[1]	**590**	
Cl4-BZ#66	**450**	E
Cl5-BZ#101/#84[1]	**710**	E
Cl5-BZ#87	**150**	
Cl7-BZ#184	0.42	U
Cl5-BZ#105	**180**	
Cl5-BZ#118	**650**	E
Cl7-BZ#183	**22**	
Cl6-BZ#167/#128[1]	**110**	
Cl6-BZ#138/#163[1]	**450**	
Cl6-BZ#153	**500**	E
Cl7-BZ#170/#190[1]	**46**	
Cl7-BZ#180	**73**	
Cl7-BZ#182/#187[1]	**57**	
Cl8-BZ#195	**5.2**	
Cl9-BZ#206	**7.6**	
Cl10-BZ#209	**3.8**	

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	82	50-125
Cl8-BZ#202-C13	83	50-125

N/A - Not Applicable
E - Estimated value, exceeds the upper limit of calibration.
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/04/06 15:17

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **506 composite**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0611024**
Lab ID: **0611024-06E**
Associated Blank: **SS111506B13**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
11/03/06	11/03/06	11/15/06	12/02/06	44.1	5.37	2	5	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**54**
Cl3-BZ#18	**110**
Cl3-BZ#28/#31[1]	**860**
Cl4-BZ#44	**150**
Cl4-BZ#52	**370**
Cl4-BZ#43/#49[1]	**460**
Cl4-BZ#66	**360**
Cl5-BZ#101/#84[1]	**580**
Cl5-BZ#87	**130**
Cl7-BZ#184	2.1 U
Cl5-BZ#105	**160**
Cl5-BZ#118	**550**
Cl7-BZ#183	**20**
Cl6-BZ#167/#128[1]	**99**
Cl6-BZ#138/#163[1]	**390**
Cl6-BZ#153	**420**
Cl7-BZ#170/#190[1]	**42**
Cl7-BZ#180	**67**
Cl7-BZ#182/#187[1]	**52**
Cl8-BZ#195	**6.6**
Cl9-BZ#206	**11**
Cl10-BZ#209	**4.4**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	77	50-125
Cl8-BZ#202-C13	76	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/04/06 15:18

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **507 composite**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0611024**
Lab ID: **0611024-07**
Associated Blank: **SS111506B13**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
11/03/06	11/03/06	11/15/06	11/30/06	37.4	5.82	2	1	TLW

Parameter	Result	
Cl2-BZ#5/#8[1]	**72**	
Cl3-BZ#18	**140**	
Cl3-BZ#28/#31[1]	**1300**	E
Cl4-BZ#44	**180**	
Cl4-BZ#52	**500**	E
Cl4-BZ#43/#49[1]	**730**	
Cl4-BZ#66	**570**	E
Cl5-BZ#101/#84[1]	**880**	E
Cl5-BZ#87	**160**	
Cl7-BZ#184	0.46	U
Cl5-BZ#105	**240**	
Cl5-BZ#118	**870**	E
Cl7-BZ#183	**29**	
Cl6-BZ#167/#128[1]	**150**	
Cl6-BZ#138/#163[1]	**590**	
Cl6-BZ#153	**680**	E
Cl7-BZ#170/#190[1]	**60**	
Cl7-BZ#180	**96**	
Cl7-BZ#182/#187[1]	**77**	
Cl8-BZ#195	**5.7**	
Cl9-BZ#206	**12**	
Cl10-BZ#209	**23**	

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	76	50-125
Cl8-BZ#202-C13	84	50-125

N/A - Not Applicable
E - Estimated value, exceeds the upper limit of calibration.
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/04/06 15:18

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **507 composite**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0611024**
Lab ID: **0611024-07E**
Associated Blank: **SS111506B13**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
11/03/06	11/03/06	11/15/06	12/02/06	37.4	5.82	2	5	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**54**
Cl3-BZ#18	**100**
Cl3-BZ#28/#31[1]	**1000**
Cl4-BZ#44	**150**
Cl4-BZ#52	**410**
Cl4-BZ#43/#49[1]	**590**
Cl4-BZ#66	**470**
Cl5-BZ#101/#84[1]	**730**
Cl5-BZ#87	**140**
Cl7-BZ#184	2.3 U
Cl5-BZ#105	**200**
Cl5-BZ#118	**740**
Cl7-BZ#183	**26**
Cl6-BZ#167/#128[1]	**130**
Cl6-BZ#138/#163[1]	**520**
Cl6-BZ#153	**590**
Cl7-BZ#170/#190[1]	**54**
Cl7-BZ#180	**86**
Cl7-BZ#182/#187[1]	**70**
Cl8-BZ#195	**4.7**
Cl9-BZ#206	**12**
Cl10-BZ#209	**22**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	72	50-125
Cl8-BZ#202-C13	81	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/04/06 15:19

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **508 composite**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0611024**
Lab ID: **0611024-08**
Associated Blank: **SS111506B13**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
11/03/06	11/03/06	11/15/06	11/30/06	47.2	5.32	2	1	TLW

Parameter	Result	
Cl2-BZ#5/#8[1]	**70**	
Cl3-BZ#18	**170**	
Cl3-BZ#28/#31[1]	**1000**	E
Cl4-BZ#44	**210**	
Cl4-BZ#52	**490**	E
Cl4-BZ#43/#49[1]	**540**	
Cl4-BZ#66	**440**	E
Cl5-BZ#101/#84[1]	**700**	E
Cl5-BZ#87	**160**	
Cl7-BZ#184	0.40	U
Cl5-BZ#105	**200**	
Cl5-BZ#118	**620**	E
Cl7-BZ#183	**21**	
Cl6-BZ#167/#128[1]	**110**	
Cl6-BZ#138/#163[1]	**450**	
Cl6-BZ#153	**450**	E
Cl7-BZ#170/#190[1]	**46**	
Cl7-BZ#180	**70**	
Cl7-BZ#182/#187[1]	**50**	
Cl8-BZ#195	**3.9**	
Cl9-BZ#206	**6.7**	
Cl10-BZ#209	**3.8**	

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	79	50-125
Cl8-BZ#202-C13	85	50-125

N/A - Not Applicable
E - Estimated value, exceeds the upper limit of calibration.
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/04/06 15:18

PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **508 composite**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0611024**
Lab ID: **0611024-08E**
Associated Blank: **SS111506B13**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
11/03/06	11/03/06	11/15/06	12/02/06	47.2	5.32	2	5	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	**53**
Cl3-BZ#18	**120**
Cl3-BZ#28/#31[1]	**760**
Cl4-BZ#44	**160**
Cl4-BZ#52	**370**
Cl4-BZ#43/#49[1]	**410**
Cl4-BZ#66	**340**
Cl5-BZ#101/#84[1]	**550**
Cl5-BZ#87	**130**
Cl7-BZ#184	2.0 U
Cl5-BZ#105	**160**
Cl5-BZ#118	**500**
Cl7-BZ#183	**20**
Cl6-BZ#167/#128[1]	**98**
Cl6-BZ#138/#163[1]	**370**
Cl6-BZ#153	**370**
Cl7-BZ#170/#190[1]	**41**
Cl7-BZ#180	**62**
Cl7-BZ#182/#187[1]	**44**
Cl8-BZ#195	**4.1**
Cl9-BZ#206	**8.8**
Cl10-BZ#209	**3.2**

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	66	50-125
Cl8-BZ#202-C13	78	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/04/06 15:19

Blank
PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **Blank**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0611024**
Lab ID: **SS111506B13**
Associated Blank: **N/A**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Date Analyzed	Percent Solid	Sample Amount (g)	Final Volume (ml)	Dilution Factor	Analyst
N/A	N/A	11/15/06	11/30/06	100	5.00	2	1	TLW

Parameter	Result
Cl2-BZ#5/#8[1]	0.40 U
Cl3-BZ#18	0.20 U
Cl3-BZ#28/#31[1]	0.40 U
Cl4-BZ#44	0.20 U
Cl4-BZ#52	0.20 U
Cl4-BZ#43/#49[1]	0.40 U
Cl4-BZ#66	0.20 U
Cl5-BZ#101/#84[1]	0.40 U
Cl5-BZ#87	0.20 U
Cl7-BZ#184	0.20 U
Cl5-BZ#105	0.20 U
Cl5-BZ#118	0.20 U
Cl7-BZ#183	0.20 U
Cl6-BZ#167/#128[1]	0.40 U
Cl6-BZ#138/#163[1]	0.40 U
Cl6-BZ#153	0.20 U
Cl7-BZ#170/#190[1]	0.40 U
Cl7-BZ#180	0.20 U
Cl7-BZ#182/#187[1]	0.40 U
Cl8-BZ#195	0.20 U
Cl9-BZ#206	0.20 U
Cl10-BZ#209	0.20 U

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery	Acceptance Range (%)
Cl3-BZ#19-C13	88	50-125
Cl8-BZ#202-C13	80	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

12/04/06 15:16

Laboratory Control Summary
PCB by GC/MS

ALPHA WOODS HOLE LABS

Client: **Apex Environmental, Inc.**
Project: **New Bedford Harbor**
Client ID: **Laboratory Control Sample**
Case: **N/A** SDG: **N/A**
Matrix: **Sediment**

Lab Code: **MA00030**
ETR: **0611024**
Lab ID: **See Below**
Associated Blank: **SS111506B13**
Concentration Units: **µg/Kg**

Date Collected	Date Received	Date Extracted	Percent Solid	Analyst
N/A	N/A	11/15/06	100	TLW

Lab ID:	SS111506B13		SS111506LCS11		SS111506LCSD11				
Parameter	**Blank Conc.**		**LCS Conc.**	**LCS % Recovery**	**LCSD Conc.**	**LCSD % Recovery**	**% RPD**	**RPD Limit**	**% Recovery Limits**
Cl2-BZ#5/#8[1]	0.40	U	6.0	76	6.9	86	13	50	40-140
Cl3-BZ#18	0.20	U	5.9	74	6.8	85	13	50	40-140
Cl3-BZ#28/#31[1]	0.40	U	11	69	13	80	14	50	40-140
Cl4-BZ#44	0.20	U	5.4	68	6.1	77	13	50	40-140
Cl4-BZ#52	0.20	U	5.5	69	6.3	78	13	50	40-140
Cl4-BZ#43/#49[1]	0.40	U	6.2	77	7.1	89	14	50	40-140
Cl4-BZ#66	0.20	U	5.6	70	6.0	75	6	50	40-140
Cl5-BZ#101/#84[1]	0.40	U	6.0	75	6.7	84	12	50	40-140
Cl5-BZ#87	0.20	U	4.9	61	5.5	69	12	50	40-140
Cl5-BZ#105	0.20	U	5.2	65	5.7	71	9	50	40-140
Cl5-BZ#118	0.20	U	5.0	63	5.6	70	11	50	40-140
Cl7-BZ#183	0.20	U	5.9	73	6.3	79	7	50	40-140
Cl6-BZ#167/#128[1]	0.40	U	12	73	13	80	9	50	40-140
Cl6-BZ#138/#163[1]	0.40	U	4.9	61	5.4	67	10	50	40-140
Cl6-BZ#153	0.20	U	5.7	71	6.2	77	9	50	40-140
Cl7-BZ#170/#190[1]	0.40	U	5.2	65	5.6	70	7	50	40-140
Cl7-BZ#180	0.20	U	5.9	73	6.6	83	12	50	40-140
Cl7-BZ#182/#187[1]	0.40	U	6.3	79	6.7	84	7	50	40-140
Cl8-BZ#195	0.20	U	6.1	76	6.6	82	7	50	40-140
Cl9-BZ#206	0.20	U	6.2	78	6.9	86	11	50	40-140
Cl10-BZ#209	0.20	U	6.1	76	6.8	84	10	50	40-140

[1] = These two Congeners are reported as a co-eluting pair.

Surrogate	% Recovery		Acceptance Range (%)
Cl3-BZ#19-C13	88	94	50-125
Cl8-BZ#202-C13	77	84	50-125

N/A - Not Applicable
U - The analyte was analyzed for but not detected at the sample specific level reported.

Concentrations reported as calculated values, which includes rounding for significant figures. Percent recoveries and RPD values are calculated from the unrounded result.

12/04/06 15:19

CHAIN OF CUSTODY RECORDS

CHAIN OF CUSTODY

PAGE 1 OF 1

Date Rec'd in Lab:

ALPHA Job #: 0611024

ALPHA LABS
WESTBORO, MA
TEL: 508-898-9220
FAX: 508-898-9193
RAYNHAM, MA
TEL: 508-822-9300
FAX: 508-822-3288

Client Information

Client: Apex Companies LLC
Address: 115 Broad St. Suite 200
Phone: 617.728.0070
Fax: 617.728.0080
Email: KvanNaerssen@apexcos.com

☐ These samples have been previously analyzed by Alpha

Project Information

Project Name: New Bedford Harbor
Project Location: Fairhaven
Project #: 6591.002
Project Manager: Kris van Naerssen
ALPHA Quote #:

Turn-Around Time

☒ Standard ☐ RUSH (only confirmed if pre-approved!)

Date Due: Time:

Report Information - Data Deliverables

☒ FAX ☒ EMAIL
☐ ADEx ☐ Add'l Deliverables

Billing Information

☐ Same as Client info PO #:

Regulatory Requirements/Report Limits

State /Fed Program | Criteria

MA MCP PRESUMPTIVE CERTAINTY --- CT REASONABLE CONFIDENCE PROTOCOLS

☐ Yes ☐ No Are MCP Analytical Methods Required?
☐ Yes ☐ No Are CT RCP (Reasonable Confidence Protocols) Required?

Other Project Specific Requirements/Comments/Detection Limits:

Minimum detection limit 0.001 ppm.

ANALYSIS: PCB summation w/ congeners

SAMPLE HANDLING
Filtration
☐ Done
☐ Not needed
☐ Lab to do
Preservation
☐ Lab to do
(Please specify below)

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials	PCB summation w/ congeners	Sample Specific Comments	TOTAL # BOTTLES
1	501 grab	11/3/06	13:30	SE	JR KVN	✓		
2	502 grab	11/3/06	14:00	SE	JR KVN	✓		
3	503 grab	11/3/06	14:10	SE	JR KVN	✓		
4	504 grab	11/3/06	14:20	SE	JR KVN	✓		
5	505 composite	11/3/06	14:30	SE	JR KVN	✓		
6	506 composite	11/3/06	15:15	SE	JR KVN	✓		
7	507 composite	11/3/06	15:[illegible]	SE	JR KVN	✓		
8	508 composite	11/3/06	15:45	SE	JR KVN	✓		

PLEASE ANSWER QUESTIONS ABOVE!

IS YOUR PROJECT MA MCP or CT RCP?

Container Type	
Preservative	

Relinquished By:	Date/Time	Received By:	Date/Time
[signature]	11/3/06 16:15	Paul Gilbert	11-3-06 16:15
Paul Gilbert	11-3-06	[signature]	11/3/06 1650

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Payment Terms. See reverse side.

FORM NO: 01-01 (rev. 10-OCT-05)

Sample Receipt Checklist

Client: APEENV		**Receipt Date:** 11/3/06	
Project: New Bedford Harbor		**Log-in Date:**	
ETR #: 0611024		**Inspection by:**	**Login by:**

ALL SECTIONS BELOW MUST BE COMPLETED

Comments / Notes

Were samples shipped? Yes, FedEx / UPS / Other:_____
(No), WHG Courier pick-up / Hand delivered

Is bill of lading retained? Yes, Tracking #:_____
No, Unavailable / (NA)

Number of coolers received for this project delivery: 1

Indicate cooler temperature upon opening (if multiple coolers, record all temps):

Note: If all coolers are 2-6°C, use one checklist, if NOT, use separate checklists and note all samples received *above* 6°C.

Cooler 1:
Temperature(s) taken from: 4° IR Gun, 3.5° Temp. Blank, / NA

Were samples received on ice? (Yes) / No

Chain-of-Custody present? (Yes) / No
Complete? (Yes) / No

Custody seals present on Cooler? Yes / (No)
on Bottles? Yes / (No)
Intact? Yes / No / (NA)
Note: Affix custody seals to back of this page.

Were sample containers intact? (Yes) / No If No, list samples: →

Did VOA/VPH waters contain headspace (>5mm)? Yes / No / (NA) If Yes, list samples: →

Were 5035 VOA soils, or VPH soils, *covered* with MeOH? Yes / No / (NA)
If No, list samples: →

Was a sufficient amount of sample received for each test indicated on the COC?
(Yes) / No If No, list samples: →

If chemical preservation is appropriate -
Were samples field preserved? Yes / No / (NA)
☐ C=HCl ☐ M=MeOH ☐ S=H_2SO4
☐ H=NaOH ☐ N=HNO_3 ☐ Other:_____ ☐ U= Unknown

Preservation (pH) verified at lab for *EVERY* bottle? (Not: VOA / VPH / Sulfide)
YES: <2 or >12 (CN) or NO (NA)
If No, why?:

Were samples received within hold time? (Yes) / No If No, list samples: →

Discrepancy between samples rec'd & COC ? Yes / (No) If Yes, list samples: →

Was the Project Manager notified of any other problems? Yes / No / NA

Project Manager Acknowledgement: Nancy Giles Date: 11/3/06

Sample storage refrigerator #: C3

Sample storage freezer #:_____

Cooler 2:_____ Cooler 3:_____

Cooler 4:_____ Cooler 5:_____

Cooler 6:_____ Cooler 7:_____

More:_____

Chemical preservation OK for ALL samples?

Yes / No / (N/A)

If No, list samples below:

Please use back for any additional notes!

Certificate Program Summary

Method numbers assume the most recent EPA revisions. For a complete listing of analytes for the referenced methods please contact your Alpha Woods Hole Lab Project Manager or the Quality Assurance Manager.

Connecticut Department of Public Health Certificate No. : PH-0141 - *Wastewater* (General Chemistry: 120.1, 150.1, 160.1, 160.2, 180.1, 300.0, 310.1, 335.2, 365.2, 405.1, 413.1, COD HACH 8000; Metals: 200.7, 245.1; Organics: 608, 624, 625). *Solid Waste/Soil* (General Chemistry: 1010, 9010/9014, 9045, 9056, 9060; Metals: 6010, 6020, 7041, 7471; Organics: 8081, 8082, 8260, 8270, ETPH).

Florida Department of Health Certificate No. : E87814 - Secondary NELAP Accreditation for *Wastewater* (General Chemistry: 120.1/2510B, 150.1, 160.1/SM2540C, 160.2/SM2540D, 180.1, 300.0, SM2320B, 335.2, 365.2, 413.1, 420.1, SM2540G, COD HACH 8000; Metals: 200.7, 204.2, 206.2, 239.2, 245.1, 270.2, 279.2; Organics: 608, 624, 625). *Solid and Hazardous Waste* (General Chemistry: 9010/9014, 9045, 9050, 9056, 9060, 9065; Metals: 6010, 6020, 7041, 7060, 7421, 7470, 7471, 7740, 7841; Organics: 8081, 8082, 8260, 8270).

Louisiana Department of Environmental Quality Certificate No. : 03090 - Primary NELAP Accrediting Authority for *Wastewater* (General Chemistry: 120.1/2510B, 150.1, 160.1/SM2540C, 160.2/SM2540D, 180.1, 300.0, 310.1/SM2320B, 335.2, 365.2, 376.2, 405.1, 413.1, 420.1, SM2540G, COD HACH 8000; Metals: 200.7, 204.2, 206.2, 239.2, 245.1, 270.2, 279.2; Organics: 608, 624, 625). *Solid and Hazardous Waste* (General Chemistry:1010, 1311, 9010/9014, 9045, 9056, 9060; Metals: 6010, 6020, 7041, 7060, 7191, 7421, 7470, 7471, 7740, 7841; Organics: 8081, 8082, 8260, 8270).

Maine Department of Human Services Certificate No. : MA030 - *Wastewater* (General Chemistry: 120.1/2510B, 150.1, 160.1/SM2540C, 160.2/SM2540D, 180.1, 300.0, 310.1/SM2320B, 335.2, 365.2, 405.1, 413.1, 420.1, COD HACH 8000; Metals: 200.7, 239.2, 245.1, 270.2, 279.2; Organics: 608, 624).

Massachusetts Department of Environmental Protection Certificate No. : M-MA030 - *Wastewater* (General Chemistry: 120.1/2510B, 150.1, 160.1/SM2540C, 160.2/SM2540D, 180.1, 300.0, 310.1/SM2320B, 335.2, 365.2, 405.1, 413.1, 420.1, COD HACH 8000; Metals: 200.7, 239.2, 245.1, 270.2, 279.2; Organics: 608, 624).

New Hampshire Department of Environmental Services Certificate No. : 220604 - Secondary NELAP Accreditation for *Wastewater* (General Chemistry: 120.1/2510B, 150.1, 160.1/SM2540C, 160.2/SM2540D, 180.1, 300.0, 310.1/SM2320B, 335.2, 365.2, 376.2, 405.1, 413.1, 420.1, COD HACH 8000, SM2540G; Metals: 200.7, 204.2, 206.2, 239.2, 245.1, 270.2, 279.2; Organics: 608, 624, 625).

New Jersey Department of Environmental Protection Certificate No. : MA015 - *Solid and Hazardous Waste* (General Chemistry: 1010, 1311, 3060, 7196, 9010/9014, 9045, 9056, 9060; Metals: 3010, 3015, 3020, 3050, 3051, 6010, 6020, 7041, 7060, 7131, 7191, 7211, 7421, 7470, 7471, 7520, 7740, 7761, 7841; Organics: 3510, 3545, 5030, 5035, 3620, 3630, 3640, 3660, 8081, 8082, 8100, 8260, 8270).

New York Department of Health Certificate No. : 11627 - Secondary NELAP Accreditation for *Wastewater* (Metals: 200.7, 204.2, 206.2, 239.2, 245.1, 270.2, 279.2; Organics: 608, 624, 625). *Solid and Hazardous Waste* (Metals: 6010, 7041, 7060, 7470, 7471, 7740; Organics: 8081, 8082, 8260, 8270).

Rhode Island Department of Health Certificate No. : 00064 - Chemistry: *Organic and Inorganic in Surface Water, Wastewater/Sewage and Soil* (Method numbers not specified with certificate.)

U.S. Army Corps of Engineers - General Chemistry: 9010/9014, 9071/418.1, 9060; Organics: 8081, 8082, 8260, 8270, 8270-SIM; Metals: 6010, 6020, 7000.

Department of the Navy - General Chemistry: 9010/9014, 9060; Organics: 8081, 8082, 8015-mod, 8260, 8270, 8270-SIM; Metals: 6010, 6020.

ANALYTICAL REPORT

Lab Number:	L1001187
Client:	Apex Companies 115 Broad Street Suite 200 Boston, MA 02110
ATTN:	Chet Myers
Project Name:	NBH PHASE III
Project Number:	6690.001
Report Date:	01/29/10

Certifications & Approvals: MA (M-MA030), NY (11627), CT (PH-0141), NH (2206), NJ (MA015), RI (LAO00299), ME (MA0030), PA (Registration #68-02089), LA NELAC (03090), FL NELAC (E87814), US Army Corps of Engineers.

320 Forbes Boulevard, Mansfield, MA 02048-1806
508-822-9300 (Fax) 508-822-3288 800-624-9220 - www.alphalab.com

Project Name: NBH PHASE III
Project Number: 6690.001

Lab Number: L1001187
Report Date: 01/29/10

Alpha Sample ID	Client ID	Sample Location	Collection Date/Time
L1001187-01	POST_012010_G1	NEW BEDFORD, MA	01/20/10 10:16
L1001187-02	POST_012010_TP2	NEW BEDFORD, MA	01/20/10 12:45
L1001187-03	POST_012010_UW1	NEW BEDFORD, MA	01/20/10 12:17
L1001187-04	POST_012010_PACK1	NEW BEDFORD, MA	01/20/10 14:20
L1001187-05	POST_012010_BHB1	NEW BEDFORD, MA	01/20/10 14:46
L1001187-06	POST_012010_ONWF1	NEW BEDFORD, MA	01/20/10 13:48
L1001187-07	POST_012010_SA1	NEW BEDFORD, MA	01/20/10 11:20
L1001187-08	POST_012010_SA2	NEW BEDFORD, MA	01/20/10 11:30
L1001187-09	POST_012010_SA3	NEW BEDFORD, MA	01/20/10 11:45
L1001187-10	POST_012010_TP1	NEW BEDFORD, MA	01/20/10 13:00

Project Name: NBH PHASE III **Lab Number:** L1001187
Project Number: 6690.001 **Report Date:** 01/29/10

Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet all of the requirements of NELAC, for all NELAC accredited parameters. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively. When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report.

Please see the associated ADEx data file for a comparison of laboratory reporting limits that were achieved with the regulatory Numerical Standards requested on the Chain of Custody.

For additional information, please contact Client Services at 800-624-9220.

PCB Congeners

L1001187-05 was re-analyzed on dilution in order to quantitate the sample within the calibration range. The result should be considered estimated, and is qualified with an E flag, for any compound that exceeded the calibration on the initial analysis. The re-analysis was performed only for the compound that exceeded the calibration range.

Project Name:	NBH PHASE III	**Lab Number:**	L1001187
Project Number:	6690.001	**Report Date:**	01/29/10

Case Narrative (continued)

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature: Kathleen M. O'Brien

Title: Technical Director/Representative

Date: 01/29/10

ORGANICS

PCBS

Project Name: NBH PHASE III **Lab Number:** L1001187

Project Number: 6690.001 **Report Date:** 01/29/10

SAMPLE RESULTS

Lab ID:	L1001187-01	Date Collected:	01/20/10 10:16
Client ID:	POST_012010_G1	Date Received:	01/22/10
Sample Location:	NEW BEDFORD, MA	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3570
Analytical Method:	1,8270C-SIM	Extraction Date:	01/25/10 14:11
Analytical Date:	01/28/10 16:51	Cleanup Method1:	- - - -
Analyst:	WN		
Percent Solids:	76%		

Parameter	Result	Qualifier	Units	RDL	Dilution Factor
PCB Congeners (NOAA List) - Mansfield Lab					
Cl2-BZ#8	20.4		ug/kg	0.954	1
Cl3-BZ#18	64.8		ug/kg	0.954	1
Cl3-BZ#28	204		ug/kg	0.954	1
Cl4-BZ#44	58.5		ug/kg	0.954	1
Cl4-BZ#49	70.3		ug/kg	0.954	1
Cl4-BZ#52	129		ug/kg	0.954	1
Cl4-BZ#66	25.0		ug/kg	0.954	1
Cl5-BZ#87	ND		ug/kg	0.954	1
Cl5-BZ#101	75.7		ug/kg	0.954	1
Cl5-BZ#105	25.3		ug/kg	0.954	1
Cl5-BZ#118	76.9		ug/kg	0.954	1
Cl6-BZ#128	10.4		ug/kg	0.954	1
Cl6-BZ#138	66.7		ug/kg	0.954	1
Cl6-BZ#153	30.4		ug/kg	0.954	1
Cl7-BZ#170	7.11		ug/kg	0.954	1
Cl7-BZ#180	7.56		ug/kg	0.954	1
Cl7-BZ#183	ND		ug/kg	0.954	1
Cl7-BZ#184	ND		ug/kg	0.954	1
Cl7-BZ#187	4.11		ug/kg	0.954	1
Cl8-BZ#195	ND		ug/kg	0.954	1
Cl9-BZ#206	ND		ug/kg	0.954	1
Cl10-BZ#209	ND		ug/kg	0.954	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
DBOB	81		50-125
BZ 198	81		50-125

Project Name: NBH PHASE III **Lab Number:** L1001187

Project Number: 6690.001 **Report Date:** 01/29/10

SAMPLE RESULTS

Lab ID:	L1001187-02	Date Collected:	01/20/10 12:45
Client ID:	POST_012010_TP2	Date Received:	01/22/10
Sample Location:	NEW BEDFORD, MA	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3570
Analytical Method:	1,8270C-SIM	Extraction Date:	01/25/10 14:11
Analytical Date:	01/28/10 17:30	Cleanup Method1:	- - - -
Analyst:	WN		
Percent Solids:	66%		

Parameter	Result	Qualifier	Units	RDL	Dilution Factor
PCB Congeners (NOAA List) - Mansfield Lab					
Cl2-BZ#8	ND		ug/kg	1.08	1
Cl3-BZ#18	ND		ug/kg	1.08	1
Cl3-BZ#28	ND		ug/kg	1.08	1
Cl4-BZ#44	ND		ug/kg	1.08	1
Cl4-BZ#49	ND		ug/kg	1.08	1
Cl4-BZ#52	ND		ug/kg	1.08	1
Cl4-BZ#66	ND		ug/kg	1.08	1
Cl5-BZ#87	ND		ug/kg	1.08	1
Cl5-BZ#101	ND		ug/kg	1.08	1
Cl5-BZ#105	ND		ug/kg	1.08	1
Cl5-BZ#118	ND		ug/kg	1.08	1
Cl6-BZ#128	ND		ug/kg	1.08	1
Cl6-BZ#138	ND		ug/kg	1.08	1
Cl6-BZ#153	ND		ug/kg	1.08	1
Cl7-BZ#170	ND		ug/kg	1.08	1
Cl7-BZ#180	ND		ug/kg	1.08	1
Cl7-BZ#183	ND		ug/kg	1.08	1
Cl7-BZ#184	ND		ug/kg	1.08	1
Cl7-BZ#187	ND		ug/kg	1.08	1
Cl8-BZ#195	ND		ug/kg	1.08	1
Cl9-BZ#206	ND		ug/kg	1.08	1
Cl10-BZ#209	ND		ug/kg	1.08	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
DBOB	88		50-125
BZ 198	89		50-125

Project Name: NBH PHASE III **Lab Number:** L1001187

Project Number: 6690.001 **Report Date:** 01/29/10

SAMPLE RESULTS

Lab ID:	L1001187-03	Date Collected:	01/20/10 12:17
Client ID:	POST_012010_UW1	Date Received:	01/22/10
Sample Location:	NEW BEDFORD, MA	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3570
Analytical Method:	1,8270C-SIM	Extraction Date:	01/25/10 14:11
Analytical Date:	01/28/10 18:08	Cleanup Method1:	- - - -
Analyst:	WN		
Percent Solids:	35%		

Parameter	Result	Qualifier	Units	RDL	Dilution Factor
PCB Congeners (NOAA List) - Mansfield Lab					
Cl2-BZ#8	30.1		ug/kg	2.10	1
Cl3-BZ#18	192		ug/kg	2.10	1
Cl3-BZ#28	397		ug/kg	2.10	1
Cl4-BZ#44	112		ug/kg	2.10	1
Cl4-BZ#49	92.1		ug/kg	2.10	1
Cl4-BZ#52	218		ug/kg	2.10	1
Cl4-BZ#66	42.4		ug/kg	2.10	1
Cl5-BZ#87	ND		ug/kg	2.10	1
Cl5-BZ#101	158		ug/kg	2.10	1
Cl5-BZ#105	70.3		ug/kg	2.10	1
Cl5-BZ#118	170		ug/kg	2.10	1
Cl6-BZ#128	41.0		ug/kg	2.10	1
Cl6-BZ#138	209		ug/kg	2.10	1
Cl6-BZ#153	102		ug/kg	2.10	1
Cl7-BZ#170	45.5		ug/kg	2.10	1
Cl7-BZ#180	67.9		ug/kg	2.10	1
Cl7-BZ#183	9.25		ug/kg	2.10	1
Cl7-BZ#184	ND		ug/kg	2.10	1
Cl7-BZ#187	54.1		ug/kg	2.10	1
Cl8-BZ#195	ND		ug/kg	2.10	1
Cl9-BZ#206	ND		ug/kg	2.10	1
Cl10-BZ#209	ND		ug/kg	2.10	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
DBOB	88		50-125
BZ 198	119		50-125

Project Name: NBH PHASE III **Lab Number:** L1001187

Project Number: 6690.001 **Report Date:** 01/29/10

SAMPLE RESULTS

Lab ID:	L1001187-04	Date Collected:	01/20/10 14:20
Client ID:	POST_012010_PACK1	Date Received:	01/22/10
Sample Location:	NEW BEDFORD, MA	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3570
Analytical Method:	1,8270C-SIM	Extraction Date:	01/25/10 14:11
Analytical Date:	01/28/10 18:47	Cleanup Method1:	- - - -
Analyst:	WN		
Percent Solids:	81%		

Parameter	Result	Qualifier	Units	RDL	Dilution Factor
PCB Congeners (NOAA List) - Mansfield Lab					
Cl2-BZ#8	ND		ug/kg	0.923	1
Cl3-BZ#18	1.74		ug/kg	0.923	1
Cl3-BZ#28	8.85		ug/kg	0.923	1
Cl4-BZ#44	1.98		ug/kg	0.923	1
Cl4-BZ#49	4.04		ug/kg	0.923	1
Cl4-BZ#52	5.71		ug/kg	0.923	1
Cl4-BZ#66	4.04		ug/kg	0.923	1
Cl5-BZ#87	ND		ug/kg	0.923	1
Cl5-BZ#101	4.46		ug/kg	0.923	1
Cl5-BZ#105	ND		ug/kg	0.923	1
Cl5-BZ#118	2.96		ug/kg	0.923	1
Cl6-BZ#128	ND		ug/kg	0.923	1
Cl6-BZ#138	2.58		ug/kg	0.923	1
Cl6-BZ#153	2.48		ug/kg	0.923	1
Cl7-BZ#170	ND		ug/kg	0.923	1
Cl7-BZ#180	ND		ug/kg	0.923	1
Cl7-BZ#183	ND		ug/kg	0.923	1
Cl7-BZ#184	ND		ug/kg	0.923	1
Cl7-BZ#187	ND		ug/kg	0.923	1
Cl8-BZ#195	ND		ug/kg	0.923	1
Cl9-BZ#206	ND		ug/kg	0.923	1
Cl10-BZ#209	ND		ug/kg	0.923	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
DBOB	88		50-125
BZ 198	88		50-125

Project Name: NBH PHASE III **Lab Number:** L1001187

Project Number: 6690.001 **Report Date:** 01/29/10

SAMPLE RESULTS

Lab ID:	L1001187-05	Date Collected:	01/20/10 14:46
Client ID:	POST_012010_BHB1	Date Received:	01/22/10
Sample Location:	NEW BEDFORD, MA	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3570
Analytical Method:	1,8270C-SIM	Extraction Date:	01/25/10 14:11
Analytical Date:	01/28/10 21:21	Cleanup Method1:	- - - -
Analyst:	WN		
Percent Solids:	72%		

Parameter	Result	Qualifier	Units	RDL	Dilution Factor
PCB Congeners (NOAA List) - Mansfield Lab					
Cl2-BZ#8	322	E	ug/kg	0.988	1
Cl3-BZ#18	991	E	ug/kg	0.988	1
Cl3-BZ#28	2820	E	ug/kg	0.988	1
Cl4-BZ#44	968	E	ug/kg	0.988	1
Cl4-BZ#49	847	E	ug/kg	0.988	1
Cl4-BZ#52	1770	E	ug/kg	0.988	1
Cl4-BZ#66	260	E	ug/kg	0.988	1
Cl5-BZ#87	ND		ug/kg	0.988	1
Cl5-BZ#101	789	E	ug/kg	0.988	1
Cl5-BZ#105	140		ug/kg	0.988	1
Cl5-BZ#118	524	E	ug/kg	0.988	1
Cl6-BZ#128	39.4		ug/kg	0.988	1
Cl6-BZ#138	314	E	ug/kg	0.988	1
Cl6-BZ#153	285	E	ug/kg	0.988	1
Cl7-BZ#170	31.8		ug/kg	0.988	1
Cl7-BZ#180	30.3		ug/kg	0.988	1
Cl7-BZ#183	6.06		ug/kg	0.988	1
Cl7-BZ#184	ND		ug/kg	0.988	1
Cl7-BZ#187	28.7		ug/kg	0.988	1
Cl8-BZ#195	ND		ug/kg	0.988	1
Cl9-BZ#206	4.35		ug/kg	0.988	1
Cl10-BZ#209	1.74		ug/kg	0.988	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
DBOB	76		50-125
BZ 198	105		50-125

Project Name: NBH PHASE III **Lab Number:** L1001187

Project Number: 6690.001 **Report Date:** 01/29/10

SAMPLE RESULTS

Lab ID:	L1001187-05 D	Date Collected:	01/20/10 14:46
Client ID:	POST_012010_BHB1	Date Received:	01/22/10
Sample Location:	NEW BEDFORD, MA	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3570
Analytical Method:	1,8270C-SIM	Extraction Date:	01/25/10 14:11
Analytical Date:	01/28/10 19:25	Cleanup Method1:	- - - -
Analyst:	WN		
Percent Solids:	72%		

Parameter	Result	Qualifier	Units	RDL	Dilution Factor
PCB Congeners (NOAA List) - Mansfield Lab					
Cl2-BZ#8	568		ug/kg	19.8	20
Cl3-BZ#18	1780		ug/kg	19.8	20
Cl3-BZ#28	4900		ug/kg	19.8	20
Cl4-BZ#44	1590		ug/kg	19.8	20
Cl4-BZ#49	1620		ug/kg	19.8	20
Cl4-BZ#52	2530		ug/kg	19.8	20
Cl4-BZ#66	466		ug/kg	19.8	20
Cl5-BZ#101	756		ug/kg	19.8	20
Cl5-BZ#118	631		ug/kg	19.8	20
Cl6-BZ#138	413		ug/kg	19.8	20
Cl6-BZ#153	356		ug/kg	19.8	20

Project Name: NBH PHASE III **Lab Number:** L1001187

Project Number: 6690.001 **Report Date:** 01/29/10

SAMPLE RESULTS

Lab ID:	L1001187-06	Date Collected:	01/20/10 13:48
Client ID:	POST_012010_ONWF1	Date Received:	01/22/10
Sample Location:	NEW BEDFORD, MA	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3570
Analytical Method:	1,8270C-SIM	Extraction Date:	01/25/10 14:11
Analytical Date:	01/28/10 20:43	Cleanup Method1:	- - - -
Analyst:	WN		
Percent Solids:	74%		

Parameter	Result	Qualifier	Units	RDL	Dilution Factor
PCB Congeners (NOAA List) - Mansfield Lab					
Cl2-BZ#8	8.68		ug/kg	0.965	1
Cl3-BZ#18	47.0		ug/kg	0.965	1
Cl3-BZ#28	143		ug/kg	0.965	1
Cl4-BZ#44	49.3		ug/kg	0.965	1
Cl4-BZ#49	50.7		ug/kg	0.965	1
Cl4-BZ#52	92.8		ug/kg	0.965	1
Cl4-BZ#66	17.6		ug/kg	0.965	1
Cl5-BZ#87	ND		ug/kg	0.965	1
Cl5-BZ#101	72.8		ug/kg	0.965	1
Cl5-BZ#105	21.2		ug/kg	0.965	1
Cl5-BZ#118	77.2		ug/kg	0.965	1
Cl6-BZ#128	19.7		ug/kg	0.965	1
Cl6-BZ#138	80.4		ug/kg	0.965	1
Cl6-BZ#153	37.0		ug/kg	0.965	1
Cl7-BZ#170	4.90		ug/kg	0.965	1
Cl7-BZ#180	11.3		ug/kg	0.965	1
Cl7-BZ#183	ND		ug/kg	0.965	1
Cl7-BZ#184	ND		ug/kg	0.965	1
Cl7-BZ#187	6.66		ug/kg	0.965	1
Cl8-BZ#195	ND		ug/kg	0.965	1
Cl9-BZ#206	ND		ug/kg	0.965	1
Cl10-BZ#209	ND		ug/kg	0.965	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
DBOB	92		50-125
BZ 198	103		50-125

Project Name: NBH PHASE III **Lab Number:** L1001187

Project Number: 6690.001 **Report Date:** 01/29/10

SAMPLE RESULTS

Lab ID:	L1001187-07	Date Collected:	01/20/10 11:20
Client ID:	POST_012010_SA1	Date Received:	01/22/10
Sample Location:	NEW BEDFORD, MA	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3570
Analytical Method:	1,8270C-SIM	Extraction Date:	01/25/10 14:11
Analytical Date:	01/28/10 22:00	Cleanup Method1:	- - - -
Analyst:	WN		
Percent Solids:	81%		

Parameter	Result	Qualifier	Units	RDL	Dilution Factor
PCB Congeners (NOAA List) - Mansfield Lab					
Cl2-BZ#8	ND		ug/kg	0.925	1
Cl3-BZ#18	ND		ug/kg	0.925	1
Cl3-BZ#28	18.4		ug/kg	0.925	1
Cl4-BZ#44	ND		ug/kg	0.925	1
Cl4-BZ#49	6.46		ug/kg	0.925	1
Cl4-BZ#52	15.2		ug/kg	0.925	1
Cl4-BZ#66	2.28		ug/kg	0.925	1
Cl5-BZ#87	ND		ug/kg	0.925	1
Cl5-BZ#101	8.49		ug/kg	0.925	1
Cl5-BZ#105	ND		ug/kg	0.925	1
Cl5-BZ#118	10.8		ug/kg	0.925	1
Cl6-BZ#128	ND		ug/kg	0.925	1
Cl6-BZ#138	10.4		ug/kg	0.925	1
Cl6-BZ#153	8.73		ug/kg	0.925	1
Cl7-BZ#170	ND		ug/kg	0.925	1
Cl7-BZ#180	ND		ug/kg	0.925	1
Cl7-BZ#183	ND		ug/kg	0.925	1
Cl7-BZ#184	ND		ug/kg	0.925	1
Cl7-BZ#187	ND		ug/kg	0.925	1
Cl8-BZ#195	ND		ug/kg	0.925	1
Cl9-BZ#206	ND		ug/kg	0.925	1
Cl10-BZ#209	ND		ug/kg	0.925	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
DBOB	96		50-125
BZ 198	69		50-125

Project Name: NBH PHASE III
Project Number: 6690.001

Lab Number: L1001187
Report Date: 01/29/10

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8270C-SIM
Analytical Date: 01/28/10 14:55
Analyst: WN

Extraction Method: EPA 3570
Extraction Date: 01/25/10 14:11
Cleanup Method1: - - - -
Cleanup Date1:

Parameter	Result	Qualifier	Units	RDL
PCB Congeners (NOAA List) - Mansfield Lab for sample(s): 01-07 Batch: WG397971-1				
Cl2-BZ#8	ND		ug/kg	0.800
Cl3-BZ#18	ND		ug/kg	0.800
Cl3-BZ#28	ND		ug/kg	0.800
Cl4-BZ#44	ND		ug/kg	0.800
Cl4-BZ#49	ND		ug/kg	0.800
Cl4-BZ#52	ND		ug/kg	0.800
Cl4-BZ#66	ND		ug/kg	0.800
Cl5-BZ#87	ND		ug/kg	0.800
Cl5-BZ#101	ND		ug/kg	0.800
Cl5-BZ#105	ND		ug/kg	0.800
Cl5-BZ#118	ND		ug/kg	0.800
Cl6-BZ#128	ND		ug/kg	0.800
Cl6-BZ#138	ND		ug/kg	0.800
Cl6-BZ#153	ND		ug/kg	0.800
Cl7-BZ#170	ND		ug/kg	0.800
Cl7-BZ#180	ND		ug/kg	0.800
Cl7-BZ#183	ND		ug/kg	0.800
Cl7-BZ#184	ND		ug/kg	0.800
Cl7-BZ#187	ND		ug/kg	0.800
Cl8-BZ#195	ND		ug/kg	0.800
Cl9-BZ#206	ND		ug/kg	0.800
Cl10-BZ#209	ND		ug/kg	0.800

Surrogate	%Recovery	Qualifier	Acceptance Criteria
DBOB	75		50-125
BZ 198	88		50-125

Lab Control Sample Analysis
Batch Quality Control

Project Name: NBH PHASE III
Project Number: 6690.001

Lab Number: L1001187
Report Date: 01/29/10

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
PCB Congeners (NOAA List) - Mansfield Lab Associated sample(s): 01-07 Batch: WG397971-2 WG397971-3								
Cl2-BZ#8	57		73		40-140	25		30
Cl3-BZ#18	56		71		40-140	24		30
Cl3-BZ#28	57		70		40-140	20		30
Cl4-BZ#44	59		72		40-140	20		30
Cl4-BZ#49	47		55		40-140	16		30
Cl4-BZ#52	69		92		40-140	29		30
Cl4-BZ#66	61		75		40-140	21		30
Cl5-BZ#87	63		71		40-140	12		30
Cl5-BZ#101	58		70		40-140	19		30
Cl5-BZ#105	41		50		40-140	20		30
Cl5-BZ#118	63		71		40-140	12		30
Cl6-BZ#128	62		75		40-140	19		30
Cl6-BZ#138	62		77		40-140	22		30
Cl6-BZ#153	61		72		40-140	17		30
Cl7-BZ#170	68		78		40-140	14		30
Cl7-BZ#180	66		75		40-140	13		30
Cl7-BZ#183	43		44		40-140	2		30
Cl7-BZ#184	59		73		40-140	21		30
Cl7-BZ#187	82		102		40-140	22		30
Cl8-BZ#195	58		66		40-140	13		30
Cl9-BZ#206	67		80		40-140	18		30

Lab Control Sample Analysis

Batch Quality Control

Project Name: NBH PHASE III

Project Number: 6690.001

Lab Number: L1001187

Report Date: 01/29/10

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
PCB Congeners (NOAA List) - Mansfield Lab Associated sample(s): 01-07 Batch: WG397971-2 WG397971-3								
Cl10-BZ#209	58		70		40-140	19		30

Surrogate	LCS %Recovery	Qual	LCSD %Recovery	Qual	Acceptance Criteria
DBOB	58		73		50-125
BZ 198	69		75		50-125

INORGANICS
&
MISCELLANEOUS

Project Name: NBH PHASE III
Project Number: 6690.001

Lab Number: L1001187
Report Date: 01/29/10

SAMPLE RESULTS

Lab ID: L1001187-01
Client ID: POST_012010_G1
Sample Location: NEW BEDFORD, MA
Matrix: Soil

Date Collected: 01/20/10 10:16
Date Received: 01/22/10
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Mansfield Lab									
Solids, Total	76.1		%	0.100	1	-	01/25/09 13:15	30,2540G	KB

Project Name: NBH PHASE III
Project Number: 6690.001

Lab Number: L1001187
Report Date: 01/29/10

SAMPLE RESULTS

Lab ID: L1001187-02
Client ID: POST_012010_TP2
Sample Location: NEW BEDFORD, MA
Matrix: Soil

Date Collected: 01/20/10 12:45
Date Received: 01/22/10
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Mansfield Lab									
Solids, Total	66.0		%	0.100	1	-	01/25/09 13:15	30,2540G	KB

Project Name: NBH PHASE III
Project Number: 6690.001

Lab Number: L1001187
Report Date: 01/29/10

SAMPLE RESULTS

Lab ID: L1001187-03
Client ID: POST_012010_UW1
Sample Location: NEW BEDFORD, MA
Matrix: Soil

Date Collected: 01/20/10 12:17
Date Received: 01/22/10
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Mansfield Lab									
Solids, Total	34.5		%	0.100	1	-	01/25/09 13:15	30,2540G	KB

Project Name: NBH PHASE III
Project Number: 6690.001

Lab Number: L1001187
Report Date: 01/29/10

SAMPLE RESULTS

Lab ID: L1001187-04
Client ID: POST_012010_PACK1
Sample Location: NEW BEDFORD, MA
Matrix: Soil

Date Collected: 01/20/10 14:20
Date Received: 01/22/10
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Mansfield Lab									
Solids, Total	81.3		%	0.100	1	-	01/25/09 13:15	30,2540G	KB

Project Name: NBH PHASE III
Project Number: 6690.001

Lab Number: L1001187
Report Date: 01/29/10

SAMPLE RESULTS

Lab ID: L1001187-05
Client ID: POST_012010_BHB1
Sample Location: NEW BEDFORD, MA
Matrix: Soil

Date Collected: 01/20/10 14:46
Date Received: 01/22/10
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Mansfield Lab									
Solids, Total	71.9		%	0.100	1	-	01/25/09 13:15	30,2540G	KB

Project Name: NBH PHASE III
Project Number: 6690.001

Lab Number: L1001187
Report Date: 01/29/10

SAMPLE RESULTS

Lab ID: L1001187-06
Client ID: POST_012010_ONWF1
Sample Location: NEW BEDFORD, MA
Matrix: Soil

Date Collected: 01/20/10 13:48
Date Received: 01/22/10
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Mansfield Lab									
Solids, Total	73.9		%	0.100	1	-	01/25/09 13:15	30,2540G	KB

Project Name: NBH PHASE III
Project Number: 6690.001

Lab Number: L1001187
Report Date: 01/29/10

SAMPLE RESULTS

Lab ID: L1001187-07
Client ID: POST_012010_SA1
Sample Location: NEW BEDFORD, MA
Matrix: Soil

Date Collected: 01/20/10 11:20
Date Received: 01/22/10
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Mansfield Lab									
Solids, Total	80.5		%	0.100	1	-	01/25/09 13:15	30,2540G	KB

Lab Duplicate Analysis
Batch Quality Control

Project Name: NBH PHASE III
Project Number: 6690.001

Lab Number: L1001187
Report Date: 01/29/10

Parameter	Native Sample	Duplicate Sample	Units	RPD	Qual	RPD Limits
General Chemistry - Mansfield Lab Associated sample(s): 01-07 QC Batch ID: WG397944-1 QC Sample: L1001187-01 Client ID: POST_012010_G1						
Solids, Total	76.1	75.3	%	1		20

Project Name: NBH PHASE III
Project Number: 6690.001

Lab Number: L1001187
Report Date: 01/29/10

Sample Receipt and Container Information

Were project specific reporting limits specified? YES

Cooler Information

Cooler	Custody Seal
A	Absent

Container Information

Container ID	Container Type	Cooler	pH	Temp deg C	Pres	Seal	Analysis
L1001187-01A	Glass 100ml unpreserved	A	N/A	3	Y	Absent	A2-PCBCONG-8270-NOAA(),A2-TS(7)
L1001187-02A	Glass 100ml unpreserved	A	N/A	3	Y	Absent	A2-PCBCONG-8270-NOAA(),A2-TS(7)
L1001187-03A	Glass 100ml unpreserved	A	N/A	3	Y	Absent	A2-PCBCONG-8270-NOAA(),A2-TS(7)
L1001187-04A	Glass 100ml unpreserved	A	N/A	3	Y	Absent	A2-PCBCONG-8270-NOAA(),A2-TS(7)
L1001187-05A	Glass 100ml unpreserved	A	N/A	3	Y	Absent	A2-PCBCONG-8270-NOAA(),A2-TS(7)
L1001187-06A	Glass 100ml unpreserved	A	N/A	3	Y	Absent	A2-PCBCONG-8270-NOAA(),A2-TS(7)
L1001187-07A	Glass 100ml unpreserved	A	N/A	3	Y	Absent	A2-PCBCONG-8270-NOAA(),A2-TS(7)
L1001187-08A	Glass 100ml unpreserved	A	N/A	3	Y	Absent	HOLD(14)
L1001187-09A	Glass 100ml unpreserved	A	N/A	3	Y	Absent	HOLD(14)
L1001187-10A	Glass 100ml unpreserved	A	N/A	3	Y	Absent	HOLD(14)

*Hold days indicated by values in parentheses

Project Name:	NBH PHASE III	**Lab Number:**	L1001187
Project Number:	6690.001	**Report Date:**	01/29/10

GLOSSARY

Acronyms

EPA	· Environmental Protection Agency.
LCS	· Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
LCSD	· Laboratory Control Sample Duplicate: Refer to LCS.
MS	· Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available.
MSD	· Matrix Spike Sample Duplicate: Refer to MS.
NA	· Not Applicable.
NC	· Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.
ND	· Not detected at the reported detection limit for the sample.
NI	· Not Ignitable.
RDL	· Reported Detection Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
RPD	· Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.

Terms

Analytical Method: Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

Data Qualifiers

A	- Spectra identified as "Aldol Condensation Product".
B	- The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than five times (5x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank.
D	- Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.
E	- Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.
H	- The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.
P	- The RPD between the results for the two columns exceeds the method-specified criteria.
Q	- The quality control sample exceeds the associated acceptance criteria. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less than 5x the RDL. (Metals only.)
R	- Analytical results are from sample re-analysis.
RE	- Analytical results are from sample re-extraction.
J	- Estimated value. This represents an estimated concentration for Tentatively Identified Compounds (TICs).

Report Format: Data Usability Report

Project Name:	NBH PHASE III	**Lab Number:**	L1001187
Project Number:	6690.001	**Report Date:**	01/29/10

REFERENCES

1 Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. EPA SW-846. Third Edition. Updates I - IIIA, 1997.

30 Standard Methods for the Examination of Water and Wastewater. APHA-AWWA-WPCF. 18th Edition. 1992.

LIMITATION OF LIABILITIES

Alpha Analytical performs services with reasonable care and diligence normal to the analytical testing laboratory industry. In the event of an error, the sole and exclusive responsibility of Alpha Woods Hole Labs shall be to re-perform the work at it's own expense. In no event shall Alpha Analytical be held liable for any incidental, consequential or special damages, including but not limited to, damages in any way connected with the use of, interpretation of, information or analysis provided by Alpha Woods Hole Labs.

We strongly urge our clients to comply with EPA protocol regarding sample volume, preservation, cooling, containers, sampling procedures, holding time and splitting of samples in the field.

Certificate/Approval Program Summary

Last revised December 15, 2009 – Mansfield Facility

The following list includes only those analytes/methods for which certification/approval is currently held.
For a complete listing of analytes for the referenced methods, please contact your Alpha Customer Service Representative.

Connecticut Department of Public Health Certificate/Lab ID: PH-0141.

Wastewater/Non-Potable Water (Inorganic Parameters: pH, Turbidity, Conductivity, Alkalinity, Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Strontium, Thallium, Tin, Vanadium, Zinc, Total Residue (Solids), Total Suspended Solids (non-filterable), Total Cyanide. Organic Parameters: PCBs, Organochlorine Pesticides, Technical Chlordane, Toxaphene, Acid Extractables, Benzidines, Phthalate Esters, Nitrosamines, Nitroaromatics & Isophorone, PAHs, Haloethers, Chlorinated Hydrocarbons, Volatile Organics.)

Solid Waste/Soil (Inorganic Parameters: pH, Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Calcium, Chromium, Hexavalent Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Thallium, Vanadium, Zinc, Total Organic Carbon, Total Cyanide, Corrosivity, TCLP 1311. Organic Parameters: PCBs, Organochlorine Pesticides, Technical Chlordane, Toxaphene, Volatile Organics, Acid Extractables, Benzidines, Phthalates, Nitrosamines, Nitroaromatics & Cyclic Ketones, PAHs, Haloethers, Chlorinated Hydrocarbons.)

Florida Department of Health Certificate/Lab ID: E87814. ***NELAP Accredited.***

Non-Potable Water (Inorganic Parameters: SM2320B, EPA 120.1, SM2510B, EPA 245.1, EPA 150.1, EPA 160.2, SM2540D, EPA 335.2, SM2540G, EPA 180.1. Organic Parameters: EPA 625, 608.)

Solid & Chemical Materials (Inorganic Parameters: 6020, 7470, 7471, 9045, 9014. Organic Parameters: EPA 8260, 8270, 8082, 8081.)

Air & Emissions (EPA TO-15.)

Louisiana Department of Environmental Quality Certificate/Lab ID: 03090. ***NELAP Accredited.***

Non-Potable Water (Inorganic Parameters: EPA 120.1, 150.1, 160.2, 180.1, 200.8, 245.1, 310.1, 335.2, 608, 625, 1631, 3010, 3015, 3020, 6020, 9010, 9014, 9040, SM2320B, 2510B, 2540D, 2540G, 4500CN-E, 4500H-B, Organic Parameters: EPA 3510, 3580, 3630, 3640, 3660, 3665, 5030, 8015 (mod), 3570, 8081, 8082, 8260, 8270,)

Solid & Chemical Materials (Inorganic Parameters: 6020, 7196, 7470, 7471, 7474, 9010, 9014, 9040, 9045, 9060. Organic Parameters: EPA 8015 (mod), EPA 3570, 1311, 3050, 3051, 3060, 3580, 3630, 3640, 3660, 3665, 5035, 8081, 8082, 8260, 8270.)

Biological Tissue (Inorganic Parameters: EPA 6020. Organic Parameters: EPA 3570, 3510, 3610, 3630, 3640, 8270.)

Maine Department of Human Services Certificate/Lab ID: MA0030.

Wastewater (Inorganic Parameters: EPA 120.1, 300.0, SM 2320, 2510B, 2540C, 2540D, EPA 245.1. Organic Parameters: 608, 624.)

Massachusetts Department of Environmental Protection Certificate/Lab ID: M-MA030.

Non-Potable Water (Inorganic Parameters: SM4500H+B. Organic Parameters: EPA 624.)

New Hampshire Department of Environmental Services Certificate/Lab ID: 2206. ***NELAP Accredited.***

Non-Potable Water (Inorganic Parameters: EPA 200.8, 245.1, 1631E, 120.1, 150.1, 180.1, 310.1, 335.2, 160.2, SM2540D, 2540G, 4500CN-E, 4500H+B, 2320B, 2510B. Organic Parameters: EPA 625, 608.)

New Jersey Department of Environmental Protection Certificate/Lab ID: MA015. ***NELAP Accredited.***

Non-Potable Water (Inorganic Parameters: SW-846 1312, 3010, 3020A, 3015, 6020, SM2320B, EPA 200.8, SM2540C, 2540D, 2540G, EPA 120.1, SM2510B, EPA 180.1, 245.1, 1631E, SW-846 9040B, 6020, 9010B, 9014 Organic Parameters: EPA 608, 625, SW-846 3510C, 3580A, 5030B, 3035L, 5035H, 3630C, 3640A, 3660B, 3665A, 8081A, 8082 8260B, 8270C)

Solid & Chemical Materials (Inorganic Parameters: SW-846 6020, 9010B, 9014, 1311, 1312, 3050B, 3051, 3060A, 7196A, 7470A, 7471A, 9045C, 9060. Organic Parameters: SW-846 3580A, 5030B, 3035L, 5035H, 3630C, 3640A, 3660B, 3665A, 8081A, 8082, 8260B, 8270C, 3570, 8015B.)

Atmospheric Organic Parameters (EPA TO-15)

Biological Tissue (Inorganic Parameters: SW-846 6020 Organic Parameters: SW-846 8270C, 3510C, 3570, 3610B, 3630C, 3640A)

New York Department of Health Certificate/Lab ID: 11627. ***NELAP Accredited.***

Non-Potable Water (Inorganic Parameters: EPA 310.1, SM2320B, EPA 365.2, 160.1, EPA 160.2, SM2540D, EPA 200.8, 6020, 1631E, 245.1, 335.2, 9014, 150.1, 9040B, 120.1, SM2510B, EPA 376.2, 180.1, 9010B. Organic Parameters: EPA 624, 8260B, 8270C, 608, 8081A, 625, 8082, 3510C, 3511, 5030B.)

Solid & Hazardous Waste (Inorganic Parameters: EPA 9040B, 9045C, SW-846 Ch7 Sec 7.3, EPA 6020, 7196A, 7471A, 7474, 9014, 9040B, 9045C, 9010B. Organic Parameters: EPA 8260B, 8270C, 8081A, DRO 8015B, 8082, 1311, 3050B, 3580, 3050B, 3035, 3570, 3051, 5035, 5030B.)

Air & Emissions (EPA TO-15.)

Pennsylvania Department of Environmental Protection Certificate/Lab ID: 68-02089. ***NELAP Accredited.***

Non-Potable Water (Organic Parameters: EPA 5030B, EPA 8260)

Rhode Island Department of Health Certificate/Lab ID: LAO00299. ***NELAP Accredited via LA-DEQ.***

Refer to MA-DEP Certificate for Non-Potable Water.

Refer to LA-DEQ Certificate for Non-Potable Water.

Texas Commission of Environmental Quality Certificate/Lab ID: T104704419-08-TX. ***NELAP Accredited.***

Solid & Chemical Materials (Inorganic Parameters: EPA 6020, 7470, 7471, 1311, 7196, 9014, 9040, 9045, 9060. Organic Parameters: EPA 8015, 8270, 8260, 8081, 8082.)

U.S. Army Corps of Engineers

Department of Defense Certificate/Lab ID: L2217.01.

Non-Potable Water (Inorganic Parameters: EPA 3005A,3020, 6020, 245.1, 245.7, 1631E, 7470A, 7474, 9014, 120.1, 9050A, 180.1, SM4500H-B, 2320B, 2510B, 2540D,9040. Organic Parameters: EPA 3510C, 5030B, 9010B, 624, 8260B, 8270C, 8270 Alk-PAH, 8082, 8081A, 8015 (SHC), 8015 (DRO).)

Solid & Hazardous Waste (Inorganic Parameters: EPA 1311, 1312,3051, 6020, 747A, 7474, 9045C,9060, SM 2540G, ASTM D422-63. Organic Parameters: EPA 3580, 3570, 3540C, 5035, 8260B, 8270C, 8270 Alk-PAH, 8082, 8081A, 8015 (SHC), 8015 (DRO).

Air & Emissions (EPA TO-15.)

Analytes Not Accredited by NELAP
Certification is not available by NELAP for the following analytes: **8270C:** Biphenyl.

01291010:29

CHAIN OF CUSTODY

PAGE ____ OF ____

Date Rec'd in Lab:

ALPHA Job #: L1001187

ALPHA ANALYTICAL
WESTBORO, MA TEL: 508-898-9220 FAX: 508-898-9193
MANSFIELD, MA TEL: 508-822-9300 FAX: 508-822-3288

Client Information

Client: APEX COMPANIES LLC
Address: 184 HIGH ST SUITE 502 BOSTON MA 02110
Phone: 617-728-0070
Fax: 617-728 0080
Email: CMYERS@APEXCOS.COM
☐ These samples have been previously analyzed by Alpha

Project Information

Project Name: NBH PHASE III
Project Location: NEW BEDFORD
Project #: 66690.001
Project Manager: CHET MYERS
ALPHA Quote #:

Turn-Around Time

☐ Standard ☐ RUSH (only confirmed if pre-approved!)
Date Due: Time:

Report Information - Data Deliverables

☐ FAX ☒ EMAIL
☐ ADEx ☐ Add'l Deliverables

Billing Information

☐ Same as Client info PO #:

Regulatory Requirements/Report Limits

State /Fed Program | Criteria

MA MCP PRESUMPTIVE CERTAINTY --- CT REASONABLE CONFIDENCE PROTOCOLS

☐ Yes ☐ No Are MCP Analytical Methods Required?
☐ Yes ☐ No Are CT RCP (Reasonable Confidence Protocols) Required?

Other Project Specific Requirements/Comments/Detection Limits:

ANALYSIS: PCB's NOAA CONTAINERS

SAMPLE HANDLING
Filtration
☐ Done
☐ Not needed
☐ Lab to do
Preservation
☐ Lab to do
(Please specify below)

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials	PCB's NOAA CONTAINERS	Sample Specific Comments	TOTAL # BOTTLES
-1	POST_012010_G1	1/20/10	10:16	SOIL	GCD	X		1
-2	POST_012010_TP2	1/20/10	12:45	SOIL	GCD	X		1
-3	POST_012010_OW1	1/20/10	12:17	SOIL	GCD	X		1
-4	POST_012010_PACK1	1/20/10	14:20	SOIL	GCD	X		1
-5	POST_012010_BHB1	1/20/10	14:46	SOIL	GCD	X		1
-6	POST_012010_ONWF1	1/20/10	13:48	SOIL	GCD	X		1
-7	POST_012010_SA1	1/20/10	11:20	SOIL	GCD	X		1
-8	POST_012010_SA2	1/20/10	11:30	SOIL	GCD	HOLD	HOLD	1
-9	POST_012010_SA3	1/20/10	11:45	SOIL	GCD	HOLD	HOLD	1
-10	POST_012010_TP1	1/20/10	13:00	SOIL	GCD	HOLD	HOLD	1

Container Type: AMBER GLASS
Preservative: NONE

PLEASE ANSWER QUESTIONS ABOVE!

IS YOUR PROJECT MA MCP or CT RCP?

Relinquished By:	Date/Time	Received By:	Date/Time
[signature]	1/22/10 1230	[signature]	1/22/10 1530
[signature]	1/22/10	[signature]	1/22/10 1700
[signature]	1/25/10 1030	[signature]	1/25/10 9:45
		[signature]	1/25/10 1030

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Payment Terms. See reverse side.

FORM NO: 01-01 (rev. 30-JUL-07)

APPENDIX B
WATER QUALITY MONITORING SHEETS

Dredge Water Quality Monitoring Form

Apex

PROJECT: 0615.005 NBH
JOB NUMBER:
DATE: 06/13/2008
MONITORS: MB JM
WEATHER CONDITIONS: Sunny 75°
WIND: Calm
PRIOR STORM EVENTS: None
DREDGE UPDATE: Not Begun
TYPE OF WATER QUALITY MONITORING:

UP-CURRENT

TIME: 1115
GPS FILE NAME: 06132008-00-1
NORTHING:
TIDAL STAGE:

NUMBER OF HOURS OF DREDGING: 0
DISTANCE FROM DREDGE/SILT CURTAIN:
EASTING:
WATER DEPTH: 7.6'

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
06132008-00-1-5.5	1115	5.5	0.06	DO 3.91 / pH 7.71 / ORP 289.2
06132008-00-1-2.0	1115	2.0	0.1	DO 3.51 / pH 7.73 / ORP 292.2
-00-1-3.25	1115	3.25	-0.2	DO 3.31 / pH 7.72 / ORP 299.2

AVERAGE TURBIDITY:

DOWN-CURRENT

TIME: 1045
GPS FILE NAME: 06132008-00
NORTHING: -
TIDAL STAGE: Low Tide was @ 10:11

NUMBER OF HOURS OF DREDGING: Ø
DISTANCE FROM DREDGE/SILT CURTAIN:
EASTING:
WATER DEPTH: 7.0'

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
06132008-00-9-5	1045	5	-0.1	Temp 20.7°C / 46.39 mS/cm³ / 42.44 ns/m / 70.5% DO 5.29 pH 7.8 137.2 ORP
06132008-00-9-2	1047	2	-0.5	DO 6.09 / pH 7.81 / ORP 1.511
06132008-00-9-3	1049	3	0.0	DO 5.24 / pH 7.811 / ORP 1.594

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Disposal Water Quality Monitoring Form

Apex

NOT DISPOSAL DREDGE MONITORING KUN 6/15/08

PROJECT: NBH-CAD II
JOB NUMBER: 6615.005.01
DATE: 6/14/08
DISPOSAL EVENT:
MONITORS: Jen Martino / Chris Morris
WEATHER CONDITIONS: Clear, Calm, 70°F
WIND: Cool Breeze
PRIOR STORM EVENTS: None

UP-CURRENT

TIME: 07:15am
GPS FILE NAME: 061408
NORTHING: 269 640.99
TIDAL STAGE: High to Low

TIME OF DISPOSAL:
DISTANCE FROM DISPOSAL LOCATION:
EASTING: 815 208.62
WATER DEPTH: 7.8

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES Temp	Spcon.	PH	ORP	DO	Turb
061408-00-1-5.5	0719	5.5	0	20.58°C	42.85 us/cm	7.84 pH	111.2 ORP	4.26 DO	0
061408-00-1-2.0	0720	2.0	0	20.84	42.79 us/cm	7.82 pH	122.5	4.93	0
061408-00-1-3.25	0721	3.25	0	20.84	42.77	7.81 pH	13.2	4.74	0
061408-01-9-2.0	0825	2	0	20.93	42.83	7.78	242.2	2.86	0
061408-01-9-4.0	0826	4	0.3	20.86	42.76	7.77	252.9	2.78	.3
061408-01-9-3.0	0829	3	.4	20.93	42.82	7.76	258.1	2.88	.4
061408-03-1-3.0	1017	3	.9	21.45	43.34	7.81	108.5	7.79	1.0
061408-03-1-2.5	1019	2.5	.9	21.48	43.34	7.79	132.4	7.19	.9
061408-03-1-2.0	1021	2	.9	21.52	43.37	7.79	150.1	7.78	.9
061408-03-9-5	1032	5	2	20.78	42.84	7.78	253	2.49	2
061408-03-9-2	1035	2	2	21.52	43.38	7.79	262.1	2.69	2
061408-03-9-2.5	1037	3.5	2	21.51	43.35	7.79	271.0	2.81	2

AVERAGE TURBIDITY:

DISPOSAL LOCATION

TIME:
GPS FILE NAME:
NORTHING:
TIDAL STAGE:

TIME OF DISPOSAL:
DISTANCE FROM DISPOSAL LOCATION:
EASTING:
WATER DEPTH:

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Disposal Water Quality Monitoring Form

Apex

DOWN-CURRENT

TIME:

GPS FILE NAME:

NORTHING:

TIDAL STAGE:

TIME OF DISPOSAL:

DISTANCE FROM DISPOSAL LOCATION:

EASTING:

WATER DEPTH:

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES pH	Tem	SpCn	ORP	DO	Turb
061408-05-1-2	1240	2	0	6.82	22.17	43.97	444.5	3.81	0
061408-05-1-3	1242	3	0	6.84	22.10	43.90	461.5	3.69	0
061408-05-1-2.5	1244	2.5	0	6.89	22.16	44.00	469.5	3.73	0
061408-05-9-6	1252	6	1	7.19	21.06	43.02	484.4	2.68	1
061408-05-9-2	1253	2	1	7.25	21.67	43.54	485.1	3.30	1
061408-05-9-4	1254	4	1	7.34	21.60	43.42	489.1	3.18	1
061408-07-1-2	1631	2		7.75	22.36	44.27	203.7	8.05	2.7
061408-07-1-4	1633	4		7.69	22.25	44.20	238.1	6.47	2.3
061408-07-1-6	1634	6		7.62	21.53	46.74	268.1	6.14	1.1
061808-07-9-8	1649	8		7.87	21.23	43.47	362.2	2.63	0
061808-07-9-2	1651	2		7.87	22.24	46.16	365.4	2.38	3.5
061808-07-9-5	1653	5		7.87	21.73	43.84	369.2	2.37	0

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex

PROJECT: NB H
JOB NUMBER: 66152005.01
DATE: 6/16/08
MONITORS: MB JK
WEATHER CONDITIONS: Cold 60°
WIND: 5 knts
PRIOR STORM EVENTS: None
DREDGE UPDATE: Pre
TYPE OF WATER QUALITY MONITORING: Pre Dredge

UP-CURRENT

TIME: 1645
GPS FILE NAME: 061608-1
NORTHING:
TIDAL STAGE: Low → High

NUMBER OF HOURS OF DREDGING: Ø
DISTANCE FROM DREDGE/SILT CURTAIN:
EASTING:
WATER DEPTH: 46.0

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	DO	pH	ORP	NOTES
061808-32-1	1645	32	44.1	2.03	7.86	207.1	
061808-2-1	1648	2	0.1	8.18	7.86	210.0	
061808-15-1	1653	15	-0.3	2.25	7.87	214.8	

AVERAGE TURBIDITY:

Pre-Dump

DOWN-CURRENT

TIME: 1630
GPS FILE NAME: 061608-9
NORTHING:
TIDAL STAGE: Low → High

NUMBER OF HOURS OF DREDGING: Ø
DISTANCE FROM DREDGE/SILT CURTAIN:
EASTING:
WATER DEPTH: 20'

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	DO	Ph	ORP	NOTES
061608_18_9	1629	18	-0.2	5.21	7.8	129.5	
061608_02_9	1632	2	-0.2	7.28	7.88	131.6	
061608_08_9	1635	8	-0.1	3.41	7.87	134.2	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: NBH - Top of CAD Cell 2

Dredge Water Quality Monitoring Form

JOB NUMBER: 6615.005.01

DATE: 6/19/08

MONITORS: Jen Martino & Chris Morris

WEATHER CONDITIONS: Sunny, cool, 70°F

WIND: Slight breeze

PRIOR STORM EVENTS: N/A

DREDGE UPDATE: Pre-Dredge WQ Monitoring

TYPE OF WATER QUALITY MONITORING: Pre-Dredge WQ Monitoring (up-current) (down-current)

UP-CURRENT

TIME: 0800 hrs

GPS FILE NAME: 061908-00-1

NORTHING: 2695782.23

TIDAL STAGE: Flood (low to high)

NUMBER OF HOURS OF DREDGING: 00

DISTANCE FROM DREDGE/SILT CURTAIN: 200 feet

EASTING: 815597.93

WATER DEPTH: 8.0 feet

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
061908-00-1-2	0810	2.0	5.2	
061908-00-1-4	0815	4.0	6.3	
061908-00-1-6	0820	6.0	6.7	
		Total:	18.2/3	= 6.06

AVERAGE TURBIDITY: 6.0 NTU

DOWN-CURRENT

TIME: 0830 hrs.

GPS FILE NAME: 061908-00-9

NORTHING: 2698242.76 N

TIDAL STAGE: Flood (low to high)

NUMBER OF HOURS OF DREDGING: 00

DISTANCE FROM DREDGE/SILT CURTAIN: 200 feet

EASTING: 815579.98 E

WATER DEPTH: 8.4 feet

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
061908-00-9-2	0835	2.0	1.3	
061908-00-9-4	0840	4.0	1.1	
061908-00-9-6	0845	6.0	4.1	
		Total:	6.5/3	= 2.16

AVERAGE TURBIDITY: 2.2 NTU

TURBIDITY INCREASE*: 2.2 NTU - 6.0 NTU = -3.8 NTU

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

6/19/08

Dredge Disposal Water Quality Monitoring Form

PROJECT: NBH - Top of CAD
JOB NUMBER: 6615.005.01
DATE: 6/19/08
DISPOSAL EVENT: D2 of day - dumping SE-103
MONITORS: Jen Martino + Chris Morris
WEATHER CONDITIONS: Cloudy/Sunny, warm ~ 75°F
WIND: Light breeze
PRIOR STORM EVENTS: N/A

Apex

UP-CURRENT

TIME: 1200 hrs.
GPS FILE NAME: 061908-05-1
NORTHING: 2696029.4
TIDAL STAGE: Ebb (High to low)

TIME OF DISPOSAL: 1200 hrs
DISTANCE FROM DISPOSAL LOCATION:
EASTING: 814946.07
WATER DEPTH: 40 Feet

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
061908-05-1-2	1150	2.0	27.9	
061908-05-1-16	1155	16.0	31.0	
061908-05-1-38	1200	38.0	11.4	

AVERAGE TURBIDITY:

DISPOSAL LOCATION

TIME: 1205 hrs
GPS FILE NAME: 061908-D2-05m.
NORTHING: 2695906
TIDAL STAGE: Ebb (High to low)

TIME OF DISPOSAL: 1200 hrs
DISTANCE FROM DISPOSAL LOCATION: ~~[illegible]~~ @location
EASTING: 814821
WATER DEPTH: 43 Feet

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
061908-D2-05-2	1215	2.0	1	
061908-D2-05-20	1220	20.0	2.1	
061908-D2-05-40	1225	40.0	2.2	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Apex

DOWN-CURRENT

TIME: 1230 hrs

GPS FILE NAME: 061908-05-9

NORTHING: 2695752

TIDAL STAGE: Ebb (High to low)

TIME OF DISPOSAL: 1200 hrs

DISTANCE FROM DISPOSAL LOCATION: 300 feet

EASTING: 814857

WATER DEPTH: 43 ft.

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
061908-05-9-2	1230	2.0	0.5	
061908-05-9-20	1235	20.0	0.6	
061908-05-9-40	1240	40.0	11.6	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: NBH - Top of CAP

Dredge Water Quality Monitoring Form

JOB NUMBER: 6645.005.01

DATE: 6/24/08

MONITORS: Jen Martino + Josh Ray

WEATHER CONDITIONS: Clear, overcast, cool ~ 65°F

WIND: cool breeze

PRIOR STORM EVENTS: rain

DREDGE UPDATE: started at 0800 hrs

TYPE OF WATER QUALITY MONITORING: 00 hr upcurrent / downcurrent turbidity

UP-CURRENT

TIME: 0750 hrs

GPS FILE NAME: 062408-00-1 (dredge)

NORTHING: 2695793

TIDAL STAGE: Flood

NUMBER OF HOURS OF DREDGING: 00

DISTANCE FROM DREDGE/SILT CURTAIN: 200 ft

EASTING: 815466

WATER DEPTH: 10 ft.

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
062408-00-1-2	0750	2.0	0.0	
062408-00-1-5	0755	5.0	0.2	
062408-00-1-8	0800	8.0	0.0	

AVERAGE TURBIDITY:

DOWN-CURRENT

TIME: 0800 hrs

GPS FILE NAME: 062408-00-9

NORTHING: 2696375

TIDAL STAGE: Flood

NUMBER OF HOURS OF DREDGING: 00

DISTANCE FROM DREDGE/SILT CURTAIN: 200 feet

EASTING: 815344

WATER DEPTH: 6 feet

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
062408-00-9-2	0800	2.0	0.2	
062408-00-9-3	0805	3.0	0.2	
062408-00-9-4	0810	4.0	0.2	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex

PROJECT: NBH-Dredge Top of CAD
JOB NUMBER: 6615.005.01
DATE: 6/24/08
MONITORS: Jen Martino + Josh Ray
WEATHER CONDITIONS: Sunny, hot, clear skies
WIND: slight breeze
PRIOR STORM EVENTS: rain
DREDGE UPDATE: 02 hours of dredge
TYPE OF WATER QUALITY MONITORING: turbidity dredge WQ - upcurrent + downcurrent

UP-CURRENT

TIME: 1000 hrs
GPS FILE NAME: 062408-02-1
NORTHING: 2695844
TIDAL STAGE: Flood

NUMBER OF HOURS OF DREDGING: 02
DISTANCE FROM DREDGE/SILT CURTAIN: 200 ft.
EASTING: 815382
WATER DEPTH: 31 feet

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
062408-02-1-2	1000	2.0	-0.2	
062408-02-1-13	1005	13.0	-0.2	
062408-02-1-29	1010	29.0	2.1	
		total:	1.7/3 = 0.~~12~~5	

AVERAGE TURBIDITY: 0.~~12~~5 NTU

DOWN-CURRENT

TIME: 1010 hrs.
GPS FILE NAME: 062408-02-9
NORTHING: 2696493
TIDAL STAGE: Flood

NUMBER OF HOURS OF DREDGING: 02
DISTANCE FROM DREDGE/SILT CURTAIN: 200 ft.
EASTING: 815278
WATER DEPTH: 7.5 feet

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
062408-02-9-2.0	1010	2.0	1.1	
062408-02-9-4.0	1015	4.0	-0.2	
062408-02-9-5.0	1020	5.0	-0.2	
		total:	0.7/3 = ~~0.12~~ 0.2 NTU	

AVERAGE TURBIDITY: 0.~~12~~2 NTU

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex

PROJECT: NCH
JOB NUMBER: 6615.005.001
DATE: 6/26/08
MONITORS:
WEATHER CONDITIONS:
WIND:
PRIOR STORM EVENTS:
DREDGE UPDATE:
TYPE OF WATER QUALITY MONITORING:

UP-CURRENT

TIME: 10:05
GPS FILE NAME: 62608-00-1
NORTHING: 2695861
TIDAL STAGE: flood

NUMBER OF HOURS OF DREDGING: 00
DISTANCE FROM DREDGE/SILT CURTAIN: 200'
EASTING: 915596
WATER DEPTH: 6.7'

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
062608-00-1-2	1005	2	0.3	
062608-00-1-3	1005	3	1.5	
062608-00-1-4	1006	4	3.2	

AVERAGE TURBIDITY:

DOWN-CURRENT

TIME: 10:17
GPS FILE NAME: 062608-00-9
NORTHING: 2694325
TIDAL STAGE: flood

NUMBER OF HOURS OF DREDGING: 00
DISTANCE FROM DREDGE/SILT CURTAIN: 200'
EASTING: 915684
WATER DEPTH: 8

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
062608-00-9-2	10:17	2	.5	
062608-00-9-4	10:17	4	.5	
062608-00-9-6	10:17	6	.4	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex

PROJECT: NBH - TOP OF CAP
JOB NUMBER: 6615.005.01
DATE: 6/26/08
MONITORS: Jen Martino + Warren B.
WEATHER CONDITIONS: Cloudy n 66°F
WIND: Slightly breezy
PRIOR STORM EVENTS: rain
DREDGE UPDATE: 02 hrs - dumping into Slow SE-104
TYPE OF WATER QUALITY MONITORING: Turbidity - up + down current

UP-CURRENT

TIME: 1150
GPS FILE NAME: 062608 - 02 - 1
NORTHING: 2695847
TIDAL STAGE: Flood

NUMBER OF HOURS OF DREDGING: 02
DISTANCE FROM DREDGE/SILT CURTAIN: 200 feet
EASTING: 815400
WATER DEPTH: 31 feet

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
062608-02-1-2	11.52	2	-0.3	
062608-02-1-14	11:55	14	0.6	
062608-02-1-28	1157	28	1.7	

AVERAGE TURBIDITY:

DOWN-CURRENT

TIME: 1155
GPS FILE NAME:
NORTHING: 2696567 (1)
TIDAL STAGE: Flood

NUMBER OF HOURS OF DREDGING: 02
DISTANCE FROM DREDGE/SILT CURTAIN: 200 ft
EASTING: 815755 (1)
WATER DEPTH: 9

2696556 (2)

815503 (2)

WD 7.5 (2)

	Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
(1)	062608-02-9-2	1155	2	0.5	
	062608-02-9-5	1157	5	9.7	
	062608-02-9-8	1200	8	6.4	
(2)	062608-02-9-2	1202	2	1.3	
	062608-02-9-4	1205	4	0.5	
	062608-02-9-5	1207	5	0.6	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: NBM - Top of CAD

Dredge Water Quality Monitoring Form

JOB NUMBER: 6615.005.01

DATE: 6/26/08

MONITORS: Jen Martino + Warren B.

WEATHER CONDITIONS: Overcast, rain, ~70°F humid

WIND: cool/humid breeze

PRIOR STORM EVENTS: Rain

DREDGE UPDATE: 06 hour. DI of mudcat, up-current/down current readings

TYPE OF WATER QUALITY MONITORING: Turbidity - WQ

Apex

UP-CURRENT

TIME: 1600

GPS FILE NAME:

NORTHING: 2696430

TIDAL STAGE: Ebb

NUMBER OF HOURS OF DREDGING: 06

DISTANCE FROM DREDGE/SILT CURTAIN: 200 ft.

EASTING: 815768

WATER DEPTH: 10 feet

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
062608-06-1-2	1600	2	-0.5	
062608-06-1-5	1603	5	-0.6	
	1605	8	-0.7	

AVERAGE TURBIDITY:

DOWN-CURRENT

TIME: 1607

GPS FILE NAME: 062608-06-9

NORTHING: 2695861

TIDAL STAGE: Ebb

NUMBER OF HOURS OF DREDGING: 06

DISTANCE FROM DREDGE/SILT CURTAIN: 200 feet

EASTING: 815574

WATER DEPTH: 8 feet

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
062608-06-9-2	1607	2	1.8	
062608-06-9-4	1610	4	6.6	
062608-06-9-6	1611	6	6.9	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex

PROJECT: NBH - Top of CAD
JOB NUMBER: 6615.005.01
DATE: 6/26/08
MONITORS: Jennartino + Warren B.
WEATHER CONDITIONS: Cloudy, some rain, humid ~ 75°F
WIND: no wind / slight breeze
PRIOR STORM EVENTS: Rain
DREDGE UPDATE: 08 hr dredging
TYPE OF WATER QUALITY MONITORING: turbidity up/down current

UP-CURRENT

TIME: 1800
GPS FILE NAME: 062608-08-1
NORTHING: 2696590
TIDAL STAGE: Ebb

NUMBER OF HOURS OF DREDGING: 08
DISTANCE FROM DREDGE/SILT CURTAIN: 200 ft.
EASTING: 815503
WATER DEPTH: 7.5'

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
062608-08-1-2	1800	2	0.0	
062608-08-1-4	1802	4	0.0	
062608-08-1-6	1803	6	-0.4	

AVERAGE TURBIDITY:

DOWN-CURRENT

TIME: 1805
GPS FILE NAME: ~~062608~~ 062608-08-9
NORTHING: 2695842
TIDAL STAGE: Ebb

NUMBER OF HOURS OF DREDGING: 08
DISTANCE FROM DREDGE/SILT CURTAIN: 200'
EASTING: 815579
WATER DEPTH: 6'

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
062608-08-9-2	1805	2	5.4	
062608-08-9-3	1807	3	7.3	
062608-08-9-4	1808	4	7.1	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

PROJECT: 6615.005.01 NBH Top of CAD Phase III
JOB NUMBER: 6615.005.01
DATE: 6/30/08
MONITORS: JLC, JER
WEATHER CONDITIONS: 72°F
WIND: approx 0-5 kts.
PRIOR STORM EVENTS: Heavy rain yesterday evening
DREDGE UPDATE:
TYPE OF WATER QUALITY MONITORING: Dredge Monitoring

UP-CURRENT

TIME: 07:00
GPS FILE NAME:
NORTHING: ~~2696678~~ 2696588
TIDAL STAGE: Ebb

NUMBER OF HOURS OF DREDGING: 0
DISTANCE FROM DREDGE/SILT CURTAIN: N/A
EASTING: ~~815342~~ 815379
WATER DEPTH: 7

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
063008-00.1.2	07:05	2	-0.1	
063008.00-1-4	07:05	4	0.0	
063008-00.1-5	07:06	5	-0.1	

AVERAGE TURBIDITY:

DOWN-CURRENT

TIME: 07:10
GPS FILE NAME:
NORTHING: 2696093
TIDAL STAGE: Ebb

NUMBER OF HOURS OF DREDGING: 0
DISTANCE FROM DREDGE/SILT CURTAIN: N/A
EASTING: 815613
WATER DEPTH: 10

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
063008-00-9-2	07:12	2	0.2	
063008.00-9-~~85~~	07:12	5	0.3	
063008-00-9-8	07:12	8	0.3	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

PROJECT:
JOB NUMBER:
DATE: 6/30/08
MONITORS:
WEATHER CONDITIONS:
WIND:
PRIOR STORM EVENTS:
DREDGE UPDATE:
TYPE OF WATER QUALITY MONITORING:

UP-CURRENT

TIME: 10:00
GPS FILE NAME:
NORTHING: 2696551
TIDAL STAGE: Ebb

NUMBER OF HOURS OF DREDGING: 2
DISTANCE FROM DREDGE/SILT CURTAIN: N/A
EASTING: 815310
WATER DEPTH: 6

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
063008-02-1-2	10:01	2	0.3	
063008-02-1-3	10:01	3	0.3	
063008-02-1-4	10:01	4	1.3	

AVERAGE TURBIDITY:

DOWN-CURRENT

TIME: 10:04
GPS FILE NAME:
NORTHING: 2696111
TIDAL STAGE: Ebb

NUMBER OF HOURS OF DREDGING: 2
DISTANCE FROM DREDGE/SILT CURTAIN: N/A
EASTING: 815468
WATER DEPTH: 8

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
063008-02-9-2	10:04	2	3.0	
063008-02-9-4	10:04	4	1.1	
063008-02-9-6	10:04	6	1.0	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex

PROJECT: NBH Top of CAD 2 Phase III
JOB NUMBER: 6615.005.01
DATE: 6/30/08
MONITORS: JK, JER
WEATHER CONDITIONS: HOT 80°F
WIND: 5 kts.
PRIOR STORM EVENTS: Yesterday morning rain
DREDGE UPDATE: on 4th 75ft. cut. on western side
TYPE OF WATER QUALITY MONITORING: Dredge Monitoring for Turbidity.

* GPS down *

UP-CURRENT

TIME: 12:15
GPS FILE NAME: /
NORTHING: /
TIDAL STAGE: Flood

NUMBER OF HOURS OF DREDGING: 4
DISTANCE FROM DREDGE/SILT CURTAIN: N/A
EASTING: 30-40 ft. off 2626 stem
WATER DEPTH: 9

Soft dredge length of SAMSON + 26. North of Natick Marine moorings 100 ft.

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
063008-4-1-2	12:15	2	6.7	GPS Trimble down
063008-4-1-4	12:15	4	6.7	" "
063008-4-1-7	12:15	7	7.2	" "

AVERAGE TURBIDITY:

* GPS down *

DOWN-CURRENT

TIME: 12:20
GPS FILE NAME:
NORTHING: /
TIDAL STAGE: Flood.

NUMBER OF HOURS OF DREDGING: 4
DISTANCE FROM DREDGE/SILT CURTAIN: N/A
EASTING: /
WATER DEPTH: 4.5

Location: 150 feet N. of 88 dredge. Directly N of swing bridge.

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
063008-4-9-2	12:20	2	1.6	GPS Trimble down
063008-4-9-2.5	12:20	2.5	2.3	" "
063008-4-9-3	12:20	3	2.4	" "

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: New Bedford Harbor Phase III dredging Top of CAD

Dredge Water Quality Monitoring Form

JOB NUMBER: 6615.005.01

DATE: 6/30/08

MONITORS: JK, JER, GCD

WEATHER CONDITIONS: South wind - 10 Knots clear 80's

WIND:

PRIOR STORM EVENTS:

DREDGE UPDATE:

TYPE OF WATER QUALITY MONITORING:

UP-CURRENT

TIME: ~~14:25~~ 14:25

GPS FILE NAME: NA

NORTHING: GPS Not working

TIDAL STAGE:

NUMBER OF HOURS OF DREDGING: 6

DISTANCE FROM DREDGE/SILT CURTAIN: 100'

EASTING: Sample taken Directly south of Dredge

WATER DEPTH: 10'

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
063008-06-1-2	14:25	2	2.7	
063008-06-1-5	14:25	5	2.8	
063008-06-1-8	14:25	8	3.1	

AVERAGE TURBIDITY:

DOWN-CURRENT

TIME: 2:20 or 14:20

GPS FILE NAME: NA

NORTHING: GPS Not working

TIDAL STAGE:

NUMBER OF HOURS OF DREDGING: ~~195~~ GCD, 6 hrs

DISTANCE FROM DREDGE/SILT CURTAIN: 175' ±

EASTING: Sample taken N W of Dredge site

WATER DEPTH: 7

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
~~063008-06-9-~~	~~14:20~~	~~2~~	~~3.0~~	
063008-06-9-2	14:20	2'	1.5	
063008-06-9-4	14:20	4'	3.0	
063008-06-9-5	14:20	5	3.7	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: Top of Cod

Dredge Water Quality Monitoring Form

JOB NUMBER: 6615.005.01

DATE: 6/30/08

MONITORS: Jray + JKline

WEATHER CONDITIONS: overcast + muggy, then hot + sunny

WIND: 10 MPH

PRIOR STORM EVENTS: rain last night

DREDGE UPDATE:

TYPE OF WATER QUALITY MONITORING:

Apex

* GPS down * **UP-CURRENT**

TIME: 16:10

GPS FILE NAME: N/A

NORTHING: N/A

TIDAL STAGE: Flood

NUMBER OF HOURS OF DREDGING: 8

DISTANCE FROM DREDGE/SILT CURTAIN: N/A

EASTING: N/A

WATER DEPTH: ~~8~~ 10

South of Dredge. North of Nelick Marine

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
063008.08.1-2	16:10	2	~~[illegible]~~ 3.0	
063008-08-1-5	16 10	5	4.5	
063008.08.1-8	16 10	8	5.5	

AVERAGE TURBIDITY:

* GPS down * **DOWN-CURRENT**

TIME: 16:05

GPS FILE NAME:

NORTHING:

TIDAL STAGE: Flood

NUMBER OF HOURS OF DREDGING: 8

DISTANCE FROM DREDGE/SILT CURTAIN:

EASTING:

WATER DEPTH: 8

N of SAMSON III. ~~SW~~ SE of overloaded scow w/ grass 400 yds.

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
063008-08-9-2	1600	2	-0.2	
063008.08.9-4	1602	4	0.5	
063008.08-9-6	1605	6	0.4	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Disposal Water Quality Monitoring Form

PROJECT: NBH Phase III Dredging
JOB NUMBER: 6615.005.001
DATE: 7/3/08
DISPOSAL EVENT:
MONITORS: GCD JM WB
WEATHER CONDITIONS: Clear Breezy, 70s
WIND: SSW ±
PRIOR STORM EVENTS: None

Apex

UP-CURRENT

TIME: 0646
GPS FILE NAME: N/A
NORTHING: 2695870
TIDAL STAGE: Flooding

TIME OF DISPOSAL: 0642
DISTANCE FROM DISPOSAL LOCATION: 200 ft
EASTING: 814901
WATER DEPTH: 40'

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
070308-DD-1-2	0645	2	0.0	
070308-DD-1-20	0646	20	0.3	
070308-DD-1-38	0647	38	2.2	
			2.5/3 = 0.83 NTU	

AVERAGE TURBIDITY: 0.83 NTU

DISPOSAL LOCATION

TIME: 0650
GPS FILE NAME: 070308-dl-00
NORTHING: 2696130
TIDAL STAGE: Flood

TIME OF DISPOSAL: 0642
DISTANCE FROM DISPOSAL LOCATION: @ location
EASTING: 814856
WATER DEPTH: 41 feet

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
070308-dl-00-2	0650	2.0	15.0	
070308-dl-00-20	0651	20.0	0.6	
070308-dl-00-38	0653	38.0	4.7	
			20.3/3 = 6.7	

AVERAGE TURBIDITY: 6.7 NTU

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Apex

DOWN-CURRENT

TIME: 0655
GPS FILE NAME: 070308
NORTHING: 2696381
TIDAL STAGE: Flood

TIME OF DISPOSAL: 0642
DISTANCE FROM DISPOSAL LOCATION: 200'
EASTING: 814907
WATER DEPTH: 12'

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
070308-00-9-2	0655	2.0	1.4	
070308-00-9-6	0656	6.0	0.7	
070308-00-9-10	0657	10.0	0.8	
			2.9/3 = 0.96	

AVERAGE TURBIDITY: 0.96

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex

PROJECT: NBH - Dredge CAD II
JOB NUMBER: 6615.005.01
DATE: 7/3/08
MONITORS: Jen Martino + Warren B.
WEATHER CONDITIONS: Sunny, warm, ~75°F
WIND: Slight breeze
PRIOR STORM EVENTS: Rain
DREDGE UPDATE: ~~[illegible]~~
TYPE OF WATER QUALITY MONITORING: Turbidity - up/down current + disposal

UP-CURRENT

TIME: 0840
GPS FILE NAME: 070308-02-1
NORTHING: 2696088
TIDAL STAGE: Flood

NUMBER OF HOURS OF DREDGING: 02
DISTANCE FROM DREDGE/SILT CURTAIN: 200'
EASTING: 815597
WATER DEPTH: 11'

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
070308-02-1-2	0840	2.0	3.2	
070308-02-1-6	0842	6.0	2.9	
070308-02-1-10	0843	10.0	37.0	

AVERAGE TURBIDITY:

DOWN-CURRENT

TIME: 0845
GPS FILE NAME: 070308-02-9
NORTHING: 2696618
TIDAL STAGE: Flood

NUMBER OF HOURS OF DREDGING: 02
DISTANCE FROM DREDGE/SILT CURTAIN: 200'
EASTING: 815759
WATER DEPTH: 10'

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
070308-02-9-2	0845	2.0	6.4	
070308-02-9-5	0846	5.0	5.8	
070308-02-9-8	0847	8.0	5.8	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex

PROJECT: NBH - Dredge CAD II
JOB NUMBER: 6615.005.01
DATE: 07/03/08
MONITORS: JM + WB
WEATHER CONDITIONS: Sunny, warm, 75°F ~ 80°F
WIND: Cool Breeze
PRIOR STORM EVENTS: Rain
DREDGE UPDATE: ~~[illegible]~~ 04 hrs.
TYPE OF WATER QUALITY MONITORING: Turbidity WQ - up + down current

UP-CURRENT

TIME: 1040
GPS FILE NAME: 070308-04-1
NORTHING: 2696628
TIDAL STAGE: Ebb

NUMBER OF HOURS OF DREDGING: 04
DISTANCE FROM DREDGE/SILT CURTAIN: 200'
EASTING: 815770
WATER DEPTH: 8.5'

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
070308-04-1-2	1040	2.0	0.0	
070308-04-1-4	1041	4.0	0.0	
070308-04-1-6	1043	6.0	-0.1	

AVERAGE TURBIDITY: 0.0 NTU

DOWN-CURRENT

TIME: 1045
GPS FILE NAME: 070308-04-9
NORTHING: 2696128
TIDAL STAGE: Ebb

NUMBER OF HOURS OF DREDGING: 04
DISTANCE FROM DREDGE/SILT CURTAIN: 200'
EASTING: 815446
WATER DEPTH: 10'

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
070308-04-9-2	1045	2.0	5.1	
070308-04-9-5	1046	5.0	4.2	
070308-04-9-8	1048	8.0	4.2	
			13.5/3	= 4.5

AVERAGE TURBIDITY: 4.5 NTU

TURBIDITY INCREASE*: 4.5 - 0 = 4.5 NTU

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Disposal Water Quality Monitoring Form

PROJECT: NBH - Dredge CAD II Top of CAD
JOB NUMBER: 6615.005.01
DATE: 7/3/08
DISPOSAL EVENT: D2 - mud cat
MONITORS: JM + WB
WEATHER CONDITIONS: Gusty winds! warm, sunny 80°F
WIND: Gusty, strong
PRIOR STORM EVENTS: N/A

Apex

UP-CURRENT

TIME: 1220
GPS FILE NAME: 070308-d2-06-1
NORTHING: 2696303
TIDAL STAGE: Ebb

TIME OF DISPOSAL: 1220
DISTANCE FROM DISPOSAL LOCATION: 200'
EASTING: 814738
WATER DEPTH: 18'

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
070308-06-1-2	1220	2.0	1.5	extremely high winds
070308-06-1-8	1222	8.0	1.8	
070308-06-1-16	1223	16.0	2.0	

AVERAGE TURBIDITY:

DISPOSAL LOCATION (mud cat)

TIME: 1230
GPS FILE NAME: 070308-d2-06u
NORTHING: 2696210
TIDAL STAGE: Ebb

TIME OF DISPOSAL: 1220
DISTANCE FROM DISPOSAL LOCATION: @ location
EASTING: 814762
WATER DEPTH: 40'

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
070308-d2-06-2	1230	2.0	11.0	extremely high winds / current
070308-d2-06-18	1231	18.0	46.5	
070308-d2-06-36	1232	36.0	5.4	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Apex

DOWN-CURRENT

TIME: 1240
GPS FILE NAME: 070308-06-9r
NORTHING: 2695838
TIDAL STAGE: Ebb

TIME OF DISPOSAL: 1220
DISTANCE FROM DISPOSAL LOCATION: 200'
EASTING: 814716
WATER DEPTH: 38'

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
070308-06-9-2	1240	2.0	1.6	extremely windy
070308-06-9-17	1241	17.0	3.1	
070308-06-9-33	1242	33.0	6.1	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex

PROJECT: NBH - Dredge CAD II - Top of CAD
JOB NUMBER: 6615.005.01
DATE: 7/3/08
MONITORS: JM + WB
WEATHER CONDITIONS: Gusty winds! Sunny, warm ~ 80°F
WIND: GUSTY! very strong
PRIOR STORM EVENTS: N/A
DREDGE UPDATE: 06 hr. (dumped mud cat, 3E-104)
TYPE OF WATER QUALITY MONITORING: WQ + turbidity - up + down current

UP-CURRENT

TIME: 1330
GPS FILE NAME: 070308-06-1
NORTHING: 2696672
TIDAL STAGE: Ebb

NUMBER OF HOURS OF DREDGING: 07
DISTANCE FROM DREDGE/SILT CURTAIN: 200'
EASTING: 815716
WATER DEPTH: 10'

Monitoring ID #	TIME 1330	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
070308-06-1-2		2.0	6.3	
070308-06-1-	1332	5.0	5.3	
070308-06-1-	1333	8.0	4.3	

AVERAGE TURBIDITY:

DOWN-CURRENT

TIME: 1335
GPS FILE NAME: 070308-07-9
NORTHING: 2696140
TIDAL STAGE: Ebb

NUMBER OF HOURS OF DREDGING: 07
DISTANCE FROM DREDGE/SILT CURTAIN: 200'
EASTING: 815381
WATER DEPTH: 8'

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
070308-07-9-2	1335	2.0	4.6	
070308-07-9-	1336	4.0	5.1	
070308-07-9-	1337	6.0	5.1	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex

PROJECT: NBH - Dredge - Top of CAD Cell II
JOB NUMBER: 6615.005.01
DATE: 07/03/08
MONITORS: JM + WB
WEATHER CONDITIONS: Sunny / windy / 80°F
WIND: Windy
PRIOR STORM EVENTS: N/A
DREDGE UPDATE: 09 hr of dredge (using small bucket - filling mud cat)
TYPE OF WATER QUALITY MONITORING: turbidity WQ

UP-CURRENT

TIME: 1540
GPS FILE NAME: 070308-09-1
NORTHING:
TIDAL STAGE: Flood

NUMBER OF HOURS OF DREDGING: 09
DISTANCE FROM DREDGE/SILT CURTAIN: 200'
EASTING:
WATER DEPTH: 10'

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
070308-09-1-2	1545	2	1.9	
070308-09-1-5	1546	5	1.6	
070308-09-1-8	1547	8	9.0	

AVERAGE TURBIDITY:

DOWN-CURRENT

TIME: 1555
GPS FILE NAME: 070308-09-9
NORTHING:
TIDAL STAGE: Flood

NUMBER OF HOURS OF DREDGING: 09
DISTANCE FROM DREDGE/SILT CURTAIN: 200'
EASTING:
WATER DEPTH: 10'

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
070308-09-9-2	0555	2	0.5	
070308-09-9-5	0556	5	7.5	
070308-09-9-8	0557	8	8.4	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Disposal Water Quality Monitoring Form

1/2

Apex

PROJECT: NBHDC Top of CAD
JOB NUMBER: 6615.005.01
DATE: 7/8/08
DISPOSAL EVENT: 1
MONITORS: J. Ray + M. Bruno
WEATHER CONDITIONS:
WIND:
PRIOR STORM EVENTS:

UP-CURRENT

TIME: 0705
GPS FILE NAME: N/A
NORTHING: 2695803
TIDAL STAGE: Flood

TIME OF DISPOSAL: 07:02
DISTANCE FROM DISPOSAL LOCATION: 75 ft.
EASTING: 815017
WATER DEPTH: 29 ft

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
070808.00-X-2	07:10	2	0.5	
" -X-13	07:15	13	0.6	
" -X-27	07:15	27	8.2	

AVERAGE TURBIDITY:

DISPOSAL LOCATION

TIME: ~~07:25~~ 07:32
GPS FILE NAME: ~~N/A~~ N/A
NORTHING: ~~2696278~~ 2696198
TIDAL STAGE: ~~Flood~~ Flood

TIME OF DISPOSAL: 07:02 07:02
DISTANCE FROM DISPOSAL LOCATION: 100 ft.
EASTING: ~~815041~~ 815040
WATER DEPTH: ~~8 ft~~ 27

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
070808.0737-2 07/37	0725	~~2~~	~~2.8~~	6.1 @ 2 ft
070808.0737.12 "	0726	~~4~~	~~2.7~~	4.5 @ 12 ft
070808.0737.25 "	~~0726~~	~~6~~	~~2.0~~	~~10.0~~ 46.8 @ 25 ft.

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Apex

2/2

DOWN-CURRENT

TIME: 07:25

GPS FILE NAME: N/A

NORTHING: 2696298

TIDAL STAGE: Flood

TIME OF DISPOSAL: 07:07

DISTANCE FROM DISPOSAL LOCATION: 100 ft.

EASTING: 815041

WATER DEPTH: 8

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
070808.0725.2	0725	2	2.2	
070808.0725.4	0726	4	2.1	
070808.0725.6	0726	6	2.0	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: NBH Dredge - CAD Cell II Top of CAD

Dredge Water Quality Monitoring Form

JOB NUMBER: 6615.005.01

DATE: 7/8/08

MONITORS: J. Ray + M. Bruno

WEATHER CONDITIONS:

WIND:

PRIOR STORM EVENTS:

DREDGE UPDATE:

TYPE OF WATER QUALITY MONITORING:

Apex

UP-CURRENT

TIME: 07:40

GPS FILE NAME: N/A

NORTHING: 2696275

TIDAL STAGE: Flood

NUMBER OF HOURS OF DREDGING: 0

DISTANCE FROM DREDGE/SILT CURTAIN: N/A

EASTING: 815505

WATER DEPTH: 8

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
070808.0740.2	07:40	2	0.8	
" " .4	07:40	4	1.0	
" " .6	07:40	6	1.0	

AVERAGE TURBIDITY:

DOWN-CURRENT

TIME: 07:45

GPS FILE NAME: N/A

NORTHING: -2696521

TIDAL STAGE: Flood

NUMBER OF HOURS OF DREDGING: 0

DISTANCE FROM DREDGE/SILT CURTAIN:

EASTING: 815345

WATER DEPTH: 4

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
070808.0745.2	07:45	2	.2	
" " .2.5	07:45	2.5	.2	
" " .3	07:45	3	2.2	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: NBH Dredge - CAD Cell II Top of CAD

Dredge Water Quality Monitoring Form

JOB NUMBER: 6615.005.01

DATE: 7/8/08

MONITORS: J. Ray & M. Bruno

WEATHER CONDITIONS:

WIND:

PRIOR STORM EVENTS:

DREDGE UPDATE:

TYPE OF WATER QUALITY MONITORING:

Apex

UP-CURRENT

TIME: 10:05

GPS FILE NAME:

NORTHING: 2696218

TIDAL STAGE:

NUMBER OF HOURS OF DREDGING: 2

DISTANCE FROM DREDGE/SILT CURTAIN:

EASTING: 815814

WATER DEPTH: 8

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
070808.1005.2	10:05	2	14.4	
070808.1005.4	10:05	4	14.3	
" " .6	10:05	6	14.3	

AVERAGE TURBIDITY:

DOWN-CURRENT

TIME: 10:23

GPS FILE NAME:

NORTHING: 2696887

TIDAL STAGE: Flood

NUMBER OF HOURS OF DREDGING: 2

DISTANCE FROM DREDGE/SILT CURTAIN:

EASTING: 815423

WATER DEPTH: 6

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
070808.1023.2	10:23	2	9.2	
" " .3	10:23	3	8.5	
" " .4	10:23	4	9.1	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex

PROJECT: NBH - Top of CAD2
JOB NUMBER: C615.005.01
DATE: 7/11/08
MONITORS: JM + GCD
WEATHER CONDITIONS: Sunny + Hot ~ 80°F
WIND: Cool breeze
PRIOR STORM EVENTS: N/A
DREDGE UPDATE: 00 hr
TYPE OF WATER QUALITY MONITORING: up/down turbidity

UP-CURRENT

TIME: 0750
GPS FILE NAME: 071108-00-1
NORTHING:
TIDAL STAGE: Ebb

NUMBER OF HOURS OF DREDGING: 00 hrs
DISTANCE FROM DREDGE/SILT CURTAIN: 200'
EASTING:
WATER DEPTH: 5'

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
071108-00-1-2	0750	2.0	1.5	
071108-00-1-3	0751	3.0	1.3	
071108-00-1-4	0752	4.0	1.5	

AVERAGE TURBIDITY:

DOWN-CURRENT

TIME: 0753
GPS FILE NAME: 071108-00
NORTHING:
TIDAL STAGE: Ebb

NUMBER OF HOURS OF DREDGING: 00 hrs
DISTANCE FROM DREDGE/SILT CURTAIN: 200'
EASTING:
WATER DEPTH: 9'

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
071108-00-9-2	0753	2.0	3.5	
071108-00-9-5	0754	5.0	3.9	
071108-00-9-7	0755	7.0	6.8	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex

PROJECT: NBH - Top of CAD2 Dredge
JOB NUMBER: 6615.005.01
DATE: 7/11/08
MONITORS: JM + GCD
WEATHER CONDITIONS: Sunny + warm 85°F
WIND: Slight breeze
PRIOR STORM EVENTS: N/A
DREDGE UPDATE: 02 hour of dredge
TYPE OF WATER QUALITY MONITORING: up/down current turbidity monitoring

UP-CURRENT

TIME: 1015 hrs
GPS FILE NAME: 071108-02-1
NORTHING:
TIDAL STAGE: Flood

NUMBER OF HOURS OF DREDGING: 02 hr
DISTANCE FROM DREDGE/SILT CURTAIN: 200'
EASTING:
WATER DEPTH: 9.5'

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
071108-02-1-2	1015	2.0	0.0	
071108-02-1-4	1016	4.0	0.2	
071108-02-1-	1017	7.0	0.7	
			0.9/3 = 0.3	

AVERAGE TURBIDITY: 0.3 NTU

DOWN-CURRENT

TIME: 1018 hrs
GPS FILE NAME: 071108-
NORTHING:
TIDAL STAGE: Flood

NUMBER OF HOURS OF DREDGING: 02 hr
DISTANCE FROM DREDGE/SILT CURTAIN: 200'
EASTING:
WATER DEPTH: 10'

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
071108-02-9-2	1018	2.0	4.0	
071108-02-9-	1019	5.0	21.5	
071108-02-9-	1020	8.0	27.7	
			53.2/3 = 17.73	

AVERAGE TURBIDITY: 17.73 NTU

TURBIDITY INCREASE*: 17.73 - 0.3 = 17.43 NTU

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: NBH - Top of CAD 2

Dredge Water Quality Monitoring Form

JOB NUMBER: 6615.005.01

DATE: 7/11/08

MONITORS: JM + GCD

WEATHER CONDITIONS: Sunny, HOT! 85°F

WIND: Hardly any wind. LIGHT Breeze

PRIOR STORM EVENTS: N/A

DREDGE UPDATE: 04 hr - cleaning dredge

TYPE OF WATER QUALITY MONITORING: up-current + down-current turbidity

Apex

UP-CURRENT

TIME: 1240 hrs

GPS FILE NAME: 071108-04-1

NORTHING:

TIDAL STAGE: Flood

NUMBER OF HOURS OF DREDGING: 04 hrs

DISTANCE FROM DREDGE/SILT CURTAIN: 200'

EASTING:

WATER DEPTH: 29'

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
071108-04-1-2	1240	2.0	0.4	
071108-04-1-	1241	14.0	0.6	
071108-04-1-	1242	27.0	9.7	

AVERAGE TURBIDITY:

DOWN-CURRENT

TIME: 1230 hrs

GPS FILE NAME: 071108-04-9

NORTHING: -

TIDAL STAGE: Flood

NUMBER OF HOURS OF DREDGING: 04 hrs

DISTANCE FROM DREDGE/SILT CURTAIN: 200'

EASTING:

WATER DEPTH: 10'

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
071108-04-9-2	12:18	2.0	21.2	
071108-04-9-5	12:18	5.0	23.5	
071108-04-9-8	12:18	8.0	4.5	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: NBH - Cad Cell 2 Top of CAD

Dredge Water Quality Monitoring Form

JOB NUMBER: 6615.005.01

DATE: June 17, 2008

MONITORS: Josh Ray + Jen Martino

WEATHER CONDITIONS: Clear, possibility of rain (damp) ~ 60°F to 70°F

WIND: Cool breeze

PRIOR STORM EVENTS: rain, thunder, lightening last night 6/16 - 6/17

DREDGE UPDATE:

TYPE OF WATER QUALITY MONITORING: Dredging → up-current & down current monitoring

UP-CURRENT

TIME: 0700 hrs

GPS FILE NAME: 061708

NORTHING: 2696628.4

TIDAL STAGE: Ebbing

NUMBER OF HOURS OF DREDGING: 06 hrs.

DISTANCE FROM DREDGE/SILT CURTAIN: 200 feet

EASTING: 815259.8

WATER DEPTH: 5.5 feet

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES 49.2 DO% 41.20 ms/cm
061708-02-1-2	0800	2ft	0.1	2.65 = DO 7.89 pH 124.3 ORP 45.42 mS/cm
061708-02-1-4	0800	4ft	3.7	3.50 DO, 7.86 PH, 132.8 ORP, 45.69 41.72 cm 45.0
061708-02-1-6	0800	6ft	10.3	3.22 DO, 7.83 pH, 140.8 ORP, 46.33, 42.12 42.2 DO%
061708-06-1-2	1300	2ft	-0.1	4.27 DO, 7.80 pH, 120.7 ORP, 45.41 ms/cm, 41.98 ms/cm, 55.0% DO
061708-06-1-2.5	1300	2.5ft	0.1	4.00 DO, 7.75 pH, 151.8 ORP, " " 54.3% DO
061708-06-1-	1300	3.0ft	-0.1	3.54 DO, 7.70 pH, 191.4 ORP, ", ", 47.6% DO

AVERAGE TURBIDITY:

DOWN-CURRENT

TIME: 0830 hrs.

GPS FILE NAME: 061708

NORTHING: 2695753.3

TIDAL STAGE: Ebbing

NUMBER OF HOURS OF DREDGING: 06 hrs.

DISTANCE FROM DREDGE/SILT CURTAIN: 200 feet

EASTING: 815300.1

WATER DEPTH: 34 feet

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
061708-02-9-2	0850	2ft	13.9	1.74 DO, 7.82 PH, 179.4 ORP, 45.98 mS/cm, 41.75 ms/cm 24.7 DO
061708-02-9-5	0850	5ft.	22.3	2.30 DO, 7.80 pH, 183.4 ORP, 46.03 mS/cm, 41.8 ms/cm 31.9 DO%
061708-02-9-9	0850	9ft.	36.5	2.20 DO, 7.79 pH, 185.1 ORP, 46.24 ms/cm, 41.97 ms/cm, 29.7 DO
061708-02-9-2	0900	2ft.	0.6	2.82 DO, 7.82 pH, 197.9 ORP, 45.72 ms/cm, 41.65 ms/cm 42.9 DO
061708-02-9-3.5	0900	3.5ft.	0.6	2.58 DO, 7.81 pH, 205.1 ORP, 45.89 ms/cm, 41.76 ms/cm, 34.7 DO%
061708-02-9-5	0900	5ft.	0.6	2.80 DO, 7.81 pH 211.9 ORP, 45.91 ms/cm, 41.78 ms/cm, 37.0 DO%
061708-06-9-2	1300	2ft.	1.4	1.79 DO, 7.75 pH, 257.8 ORP, ", " 25.7 DO%
061708-06-9-15	1300	15ft.	0.1	2.08 DO, 7.66 pH, 297.5 ORP, ", " 28.0 DO%
061708-06-9-32	1300	32ft.	1.5	2.24 DO, 7.64 pH, 314.8 ORP, 27.5 DO%

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex

PROJECT: NBH - Top of CAD Cell 2
JOB NUMBER: 66615.005.01
DATE: June 17, 2008
MONITORS: Jen Martino & Josh Ray
WEATHER CONDITIONS: Sunny and 70°F - Cool Breeze
WIND: Cool Breeze
PRIOR STORM EVENTS: Rain/thunder & lightening the night before
DREDGE UPDATE: 08 hr. Now using "SCOW" "SC103"
TYPE OF WATER QUALITY MONITORING: Up-current & downcurrent readings - turbidity ~200' from barge

UP-CURRENT

TIME: 15:58p ~ 1600 hrs
GPS FILE NAME: 061708-08-1
NORTHING: 2695760.15
TIDAL STAGE: Flood (low to high)
NUMBER OF HOURS OF DREDGING: 08 hrs.
DISTANCE FROM DREDGE/SILT CURTAIN: 200 feet
EASTING: 815312.86
WATER DEPTH: 36 feet

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
061708-08-1-02	1600	2ft.	0.0	5.14 DO, 7.79 pH 111.5 ORP, 68.1 DO%
061708-08-1-16	1600	16 ft.	0.1	3.41 DO, 7.66 pH, 207.8 ORP, 39.9 DO%
061708-08-1-34	1600	34 ft.	0.7	2.53 DO, 7.56 pH, 253.9 ORP, 31.9 DO%

AVERAGE TURBIDITY: 0.26

DOWN-CURRENT

TIME: 1600 hrs.
GPS FILE NAME: 061708-08-9
NORTHING: 2696535.8
TIDAL STAGE: Flood (low to high)
NUMBER OF HOURS OF DREDGING: 08 hrs.
DISTANCE FROM DREDGE/SILT CURTAIN: 200 feet
EASTING: 815236.7
WATER DEPTH: 8.0 feet

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES
061708-08-9-2.0	1600	2.0	1.5	1.64 DO, 7.76 pH, 266.9 ORP, 20.6 DO%
061708-08-9-4.0	1600	4	1.8	1.65 DO, 7.78 pH, 275.4 ORP, 23.4 DO%
061708-08-9-6.0	1600	6.0	0.7	1.96 DO, 7.79 pH, 280.4 ORP, 26.3 DO%

AVERAGE TURBIDITY: 1.3

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: NBH-CAD Cell 2 - Top of CAD
JOB NUMBER: 6615.005.01
DATE: 6/18/08
DISPOSAL EVENT: Dumping of "Mudcat" into CAD Cell I
MONITORS: Jen Martino & Josh Ray
WEATHER CONDITIONS: Sunny, clear, 70°F
WIND: None
PRIOR STORM EVENTS: N/A

Apex

UP-CURRENT

TIME: 0700 hrs.
GPS FILE NAME: 061808-00-1
NORTHING: 2695527.8
TIDAL STAGE: Flood (High to low)

TIME OF DISPOSAL: 0730 hrs.
DISTANCE FROM DISPOSAL LOCATION: 200 feet
EASTING: 814873.8
WATER DEPTH: 33 feet

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
061808-00-1-2.0	0700	2.0	-0.2	3.3 DO, 7.82 pH, 127.2 ORP, 20.38°C, 42.6 DO%
061808-00-1-16.0	0710	16.0	0.0	2.65 DO, 7.8 pH, 136.2 ORP, 33.8 DO%, 19.84°C
061808-00-1-31.0	0720	31.0	0.5	2.3 DO, 7.78 pH, 141.9 ORP, 19.47°C, 28.4 DO%

AVERAGE TURBIDITY:

DISPOSAL LOCATION

TIME: 0800 hrs.
GPS FILE NAME: 061808-D1-00
NORTHING: 2695922.1
TIDAL STAGE: Flood (low to high)

TIME OF DISPOSAL: 0730 hrs.
DISTANCE FROM DISPOSAL LOCATION: @location
EASTING: 814916.8
WATER DEPTH: 48 feet

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
061808-D1-00-2.0	0800	2.0	-0.5	1.21 DO, 7.86 pH, 150.8 ORP, 20.47°C, 20.3 DO%
061808-D1-00-23.0	0810	23.0	0.0	1.64 DO, 7.81 pH, 173.5 ORP, 20.05°C, 26.3 DO%
061808-D1-00-46.0	0820	46.0	48.7	1.8 DO, 7.76 pH, 180.0 ORP, 19.56°C, 20.4 DO%

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Apex

DOWN-CURRENT

TIME: 0730 hrs.
GPS FILE NAME: 061808-DI-00-9
NORTHING: 2696283.6
TIDAL STAGE: Flood (low to high)

TIME OF DISPOSAL: 0730 hrs.
DISTANCE FROM DISPOSAL LOCATION: 200 feet
EASTING: 814982.7
WATER DEPTH: 12 feet

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
061808-DI-00-9-2	0730	2.0	-0.2	1.89 DO, 7.82 pH, 153.7 ORP, 20.46°C, 25.8 DO%
061808-DI-00-9-6	0740	6.0	-0.2	1.94 DO, 7.81 pH, 161.8 ORP, 20.44°C, 21.4 DO%
061808-DI-00-9-9	0745	9.0	0.0	2.05 DO, 7.82 pH, 168.4 ORP, 20.23°C, 27.2 DO%

AVERAGE TURBIDITY: -0.2 NTU

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Disposal Water Quality Monitoring Form

PROJECT: NBH-CAD Cell 2-Top of CAD
JOB NUMBER: 6615.005.01
DATE: June 18, 2008
DISPOSAL EVENT: D2 of day - Dumping of mud cat
MONITORS: Jen Martino + Josh Ray
WEATHER CONDITIONS: Sunny, Breezy, 70°F
WIND: Cool, Breezy
PRIOR STORM EVENTS: N/A

Apex

UP-CURRENT

TIME: 1130 hrs
GPS FILE NAME: 061808-04-1
NORTHING: 2696228.0
TIDAL STAGE: Ebb (High to low)

TIME OF DISPOSAL: 1130 hrs
DISTANCE FROM DISPOSAL LOCATION: 100 feet
EASTING: 814971.4
WATER DEPTH: 13 feet

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
061808-04-1-2	1130	2.0	-0.4	1.45 DO, 7.34 pH, 245.6 ORP, 21.16 °C, 20.4 DO%
061808-04-1-7	1140	7.0	0.5	
061808-04-1-11	1145	11.0	11.3	

AVERAGE TURBIDITY:

DISPOSAL LOCATION

TIME: 1145 hrs
GPS FILE NAME: 061808-D2-04
NORTHING: 2695948.0
TIDAL STAGE: Ebb (High to low)

TIME OF DISPOSAL: 1130 hrs
DISTANCE FROM DISPOSAL LOCATION: @ location
EASTING: 814912.2
WATER DEPTH: 44 feet

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
061808-D2-04-2	1150	2.0 ft.	1.0	
061808-D2-04-20	1155	20.0 ft	0.1	
061808-D2-04-40	1200	40.0 ft	25.5	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Apex

DOWN-CURRENT

TIME: 1205 hrs.
GPS FILE NAME: 061808-04-9
NORTHING: 2695393.7
TIDAL STAGE: ~~[illegible]~~ Ebb (High to low)

TIME OF DISPOSAL: 1130 hrs.
DISTANCE FROM DISPOSAL LOCATION:
EASTING: 814951.a
WATER DEPTH: 32 feet

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
061808-04-9-2	1205	2	1.2	
061808-04-9-15	1210	15	3.2	
061808-04-9-30	1215	30	~~[illegible]~~ 33.0	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Disposal Water Quality Monitoring Form

PROJECT: NBH
JOB NUMBER: 16615.005
DATE: 6/23/2008
DISPOSAL EVENT: 1
MONITORS: JK MB
WEATHER CONDITIONS: cloudy 70°
WIND: calm
PRIOR STORM EVENTS:

Apex

UP-CURRENT

TIME:
GPS FILE NAME:
NORTHING:
TIDAL STAGE:

TIME OF DISPOSAL:
DISTANCE FROM DISPOSAL LOCATION:
EASTING:
WATER DEPTH:

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES

AVERAGE TURBIDITY:

DISPOSAL LOCATION 0725 - Trouble w/ dump

TIME: 0740
GPS FILE NAME: 062308_1-10-5
NORTHING: 2676126.47
TIDAL STAGE: Flood

TIME OF DISPOSAL: 0730
DISTANCE FROM DISPOSAL LOCATION: on location
EASTING: 814784.85
WATER DEPTH: 42

Trouble w/ pocket for dump for 1 hr.

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	DO	pH	ORP	NOTES
062308-1-10-5	0840	40	30.2	1.42	7.77	298.2	
062308-1-10-5	0842	2	-0.4	1.89	7.78	298.8	
062308-1-10-5	0844	20	8.2	1.79	7.78	300.5	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: NBH

Dredge Water Quality Monitoring Form

JOB NUMBER: 16615.005

DATE: 6/23/2008

MONITORS: MB JK

WEATHER CONDITIONS: Cloudy

WIND: calm

Low 5:10
High 11:52
Low 17:07

PRIOR STORM EVENTS:

DREDGE UPDATE:

TYPE OF WATER QUALITY MONITORING:

Apex

UP-CURRENT

TIME: 0730

GPS FILE NAME: 062308_D-1-0

NORTHING: 269893.32

TIDAL STAGE: Flood

NUMBER OF HOURS OF DREDGING: During

DISTANCE FROM DREDGE/SILT CURTAIN: —

EASTING: 814760.18

WATER DEPTH: 40

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)				NOTES
062308-D-1-9.38	0730	38	0.2	2.01	7.79	224.3	
062308-D-1-92	0732	2	-0.4	2.19	7.80	225.1	
062308-D-1-920	0734	20	-0.5	2.46	7.79	228.4	

AVERAGE TURBIDITY:

DOWN-CURRENT

TIME: 0725

GPS FILE NAME: 062308_D-1-0

NORTHING: 269653655.88

TIDAL STAGE: Low > High

NUMBER OF HOURS OF DREDGING: During

DISTANCE FROM DREDGE/SILT CURTAIN: —

EASTING: 814815.11

WATER DEPTH: 11'

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	DO	pH	ORP	NOTES
062308-D-1-0-9	0725	9	-0.3	3.29	7.87	169.9	
062308-D-1-0-2	0726	2	-0.2	2.96	7.85	171.8	
062308-D-1-05.5	0727	5.5	-0.2	2.95	7.84	175.6	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Disposal Water Quality Monitoring Form

PROJECT: 6615.005
JOB NUMBER:
DATE: 6/23/08
DISPOSAL EVENT:
MONITORS:
WEATHER CONDITIONS:
WIND:
PRIOR STORM EVENTS:

Apex

UP-CURRENT

TIME: 1330
GPS FILE NAME:
NORTHING: 2696245
TIDAL STAGE: Ebb

TIME OF DISPOSAL: 1335
DISTANCE FROM DISPOSAL LOCATION: Approx. 200ft up current
EASTING: 814859
WATER DEPTH: 16

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
062308-DZ01	13:33	19	2.2	ORP 226.5 pH 7.77 21.96°C 2.60 DO
062308DZ01 - 10	13:34	10	2.5	ORP 235.2 pH 7.76 22.48°C 2.88 DO
062308DZ01 - 2	13:36	2	1.5	ORP 239.4 pH 7.78 23.13°C 3.68 DO

AVERAGE TURBIDITY:

DISPOSAL LOCATION

TIME: 13:48
GPS FILE NAME:
NORTHING: 2696072
TIDAL STAGE: Ebb

TIME OF DISPOSAL: 1335
DISTANCE FROM DISPOSAL LOCATION:
EASTING: 814766
WATER DEPTH: 46

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
062308DZ-15.5 - 44	1:48	44	104.6	
062308DZ15.5 - 21	1:50	21	1.3	ORP 301.8 pH 7.76 22.01°C 2.31 DO
062308DZ155 - 2	1:53	2	1.1	ORP 304.6 pH 7.77 22.95°C 2.69 DO

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Apex

DOWN-CURRENT

TIME: 1338

GPS FILE NAME:

NORTHING: 2695796

TIDAL STAGE: Ebb

TIME OF DISPOSAL: 13:35

DISTANCE FROM DISPOSAL LOCATION: Approx. 200ft.

EASTING: 814717

WATER DEPTH: 36ft

Monitoring ID # (DWA)	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
062308D239-34	1:40	34	0.5	ORP 264.8 pH 7.76 21.68°C 2.26 DO
062308D239-16	1:41	16	0.1	ORP 271.8 pH 7.76 22.48°C 2.63 DO
062308D239-2	1:43	2	0.2	ORP 275.0 pH 7.76 22.79°C 3.10 DO

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Disposal Water Quality Monitoring Form

PROJECT: NBH - Top of CAD
JOB NUMBER: 6613.005.01
DATE: 6/24/08
DISPOSAL EVENT: D1 of Mud cat
MONITORS: Jen Martino + Josh Ray
WEATHER CONDITIONS: Clear, Cool, Overcast ~ 65°F
WIND: cool breeze
PRIOR STORM EVENTS: rain

Apex

UP-CURRENT

TIME: 0728 hrs
GPS FILE NAME: 062408-00-1
NORTHING: 2695778
TIDAL STAGE: Flood

TIME OF DISPOSAL: 07:28
DISTANCE FROM DISPOSAL LOCATION: 200 ft.
EASTING: 814772
WATER DEPTH: 42

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
062408-00-1-02	07:28	2	0.0	
062408-00-1-20	07:30	20	0.2	
062408-00-1-40	07:32	40	0.7	
		Total:	0.9/3 = 0.3	

AVERAGE TURBIDITY: 0.3 NTU

DISPOSAL LOCATION

TIME: 0745 hrs
GPS FILE NAME: 062408-D1-00
NORTHING: 2696154.8
TIDAL STAGE: Flood

TIME OF DISPOSAL: 0728 hrs
DISTANCE FROM DISPOSAL LOCATION: (1) location
EASTING: 814778
WATER DEPTH: 31 feet

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
062408-D1-00-2	0745	2.0	2.6	
062408-D1-00-16	0750	16.0	3.4	
062408-D1-00-29	0755	29.0	58.7	
		Total:	64.7/3 = 21.4	

AVERAGE TURBIDITY: 21.4 NTU

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Apex

DOWN-CURRENT

TIME: 0730 hrs

GPS FILE NAME:

NORTHING: 2696235.02

TIDAL STAGE: Flood

TIME OF DISPOSAL: 0728 hrs.

DISTANCE FROM DISPOSAL LOCATION:

EASTING: 814815.17

WATER DEPTH: ~~22~~ 11 feet

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
062408-00-9-2	0730	2.0	0.2	
062408-00-9-4	0735	4.0	0.3	
062408-00-9-9	0740	9.0	0.3	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Disposal Water Quality Monitoring Form

PROJECT: NBH - Top of CAD (Dredge + Disposal)
JOB NUMBER: 6615.005.01
DATE: 6/26/08
DISPOSAL EVENT: D1 of Mudcat (05 hrs of dredging)
MONITORS: Jen Martino + Warren B.
WEATHER CONDITIONS: overcast, muggy, ~75°F
WIND: slight breeze
PRIOR STORM EVENTS: N/A - rain

Apex

UP-CURRENT

TIME: 1500
GPS FILE NAME: 062608-05-1
NORTHING: 2696215
TIDAL STAGE: Ebb

TIME OF DISPOSAL: 1505
DISTANCE FROM DISPOSAL LOCATION: 200 feet
EASTING: 814863
WATER DEPTH: 20 feet

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
062608-05-1-2	1500	2	0.1	
062608-05-1-9	1501	9	0.2	
062608-05-1-18	1503	18	7.1	

AVERAGE TURBIDITY:

DISPOSAL LOCATION

TIME: 1515
GPS FILE NAME: 062608-D1-05m
NORTHING: 2696109
TIDAL STAGE: Ebb

TIME OF DISPOSAL: 1510
DISTANCE FROM DISPOSAL LOCATION: @ location
EASTING: 814692
WATER DEPTH: 47 feet

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
062608-D1-05-2	1515	2	2.0	
062608-D1-05-	1517	17	0.9	
	1520	45	119.5	
		23	2.3	
				119.5
				2.0
				2.3
		total = 124.7/4 = 31.1 NTU		3)123.8

AVERAGE TURBIDITY: 41.2 NTU

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Apex

DOWN-CURRENT

TIME: 1510

GPS FILE NAME: 062608-05-9

NORTHING: 2695788

TIDAL STAGE: Ebb

TIME OF DISPOSAL: 1510

DISTANCE FROM DISPOSAL LOCATION: 200 feet

EASTING: 814771

WATER DEPTH: 30 feet

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
062608-05-9-2	1510	2	1.0	
062608-05-9-14	1511	14	0.9	
062608-05-9-28	1513	28	2.2	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Disposal Water Quality Monitoring Form

Apex

PROJECT: 6615.005.01
JOB NUMBER:
DATE: 6/30/08
DISPOSAL EVENT: 1
MONITORS: JK, JER
WEATHER CONDITIONS: 65°
WIND: 5-10 kts
PRIOR STORM EVENTS: Rain yesterday evening/night

UP-CURRENT

TIME: 08:36
GPS FILE NAME:
NORTHING: 2696492
TIDAL STAGE: Ebb

TIME OF DISPOSAL: 08:45
DISTANCE FROM DISPOSAL LOCATION:
EASTING: 814732
WATER DEPTH: 10.5

Monitoring ID # (date # mins place depth)	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
063008-1-0-1-2	08:36	2	1.1	
063008-1-0-1-6	08:36	6	1.2	
063008-1-0-1-8	08:36	8	1.4	

AVERAGE TURBIDITY:

DISPOSAL LOCATION

TIME: 09:15
GPS FILE NAME:
NORTHING: 2696037
TIDAL STAGE: Ebb

TIME OF DISPOSAL: 08:45
DISTANCE FROM DISPOSAL LOCATION:
EASTING: 814777
WATER DEPTH: 39

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
063008-1-30-5-2	09:15	2	1.2	
063008-1-30-5-20	09:15	20	6.0	
063008-1-30-5-37	09:15	37	69.0	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Apex

DOWN-CURRENT

TIME: 08:50

GPS FILE NAME:

NORTHING: 2695751

TIDAL STAGE: Ebb

TIME OF DISPOSAL: 08:45

DISTANCE FROM DISPOSAL LOCATION: 150 ft.

EASTING: 814695

WATER DEPTH: 32

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
063008-1-5-9 - 2	08:50	2	.3	
063008-1-5-9 - 16	08:50	16	3.2	
063008-1-5-9 - 30	08:50	30	2.9	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Disposal Water Quality Monitoring Form

1/2

Apex

PROJECT: NBH Dredge CAD Cell II - Top of CAD
JOB NUMBER: 6615.005.01
DATE: 7/8/08
DISPOSAL EVENT:
MONITORS: J. Ray + M. Bruno
WEATHER CONDITIONS:
WIND:
PRIOR STORM EVENTS:

UP-CURRENT

TIME: 12:00
GPS FILE NAME: N/A
NORTHING: 269573 51
TIDAL STAGE:

TIME OF DISPOSAL:
DISTANCE FROM DISPOSAL LOCATION: 75
EASTING: 814 999
WATER DEPTH: 16

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
070808 - 1200 - 2	12:00	2	0.5	
" " - 7	12:00	7	0.2	
" " - 14	12:00	14	0.2	

AVERAGE TURBIDITY:

~~DISPOSAL LOCATION~~ DOWN CURRENT

TIME: 12:10
GPS FILE NAME: N/A
NORTHING: 814930
TIDAL STAGE:

TIME OF DISPOSAL:
DISTANCE FROM DISPOSAL LOCATION: 150
EASTING: 269333
WATER DEPTH: 2

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
070808 - 1210 - 2	12:10	2	1.2	
" " - 6	12:10	6	1.5	
" " - 10	12:10	10	1.9	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Apex 2/2

~~DOWN-CURRENT~~ Disposal Location

TIME: 12:25
GPS FILE NAME: N/A
NORTHING: 2696021
TIDAL STAGE:

TIME OF DISPOSAL:
DISTANCE FROM DISPOSAL LOCATION:
EASTING: 815005
WATER DEPTH: 42

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
070808.1225.2	12:25	2	1.3	
" " .3	12:25	30	6.7	
" " .4	12:25	40	13.5	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Disposal Water Quality Monitoring Form

PROJECT: NBH - Top of CAD 2
JOB NUMBER: 6615.005.01
DATE: 7/11/08
DISPOSAL EVENT: D1 of SE-103 (00 hr of dredge)
MONITORS: JM + GCD
WEATHER CONDITIONS: Sunny, Hot ~ 75°F
WIND: Cool breeze
PRIOR STORM EVENTS: N/A

Apex

UP-CURRENT

TIME: 0650 hrs
GPS FILE NAME: 071108-00-1
NORTHING:
TIDAL STAGE: Ebb

TIME OF DISPOSAL: 0650 hrs
DISTANCE FROM DISPOSAL LOCATION: 200'
EASTING:
WATER DEPTH: 30'

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
071108-00-1-2	0650	2.0	0.6	
071108-00-1-14	0651	14.0	1.3	
071108-00-1-28	0653	28.0	6.8	

AVERAGE TURBIDITY:

DISPOSAL LOCATION

TIME: 0657
GPS FILE NAME: 071108-d1-00 (SE-103)
NORTHING:
TIDAL STAGE: Ebb

TIME OF DISPOSAL: 0650
DISTANCE FROM DISPOSAL LOCATION: @ location
EASTING:
WATER DEPTH: 32'

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
071108-d1-00-2	0657	2.0	9.0	
071108-d1-00-15	0658	15.0	10.6	
071108-d1-00-30	0659	30.0	45.9	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Apex

DOWN-CURRENT

TIME: 0655 hrs

GPS FILE NAME: 071108-00-9

NORTHING:

TIDAL STAGE: Ebb

TIME OF DISPOSAL: 0850 hrs

DISTANCE FROM DISPOSAL LOCATION: 200'

EASTING:

WATER DEPTH: 31'

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
071108-00-9-2	0655	2.0	0.0	
071108-00-9-15	0656	15.0	0.0	
071108-00-9-29	0657	29.0	0.3	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Disposal Water Quality Monitoring Form

PROJECT: NBH- Top of CAD 2
JOB NUMBER: 6615.005.01
DATE: 7/15/08
DISPOSAL EVENT: D1 of SE-103, SE-104, mud cat
MONITORS: JM+JR + GCD
WEATHER CONDITIONS: Sunny, warm, 80°F
WIND: Slight breeze
PRIOR STORM EVENTS: N/A

Apex

UP-CURRENT

TIME: 0945 hrs
GPS FILE NAME: 071508-00-1
NORTHING: 2696380
TIDAL STAGE: Ebb

TIME OF DISPOSAL: 0700 - 0915 hrs
DISTANCE FROM DISPOSAL LOCATION: 200'
EASTING: 814731
WATER DEPTH: 13.0'

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
071508-00-1-2	0945	2.0	-0.2	
071508-00-1-5	0946	5.0	0.0	
071508-00-1-11	0947	11.0	0.5	

AVERAGE TURBIDITY:

DISPOSAL LOCATION

TIME: 0925 hrs
GPS FILE NAME: 071508-d01-00
NORTHING: 2695980
TIDAL STAGE: Ebb

TIME OF DISPOSAL: 0700 - 0915 hrs
DISTANCE FROM DISPOSAL LOCATION: @ location
EASTING: 814698
WATER DEPTH: 40'

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
071508-d1-00-2	0925	2.0	-0.4	
071508-d1-00-	0926	18.0	0.3	
071508-d1-00-	0927	38.0	109.7	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Apex

DOWN-CURRENT

TIME: 0935 hrs.
GPS FILE NAME: 071508-00-9
NORTHING: 2695806
TIDAL STAGE: Ebb

TIME OF DISPOSAL: 0700 - 0915 hrs
DISTANCE FROM DISPOSAL LOCATION: 200'
EASTING: 814639
WATER DEPTH: 30'

Monitoring ID #	TIME	DEPTH (ft)	AVG TURBIDITY (NTUs)	NOTES
071508-00-9-2	0925	2.0	-0.4	
071508-00-9-14	0936	14.0	-0.3	
071508-00-9-28	0937	28.0	0.5	

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex

PROJECT: Steamship Authority
JOB NUMBER: 6588.006
DATE: 7/31/08
MONITORS: EL/
WEATHER CONDITIONS: 75°F Foggy Hazy
WIND: Calm
PRIOR STORM EVENTS:
DREDGE UPDATE: Steamship barge yesterday 7/30/08
TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	2691677	0710	14	2	-0.4	N/A	Flood	200ft	0
	818167	0710	14	6	-0.4				
		0710	14	12	-0.3				
			AVERAGE TURBIDITY:		-.36				
	2691970	0915	20	2	0.1	N/A	Ebb	200 ft.	2
	818834	0915	20	9	0.7				
		0915	20	18	25.8				
			AVERAGE TURBIDITY:		8.36				
	2691903	11:10	18	2	0.1	N/A	Ebb	125ft	4
	817873	11:11	18	9	0.5				
		11:12	18	16	1.1				
			AVERAGE TURBIDITY:						
	2691598	1416	8	2	0.1	N/A	Flood ~~Ebb~~ ~~Open~~	100 ft.	7
	818281	1420	8	4	-0.2				
		1421	8	6	0.7				
			AVERAGE TURBIDITY:						
	2691666	16:45	8	2	3.4	N/A	Flood	175ft.	9
	818223	16:45	8	4	3.2				
		16:45	8	6	0.7				
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	2691944	0720	21	2	0.0	N/A	Flood	175ft	0
	817885	0720	21	9	0.2				
		0720	21	18	0.4				
			TURBIDITY INCREASE:		0.36				
	2691605	0925	8	2	-0.2	N/A	Ebb	200 ft.	2
	818368	0925	8	4	-0.4				
		0925	8	6	0.0				
			TURBIDITY INCREASE:						
	2691606	11:18	6	-0.3	2ft	N/A	Ebb	200ft	4
	818368	11:20	6	-0.5	3ft				
		11:21	6	0.0	4ft				
			TURBIDITY INCREASE:						
	2691944	1425	17	2	4.5	N/A	Flood ~~Ebb~~ ~~Open~~	200ft.	7
	817885	1427	17	8	4.7				
		1428	17	15	6.6				
			TURBIDITY INCREASE:						
	2692021	1635	17	2	0.1	N/A	Flood	150ft	9
	817961	1635	17	8	0.9				
		1635	17	15	0.8				
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex

PROJECT: Steamship Authority
JOB NUMBER: 6588.006
DATE: 8/4/08
MONITORS: JER/EWP
WEATHER CONDITIONS: 78° F
WIND: 10mph NW
PRIOR STORM EVENTS:
DREDGE UPDATE:
TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	2696189, 814743	12:00	40	2	-0.7	N/A	Ebb	75 ft	0
		12:02	40	21	0.1				
		12:08	40	39	6.8				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	2695600, 814733	12:35	34	2	-0.2	N/A	Ebb	150 ft	0
		12:37	34	16	-0.4				
		12:40	34	32	2.2				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex

PROJECT: Steamship Authority
JOB NUMBER: 6588.006
DATE: 8/5/08
MONITORS: JER/MB
WEATHER CONDITIONS: Sunny
WIND: 1-2 knots from N
PRIOR STORM EVENTS:
DREDGE UPDATE:
TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
080508-00-1-2	GPS not working	0725	6'	2'	0.0	N/A	Flood	200ft.	0
080508-00-1-8		0725	6'	8'	0.0				
080508-00-1-4		0725	6'	4'	0.8				
			AVERAGE TURBIDITY:		0.233				
080508-02-1-2	2691581 818266	09:40	11'	2'	3.2	N/A	Flood	150ft.	2
080508-02-1-8		09:42	11'	5'	0.4				
080508-02-1-9		09:44	11'	9'	-0.4				
			AVERAGE TURBIDITY:		1.07				
080508-04-1-2	2691935 818056	12:00	19'	2'	0.0	N/A	Ebb	200ft	4
080508-04-1-8		12:04	19'	8'	1.2				
080508-04-1-17		12:06	19'	17'	66.0				
			AVERAGE TURBIDITY:		22.4				
080508-06-1-2	2691936 818019	14:20	21'	2'	1.9	N/A	Ebb	200ft	4
080508-06-1-9		14:23	21'	9'	20.2				
080508-06-1-19		14:25	21'	19'	24.8				
			AVERAGE TURBIDITY:		16.23				
080508-D1-0-1-2	2696476 814665	16:46	17'	2'	0.9	N/A	Ebb	200ft	Disposal
080508-D1-2-1-8		16:48	17'	8'	0.7				
080508-D1-4-1-15		16:50	17'	15'	6.0				
			AVERAGE TURBIDITY:		2.5				

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
080508-00-9-2	Gps not working	07:40	20'	2'	0.0	N/A	Flood	200ft	0
080508-00-9-10		07:40	20'	10'	0.0				
080508-00-9-18		07:40	20'	18'	0.0				
			TURBIDITY INCREASE:		0				
080508-02-9-2	2691935 818055	0950	19'	2'	2.7	N/A	Flood	200ft	2
080508-02-9-8		0952	19'	8'	1.0				
080508-02-9-17		0954	19'	17'	1.2				
			TURBIDITY INCREASE:		.843				
080508-04-9-2	2691662 818397	12:10	8'	2	2.9	N/A	Ebb	150ft	4
080508-04-9-4		12:15	8'	4	0.4				
080508-04-9-6		12:17	8'	6	4.5				
			TURBIDITY INCREASE:		-19.86				
080508-06-9-2	2691661 818403	14:05	6'	2'	-0.4	N/A	Ebb	200ft	6
080508-06-9-8		14:07	6'	3'	1.2				
080508-06-9-4		14:10	6'	4'	1.9				
			TURBIDITY INCREASE:		-15.33				
080508-D1-9-9-2	2695612 814658	16:55	28'	2'	0.9	N/A	Ebb	150ft	Disposal
080508-D1-11-9-14		16:57	28'	14'	0.4				
080508-D1-13-9-26		16:59	28'	26'	0.7				
			TURBIDITY INCREASE:		-1.83				

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex

PROJECT: Steamship Authority
JOB NUMBER: 6588.006
DATE: 8/5/08
MONITORS: JER/MB
WEATHER CONDITIONS: Sunny
WIND: 1-2 knots from N
PRIOR STORM EVENTS:
DREDGE UPDATE:
TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
080508-00-1-2	GPS not working	0725	6'	2'	0.0	N/A	Flood	200ft.	0
080508-00-1-5		0725	6'	5'	0.0				
080508-00-1-4		0725	6'	4'	0.8				
			AVERAGE TURBIDITY:		0.233				
080508-02-1-2	2691581	09:40	11'	2'	3.2	N/A	Flood	150ft.	2
080508-02-1-5	818266	09:42	11'	5'	0.4				
080508-02-1-9		09:44	11'	9'	-0.4				
			AVERAGE TURBIDITY:		1.07				
080508-04-1-2	2691995	12:00	19'	2'	0.0	N/A	Ebb	200ft	4
080508-04-1-8	818056	12:04	19'	8'	1.2				
080508-04-1-17		12:06	19'	17'	66.0				
			AVERAGE TURBIDITY:		22.4				
080508-06-1-2	2691936	14:20	21'	2'	1.7	N/A	Ebb	200ft	4
080508-06-1-9	818019	14:23	21'	9'	20.2				
080508-06-1-19		14:25	21'	19'	24.8				
			AVERAGE TURBIDITY:		16.28				
080508-D1-0-1-2	2696476	16:46	17'	2'	0.9	N/A	Ebb	200ft	Disposal
080508-D1-2-1-8	814665	16:48	17'	8'	0.7				
080508-D1-4-1-15		16:50	17'	15'	6.0				
			AVERAGE TURBIDITY:		2.5				

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
080508-00-9-2	Gps not working	07:40	20'	2'	0.0	N/A	Flood	200ft	0
080508-00-9-10		07:40	20'	10'	0.0				
080508-00-9-18		07:40	20'	18'	0.0				
			TURBIDITY INCREASE:		0				
080508-02-9-2	2691935	0950	19'	2'	2.7	N/A	Flood	200ft	2
080508-02-9-8	818055	0952	19'	8'	1.0				
080508-02-9-17		0954	19'	17'	1.2				
			TURBIDITY INCREASE:		.563				
080508-04-9-2	2691662	12:10	8'	2	2.7	N/A	Ebb	150ft	4
080508-04-9-4	818397	12:15	8'	4	0.4				
080508-04-9-6		12:17	8'	6	4.5				
			TURBIDITY INCREASE:		-19.86				
080508-06-9-2	2691661	14:05	6'	2'	-0.4	N/A	Ebb	200ft	6
080508-06-9-3	818403	14:07	6'	3'	1.2				
080508-06-9-4		14:10	6'	4'	1.4				
			TURBIDITY INCREASE:		-15.33				
080508-D1-9-2	2695612	16:55	28'	2'	0.9	N/A	Ebb	150ft	Disposal
080508-D1-11-9-14	814658	16:57	28'	14'	0.4				
080508-D1-13-9-26		16:59	28'	26'	0.7				
			TURBIDITY INCREASE:		-1.83				

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex

PROJECT: Steamship Authority
JOB NUMBER: 6588.006
DATE: 8/7/08
MONITORS: Jen Martino + Warren B.
WEATHER CONDITIONS: Cloudy, Cold, light sprinkles - dark clouds
WIND: 15mph - cool
PRIOR STORM EVENTS: Rain
DREDGE UPDATE: 00 hr.
TYPE OF WATER QUALITY MONITORING: (DREDGE) / DISPOSAL

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
080708-00-1-2	2691582 N	1001	19'	2.0'	-0.1	080708-00-1-dredge	Flood	200'	00
080708-00-1-9	818083 E	1003	19'	9.0'	-0.3				
080708-00-1-17		1005	19'	17.0'	-0.9				
			AVERAGE TURBIDITY:						
080708-02-1-2	2691574 N	1144	11'	2'	0.7	080708	Flood	200'	02
080708-02-1-5	818255 E	1145	11'	5'	-0.8				
080708-02-1-9		1145	11'	9'	0.2				
			AVERAGE TURBIDITY:						
080708-04-1-2	2692061 N	1420	20'	2'	~~-24.8~~ 0.1	080708	Ebb	200'	04
080708-04-1-10	817789 E	1422	20'	10'	0.9				
080708-04-1-18		1424	20'		-1.4				
			AVERAGE TURBIDITY:						
080708-08-1-2	2691980	1710	20'	2.0	0.0	080708	Ebb	200'	08
080708-08-1-10	817844	1712	20'	10.0	-0.5				
080708-08-1-18		1713	20'	18.0	-1.4				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
080708-00-9-2	2691590 N	10:20	15'	2.0'	0.1		Flood	200'	00
080708-00-9-9	817763 E	12:00	15	9.0'	0.7				
080708-00-9-17			15'	17.0'	-1.0				
			TURBIDITY INCREASE:						
080708-02-9-2	2692017 N	12:00	20'	2'	~~-0.9~~	.7	Flood	200'	02
080708-02-9-10	817825 E	12:00	20'	10'	~~-0.8~~	~~37.7~~ 1.0			
080708-02-9-18		12:01	20'	18'					
			TURBIDITY INCREASE:						
080708-04-9-2	2691670 N		24'	2'	-0.3	3.1	Ebb	200'	04
080708-04-9-12	817959 E		24'	12'	~~-2.6~~				
080708-04-9-22			24'	22'	0				
			TURBIDITY INCREASE:						
080708-08-9-2	2691626	1715	18'	2'	-0.9	080708	Ebb	200'	08
080708-08-9-9	818055	1718	18'	9'	0.0				
080708-08-9-16		1720	18'	16'	-1.0				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

31 caps Freezing

calibrated YSI pio 080708-08-9-2 to sample

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex

PROJECT: Steamship Authority
JOB NUMBER: 6588.006
DATE: 08/07/08
MONITORS: JM + WB
WEATHER CONDITIONS: Sunny (60s) 70°F - 75-
WIND: 15mph or less
PRIOR STORM EVENTS: rain
DREDGE UPDATE: dump of SEI-2000
TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
080708-dl-06-1-2	2696347 N	1530	18'	2'	-0.4	080708	Ebb	200'	06
080708-dl-06-1-	814699 E	1533	18'	9'	-0.4				
080708-dl-06-1-		1535	18'	16'	0.0				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

Disposal of SEI-2000

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
one pocket missing from dump 080708-dl-06-9-2	2695733	1536	33'	2.0	-0.9	080708	Ebb	200'	06
080708-dl-06-9-15	814681	1538		19.0	-1.3				
080708-dl-06-9-30		1540		30.0	-1.2				
			TURBIDITY INCREASE:						
and casing all pockets dumped 080708-dl-06-9-2	2695784	1555	33	2.0	0.5	080708	Ebb	150'	06
080708-dl-06-9-16	814644	1600	33	16.0	5.9				
080708-dl-06-9-30		1602	33	30'	N/				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

APEX

PROJECT: Steamship Authority
JOB NUMBER: 6588.006
DATE: 8/8/08
MONITORS: JM & MB
WEATHER CONDITIONS: Sunny, clear, No wind ~70°F Mid-day-cool/wind cloudy w/some sun
WIND: No wind, clear skies
PRIOR STORM EVENTS: N/A
DREDGE UPDATE: 00 hr of dredge
TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
080808-00-1-2	2691689	0715	9'	2'	-1.6	080808	Flood	200'	00
080808-00-1-5	818	0717	9'	5'	-1.4				
080808-00-1-7		0720	9'	7'	-1.4				
			AVERAGE TURBIDITY:						
080808-06-1-2	2691911	1330	7'	2'	0.4	080808	Ebb	200'	06
080808-06-1-4	817688	1333	7'	4'	0.1				
080808-06-1-5		1335	7'	5'	0.0				
			AVERAGE TURBIDITY:						
080808-08-1-2	2691929	1545	22'	2'	0.3	080808	Ebb	200'	08
080808-08-1-10	817964	1547	22'	10'	0.4				
080808-08-1-20		1549	22'	20'	0.2				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

Dredge stopped - just restarted up

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
080808-00-9-2	2691973	0726	20'	2'	-1.7	080808	Flood	200'	00
080808-00-9-10	817648	0728	20'	10'	-1.5				
080808-00-9-18		0730	20'	18'	-0.8				
			TURBIDITY INCREASE:						
080808-06-9-2	2691682	1345	8'	2'	0.6	080808	Ebb	200'	06
080808-06-9-	818398	1347	8'	4'	9.8				
080808-06-9-		1350	8'	6'	22.8				
			TURBIDITY INCREASE:						
080808-08-9-2	2691683	1601	6'	2'	1.0	080808	Ebb	200'	08
080808-08-9-3	818399	1603	6'	3'	0.9				
080808-08-9-4		1605	6'	4	0.9				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

Dredge was on hold

ity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

ring Form jer

Dredge Water Quality Monitoring Form

PROJECT: Steamship Authority
JOB NUMBER: 6588.006
DATE: 8/11/08
MONITORS: JM + JR
WEATHER CONDITIONS: RAIN!! Thunder + Lightening – Late afternoon skies cleared – sun
WIND: 10-15mph
PRIOR STORM EVENTS: Rain
DREDGE UPDATE: Filling Eddie Current
TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
081108-00-1-2		0850	18'	2'	3.0	081108	Ebb	200'	00
081108-00-1-10		0853	18'	10'	4.0				
081108-00-1-16		0855	18'	16'	4.5				
			AVERAGE TURBIDITY:						

* Dredging continued between hrs. 02-06 however storm too strong for WQM.

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
081108-08-1-2	3 pilings from SW corner of steamship pier (GPS not connecting)	1715	20'	2'	7.3	081108	Ebb	150'	08
081108-08-1-		1716	20'	9'	0.6				
081108-08-1-		1717	20'	18'	-1.2				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
081108-00-9-2	2691579	0835	9'	2'	0.3	081108	Ebb	200'	00
081108-00-9-5	818353	0837	9'	5'	-0.1				
081108-00-9-7		0840	9'	7'	-0.9				
			TURBIDITY INCREASE:						
081108-08-9-2	Even w/ dock of steamship (100' S)	1725	7'	2'	3.2	081108	Ebb	150'	08
081108-08-9-4		1727	7'	4'	17.2				
081108-08-9-5		1729	7'	5'	24.2				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex

PROJECT: Steamship Authority
JOB NUMBER: 6588.006
DATE: 8/11/08
MONITORS: JM + JR
WEATHER CONDITIONS: Rainy + Stormy - Second half of day was Sunny + few clouds - 7
WIND: 5-10 mph
PRIOR STORM EVENTS: Rain / thunder & lightening
DREDGE UPDATE: Disposal of Scow SEI-2000
TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
081108-dl-00-1-2	S of scow SEI-2000	1630	34'	2'	4.3	081108	Flood	75' South of Scow	00 hr of disposal
081108-dl-00-1-16		1632	34'	16'	-1.7				
081108-dl-00-1-22		1633	34'	32'	1.1				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
081108-dl-00-9-2		1650	24'	2'	1.3	081108	Flood	100' N of scow toward I95 highway	00 hr of disposal
081108-dl-00-9-12		1651	24'	12'	-0.6				
081108-dl-00-9-22		1653	24'	22'	5.3				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex

PROJECT:	Steamship Authority
JOB NUMBER:	6588.006
DATE:	~~8/12/08~~ 8/12/08
MONITORS:	JER, ~~[illegible]~~ MB
WEATHER CONDITIONS:	Mid 50's in AM light rain, High 60's PM cleared up
WIND:	5-15 mph
PRIOR STORM EVENTS:	8/11/08 2.66 inches of rain, rain all night
DREDGE UPDATE:	
TYPE OF WATER QUALITY MONITORING:	DREDGE / DISPOSAL

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	2691661, 818403	11:20	5	2	-0.8	N/A	Flood	200ft	02
		11:22	5	3	-0.6				
		11:24	5	4	-0.6				
			AVERAGE TURBIDITY:						
	2691661, 818403	1345	6	2	-0.6	N/A	Flood	200ft	04
		1345	6	3	-0.2				
		1348	6	4	-0.5				
			AVERAGE TURBIDITY:						
	2691661, 818403	1530	7	2	-0.7	N/A	Flood	200ft	06
		1531	7	4	-0.5				
		1533	7	5	-0.7				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	2691933, 818091	1130	18	2	0.2	N/A	Flood	200ft	02
		1132	18	9	2.8				
		1134	18	16	1.2				
			TURBIDITY INCREASE:						
	2691938, 818094	13:30	20	2	0.7	N/A	Flood	200ft	04
		13:31	20	10	3.2				
		13:35	20	18	4.9				
			TURBIDITY INCREASE:						
	2691938, 818094	1540	20	2	3.0	N/A	Flood	200ft	06
		1541	20	9	9.6				
		1544	20	18	0.2				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex

PROJECT: Steamship Authority
JOB NUMBER: 6588.006
DATE: 081808
MONITORS: RB, JM
WEATHER CONDITIONS: Sunny, 75°
WIND: 5 mph
PRIOR STORM EVENTS: NA
DREDGE UPDATE: Morning (1) side of dock / Afternoon (2) side of dock.
TYPE OF WATER QUALITY MONITORING: (DREDGE) / /DISPOSAL

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
081808-00-1-2	2691639	0840	20	2	1.0	081808	Flood	100'	00
081808-00-1-9	818432	0842	↓	9	-1.3				
081808-00-1-19		0844		19	-1.2				
			AVERAGE TURBIDITY:						
081808-02-1-2	2692192.89	1050	22	2	-1.6	081808	ebb	150'	02
081808-02-1-10	817720.89	1052	↓	10	23.6				
081808-02-1-20		1054		20	3.6				
			AVERAGE TURBIDITY:						
081808-04-1-2	2692143	1235	20'	2	3.1	081808	Ebb	200'	04
081808-04-1-10	817801	1237	↓	10'	7.5				
081808-04-1-18		1238		18'	7.2				
			AVERAGE TURBIDITY:						
081808-07-1-2	2691690	1528	8'	2'	4.2	081808	Flood	150'	07
081808-07-1-4	818406	1529	↓	4'	5.0				
081808-07-1-6		1530		6'	8.5				
			AVERAGE TURBIDITY:						
081808-09-1-2	2691690	1734	6'	2'	0.8	081808	Flood	150'	09
081808-09-1-3	818410	1736	↓	3'	1.0				
081808-09-1-4		1737		4'	0.7				
			AVERAGE TURBIDITY:						

* Dredging halted - changed side of dock + moved crew.

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
081808-00-9-2	269	0820	21	2	-1.4	081808	Flood	200'	00
081808-00-9-9	810	0825	↓	9	-1.1				
081808-00-9-19		0830		19	5.4				
			TURBIDITY INCREASE:						
081808-02-9-2	269	1049	22	2	-1.6	081808	ebb	100'	02
081808-02-9-10		1046	↓	10	-1.5				
081808-02-9-20		1048		20	0.3				
			TURBIDITY INCREASE:						
081808-04-9-2	269	1240	19'	2'	0.3	081808	Ebb	150'	04
081808-04-9-10		1242	↓	10'	6.7				
081808-04-9-16		1244		16'	1.9				
			TURBIDITY INCREASE:						
081808-07-9-2	2691945	1532	15'	2'	1.4	081808	Flood	200'	07
081808-07-9-	818152	1534	↓	9'	1.0				
081808-07-9-		1536		13	5.8				
			TURBIDITY INCREASE:						
081808-09-9-2	2691950	1740	14'	2'	3.4	081808	Flood	200'	09
081808-09-9-6	2818153	1742	↓	6'	4.2				
081808-09-9-12		1743		12'	1.3				
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Monitoring Form.jpg

Turb. for 081808-02-1-10 = 23.6 NTU

Dredge Water Quality Monitoring Form

Apex

PROJECT: Steamship Authority
JOB NUMBER: 6588.006
DATE: 08/21/08
MONITORS: RB and JER
WEATHER CONDITIONS: Sunny, calm, no precip.
WIND: Calm
PRIOR STORM EVENTS:
DREDGE UPDATE:
TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
082108-00-	2691654	0950	7	2	1.3	NA	flood	150	0
082108-00-	818408	0952		4	0.9				
082108-00-		0955	↓	6	0.9				
			AVERAGE TURBIDITY:						
	2691988	12:45	22	2	2.8	NA	Ebb	175ft	3 *
	817915	12:45	22	10	5.0				
		12:49	22	20	3.8				
			AVERAGE TURBIDITY:						
	2691892	14:54	18	2	1.6	N/A	Ebb	175ft	5
	818221	15:00	18	8	7.5				
		15:01	18	16	11.5				
			AVERAGE TURBIDITY:						
	2691911	1733	21	2	9.4	N/A	Ebb	175'	7
	818023	1723		10	0.8				
		1733	↓	19	6.6				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

* Dredging stopped for GPS problem

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	2691940	1017	16	2	0.1	N/A	Flood	175ft	0
	818101	17	16	8	0.1				
		20	16	14	0.2				
			TURBIDITY INCREASE:						
	2691755	1250	7	2	0.0	N/A	Ebb	100ft	3 *
	818353	52	7	4	0.0				
		55	7	6	1.1				
			TURBIDITY INCREASE:						
	2691765	14:50	~~8~~ 10	~~8~~ 2	0.3	N/A	Ebb	75ft	5
	818443	14:52	~~8~~ 10	~~8~~ 5	1.4				
		14:56	~~8~~ 10	~~8~~ 8	0.2				
			TURBIDITY INCREASE:						
	2691701	1726	7	2	0.7	N/A	Ebb	75'	7
	818275	1730	7	4	0.8				
		1737	7	6	1.0				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex

PROJECT: Steamship Authority
JOB NUMBER: 6588.006
DATE: 8/21/08
MONITORS:
WEATHER CONDITIONS:
WIND:
PRIOR STORM EVENTS:
DREDGE UPDATE:
TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	269630	16:15	22	2	1.8	NA	Ebb	200'	6
	814622	16:19	↓	10	2.3				
				20	2.8				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	269722	1704	33	2	2.2	NA	Ebb	150'	6
	814552		↓	16	1.9				
				31	4.5				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

DATE: 8/26 6588.006

MONITORS:

WEATHER CONDITIONS:

WIND:

PRIOR STORM EVENTS:

DREDGE UPDATE:

TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL

Dredge Water Quality Monitoring Form

Apex

Tides: Low @ 09:44, 23:47
High @ 04:13, 16:51

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	2691931 818054	0700	~~18~~ 18	2	0.6	N/A	Ebb	180ft	00
		0702	18	9	0.5				
		0704	18	16	11.2				
			AVERAGE TURBIDITY:						
	2691947 818157	0902	17	2	16.6	N/A	Ebb	180ft	02
		0902	17	8	19.5				
		0904	17	15	19.3				
			AVERAGE TURBIDITY:						
	2691654 818410	11:05	5	2	5.6	N/A	Flood	150ft	04
		11:08	5	3	5.8				
		11:10	5	4	3.5				
			AVERAGE TURBIDITY:						
	* GPS down	13:00	6	2	2.7	N/A	flood	180ft	06
		13:02	↓	3	2.9				
		13:04		4	2.9				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	2691656 818413	0710	6	2	0.4	N/A	Ebb	150ft	00
		0711	6	3	0.5				
		0713	6	4	0.6				
			TURBIDITY INCREASE:						
	2691667 818672	0855	5	2	0.3	N/A	Ebb	175ft	02
		0858	5	3	0.3				
		0900	5	4	0.3				
			TURBIDITY INCREASE:						
	2691950 818021	11:15	18	2	5.3	N/A	Flood	175ft	04
		11:16	18	9	4.2				
		11:19	18	16	6.8				
			TURBIDITY INCREASE:						
	* GPS down	13:12	17	2	12.5	N/A	flood	100	06
		13:14	↓	8	10.7				
		13:16		15	6.0				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

* 13:00 sample (up-current) taken at blue and white mooring bal on S. side of pier. GPS battery dead

* 13:20 sample (down-current) taken at South corner of S. side of pier

Dredge Water Quality Monitoring Form

Apex Companies, LLC

PROJECT: [redacted] SS Authority
JOB NUMBER: [redacted] 6588.006.03
DATE: 8/28/08
MONITORS: JM + RB
WEATHER CONDITIONS: Sunny, trace clouds, clear
WIND: Clear calm w 5mph
PRIOR STORM EVENTS: N/A
DREDGE UPDATE: (A) side of pier in morning and (S) side of pier in afternoon
TYPE OF WATER QUALITY MONITORING: (DREDGE) / DISPOSAL

re-dredge WQM

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
082808-00-1-2	2692056	0730	18'	2'	3.4	N/A	Ebb	200'	00hrs
" -00-1-8	817802	0731	↓	8'	2.8				
" -00-1-16		0732		16'	5.1				
			AVERAGE TURBIDITY:						
082808-02-1-2	2692034	0930	19'	2'	5.0	N/A	Ebb	200'	02 hrs
" -02-1-8	817757	0931	↓	8'	5.6				
" -02-1-17		0932	↓	17'	4.7				
			AVERAGE TURBIDITY:						
082808-04-1-2	2692088	11:40	20'	2'	2.2	N/A	Ebb	200'	04 hrs
" -04-1-8	817849	11:41	↓	8'	2.6				
" -04-1-15		11:42	↓	15'	3.2				
			AVERAGE TURBIDITY:						
082808-08-1-2	2691717	1535	20'	2'	8.3	N/A	Flood	200'	08 hrs
" -08-1-10	817941	1536	↓	10'	10.5				
" -08-1-18		1537	↓	18'	11.5				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

re-dredge WQM

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
082808-00-9-2	2691882	0740	17'	2'	4.2	N/A	Ebb	200'	00 hrs
" -00-9-8	818010	0741	↓	8'	3.1				
" -00-9-15		0742	↓	15'	2.8				
			TURBIDITY INCREASE:						
082808-02-9-2	2691830	0935	21'	2'	5.6	N/A	Ebb	200'	02 hrs
" -02-9-10	817921	0936	↓	10'	6.3				
" -02-9-19		0937	↓	19'	7.0				
			TURBIDITY INCREASE:						
082808-04-9-2	2691947	11:35	18'	2'	4.9	N/A	Ebb	100'	04 hrs
" -04-9-8	818022	11:36	↓	8'	5.7				
" -04-9-16		11:37	↓	16'	8.2				
			TURBIDITY INCREASE:						
082808-08-9-2	2691985	15:28	19	2'	4.3	N/A	Flood	200'	08 hrs
" -08-9-8	816016	15:29	↓	8'	7.3				
" -08-9-17		15:30	↓	17'	7.9				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex Companies, LLC

PROJECT: ~~New Bedford Harbor Bottom of Grid 92~~ Steamship Authority
JOB NUMBER: ~~[illegible]~~ 6588.006.03
DATE: 8/28/08
MONITORS: JM + RB
WEATHER CONDITIONS: Sunny trace white clouds, calm, clear
WIND: Calm - 5mph
PRIOR STORM EVENTS: N/A
DREDGE UPDATE: Disposal of Eddie Carroll
TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
082808-D1-00-1-2	2696054	0850	30'	2'	1.5	N/A	Ebb	200'	00 hrs
" - 14	815005	0851	↓	14'	9.7				
" - 28		0852		28'	61.1				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
082808-D1-00-9-2	2695704	0857	32'	2'	2.9	N/A	Ebb	200'	00hrs
" - 15	814961	0858	↓	15'	2.6				
" - 30		0859		30'	23.4				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex

PROJECT: Steamship Authority
JOB NUMBER: 6588.006
DATE: 9/3/08
MONITORS: JM + MB
WEATHER CONDITIONS: Sunny, cool, clear skies ~70°F
WIND: ~5mph, cool breeze
PRIOR STORM EVENTS: N/A - dew in morning
DREDGE UPDATE:
TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL

TIDES: Hi: 1130s
Lo:

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
090308-00-1-2	2691648	0900	7'	2'	0.9	090308	Flood	200'	00 hrs
090308-00-1-4	818412	0901	↓	4'	1.0				
090308-00-1-6		0902	↓	6'	1.2				
			AVERAGE TURBIDITY:						
090308-02-1-2	2691608	1125	9'	2'	0.8	090308	Flood	200'	02 hrs
090308-02-1-4	818439	1126	↓	4'	0.9				
090308-02-1-7		1127	↓	7'	1.3				
			AVERAGE TURBIDITY:						
090308-04-1-2	2691955	1352	18'	2'	1.8	N/A	Ebb	200'	04 hrs
090308-04-1-	818068	1353	↓	9'	1.7				
090308-04-1-		1354	↓	16'	0.9				
			AVERAGE TURBIDITY:						
090308-07-1-2	269	17				N/A	Ebb	200'	07 hrs
090308-07-1-	818								
090308-07-1-									
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
090308-00-9-2	2691933	0911	20'	2'	5.3	090308	Flood	200'	00 hrs
090308-00-9-10	818059	0912	↓	10'	6.9				
090308-00-9-18		0913	↓	18'	8.0				
			TURBIDITY INCREASE:						
090308-02-9-2	2691982	1132	12'	2'	21.0	090308	Flood	200'	02 hrs
090308-02-9-	818044	1133	↓	5'	11.8				
090308-02-9-		1134	↓	10'	15.6				
			TURBIDITY INCREASE:						
090308-04-9-2	2691644	1344	9'	2'	1.1	N/A	Ebb	200'	04 hrs
090308-04-9-4	818404	1345	↓	4'	1.2				
090308-04-9-6		1346	↓	6'	1.5				
			TURBIDITY INCREASE:						
090308-07-9-2	269					N/A	Ebb	200'	07 hrs
090308-07-9-	818								
090308-07-9-									
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex

PROJECT: ~~Steamship Authority~~ Bottom of CAD 2 - NBH
JOB NUMBER: 6615.006.01 ~~6509.000~~
DATE: 8/27/08
MONITORS: JM + RB
WEATHER CONDITIONS: Sunny, Hot, 10mph winds
WIND: 10 mph - cool/calm
PRIOR STORM EVENTS: None
DREDGE UPDATE: Disposal of Joe Verrochi
TYPE OF WATER QUALITY MONITORING: ~~DREDGE~~ / DISPOSAL DISPOSAL

TIDES: High = 0521, 17:56
Low = 10:57

UP-CURRENT

	Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
re-dump WQM	082708-D1-1-2	2695659	13:30	32'	2'	2.3	N/A	Flood	200'	00 hrs - D1 of J.V.
	082708-D1-1-15	814914.6	13:31	↓	15'	2.3				
	082708-D1-1-30		13:32		30'	2.1				
				AVERAGE TURBIDITY:						
st-dump WQM	082708-D1-1-2	2695836	13:47	38'	2'	2.8	N/A	Flood	150'	Post dump WQM - J.V.
	082708-D1-1-19	814918	13:48		19'	2.3				
	082708-D1-1-36		13:50	↓	36'	3.4				
				AVERAGE TURBIDITY:						
				AVERAGE TURBIDITY:						
				AVERAGE TURBIDITY:						
				AVERAGE TURBIDITY:						

DOWN-CURRENT

	Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
e-dump WQM	082708-D1-9-2	2696320	13:33	12'	2'	3.2	N/A	Flood	200'	D1 - ~~Post~~ Pre-dump of J.V.
	082708-D1-9-5	814870	13:35	↓	5'	4.0				
	082708-D1-9-10		13:37		10'	4.8				
				TURBIDITY INCREASE:						
st-mp WQM	082708-D1-9-2	2696194	13:40	19'	2'	9.8	N/A	Flood	100'	post dump of JV
	082708-D1-9-9	814934	13:42	↓	9'	7.8				
	082708-D1-9-17		13:45		17'	8.1				
				TURBIDITY INCREASE:						
				TURBIDITY INCREASE:						
				TURBIDITY INCREASE:						
				TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex

PROJECT: ~~Steamship Authority~~ Bottom of CAD2 - NBH
JOB NUMBER: 6615.006 ~~6598.000~~
DATE: 8/27/08
MONITORS: JM + RB
WEATHER CONDITIONS: Sunny Warm, 80°F
WIND: ~~[illegible]~~ Cool ~ 10mph
PRIOR STORM EVENTS: N/A
DREDGE UPDATE: Afternoon
TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL

tides - high: 0521, 1756
low: 1057

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
082708-02-1-2	2695800	1542	36'	2'	2.4	N/A	Flood	150'	02 hrs ~~after 1st~~ WQM
" - " - 1-17	815170	1543	↓	17'	1.9				
" - " - 1-34		1545		34'	2.0				
			AVERAGE TURBIDITY:						
082708-04-1-2	2695841	1720	39'	2'	1.4	N/A	Flood	200'	04 hrs after 1st WQM
082708-04-1-18	815089	1733		18'	2.3				
082708-04-1-37		1735	↓	37'	3.0				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
082708-04-9-2	2696257	1535	11'	2'	4.3	N/A	Flood	150'	02 after 1st WQM
082708-04-9-5	815277	1537	↓	5'	3.4				
082708-04-9-9		1540		9'	5.0				
			TURBIDITY INCREASE:						
082708-04-9-2	2696287	1742	13'	2'	1.5	N/A	Flood	200'	04 after 1st WQM
082708-04-9-6	815429	1744		6'	1.4				
082708-04-9-11		1747	↓	11'	9.5				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: New Bedford Harbor: Bottom of CAD #2
JOB NUMBER: 6615.006.01
DATE: 8/28/08
MONITORS: JM + RB
WEATHER CONDITIONS: Sunny, trace clouds; some wind
WIND: Calm w 5 mph
PRIOR STORM EVENTS: N/A
DREDGE UPDATE: Dredge on pause throughout morning - started up @ 1:00pm
TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL

Dredge Water Quality Monitoring Form

Apex Companies, LLC

TIDE: High = 0620; 1852
Low = 1159

* Dredge paused in morning for survey + mechanical issues aboard A.S.

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
re-edge AM									
082808-00-1-2	2695826	0800	34'	2'	1.6	082808	Ebb	200'	00hrs 1st wqm of the day
082808-00-1-18	815241.4	0803	↓	18'	2.2				
082808-00-1-37		0805	↓	37'	1.9				
			AVERAGE TURBIDITY:						
082808-02-1-2	2696048	1030	31'	2'	2.4	082808	Ebb	200'	02 hrs
082808-02-1-15	815116.8	1031	↓	15'	3.2				
082808-02-1-29		1032	↓	29'	7.1				
			AVERAGE TURBIDITY:						
082808-04-1-2	2695766	1222	33'	2'	1.6	082808	Flood	100'	04 hrs
082808-04-1-15	815122	1223	↓	15'	3.8				
082808-04-1-31		1224	↓	31'	5.8				
			AVERAGE TURBIDITY:						
down-current 082808-06-1-2	2696418	1445	10'	2'	4.2	N/A	Flood	150'	06 hrs
082808-06-1-5	815459	1447	↓	5'	7.3				
082808-06-1-8		1449	↓	8'	15.5				
			AVERAGE TURBIDITY:						
082808-08-1-2	2695910	1640	34'	2'	1.6	N/A	Flood	200'	08hrs
082808-08-1-16	815205	1641	↓	16'	1.4				
082808-08-1-32		1642	↓	32'	1.8				
			AVERAGE TURBIDITY:						

range on hold

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
re-edge AM									
082808-00-9-2	2695672	0810	40'	2'	2.1	N/A	Ebb	200'	00hrs
" -00-9-20	815136	0811	↓	20'	1.3				
" -00-9-38		0813	↓	38'	1.2				
			TURBIDITY INCREASE:						
082808-02-9-2	2695593	1024	32'	2'	2.5	N/A	Ebb	200'	02 hrs
" -02-9-15	814981	1025	↓	15'	2.6				
" -02-9-30		1026	↓	30'	4.4				
			TURBIDITY INCREASE:						
082808-04-9-2	2696055	1227	21'	2'	2.0	N/A	Flood	200'	04 hrs
" -04-9-10	815196	1228	↓	10'	2.5				
" -04-9-19		1229	↓	19'	2.2				
			TURBIDITY INCREASE:						
current 082808-06-9-2	2695983	1450	11'	2'	1.8	N/A	Flood	200'	06 hrs
" -06-9-5	815301	1451	↓	5'	1.8				
" -06-9-9		1452	↓	9'	1.9				
			TURBIDITY INCREASE:						
082808-08-9-2	2696339	1650	12'	2'	7.0	N/A	Flood	200'	08 hrs
" -08-9-5	815423	1651	↓	5'	3.0				
" -08-9-10		1652	↓	10'	2.4				
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: New Bedford Harbor: Bottom of CAD #2
JOB NUMBER: 6615.006.01
DATE: 9/3/08
MONITORS: TM
WEATHER CONDITIONS: Sunny, clear skies, warm ~ 70°F - 75°F
WIND: cool breeze ~ 5mph
PRIOR STORM EVENTS: N/A
DREDGE UPDATE: Dredging started @ 800 am - disposal of material into scow "Mighty Quinn"
TYPE OF WATER QUALITY MONITORING: DREDGE DISPOSAL

Dredge Water Quality Monitoring Form

Apex Companies, LLC

re-dredge warm

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
090308-00-1-2	2695930	0810	10'	2'	2.5	N/A	Flood	100'	00
090308-00-1-5	815628	0812	↓	5'	3.3				
090308-00-1-8		0813		8'	4.8				
			AVERAGE TURBIDITY:						
090308-02-1-2	2695618	1054	15'	2'	4.1	N/A	Flood	200'	02
090308-02-1-6	815603	1055	↓	6'	4.2				
090308-02-1-13		1056		13'	4.0				
			AVERAGE TURBIDITY:						
090308-04-1-2	2696258	1305	10'	2'	1.7	N/A	Ebb	200'	04
090308-04-1-4	815241	1306	↓	4'	2.0				
090308-04-1-8		1307		8'	1.2				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
* 090308-00-9-2	2696257	0805	30'	2'	1.8	N/A	Flood	100'	00
090308-00-9-15	815472	0806	↓	15'	7.8				
090308-00-9-28		0807		28	48.2				
			TURBIDITY INCREASE:						
090308-02-9-2	2696430	1102	13'	2'	1.2	N/A	Flood	200'	02
090308-02-9-6	818244	1103	↓	6'	1.8				
090308-02-9-11		1104		11'	2.8				
			TURBIDITY INCREASE:						
090308-04-9-2	2695797	1317	39'	2'	10.2	N/A	Ebb	200'	04
090308-04-9-18	815299	1318		18'	4.7				
090308-04-9-37		1319	↓	37'	7.5				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex Companies, LLC

PROJECT: New Bedford Harbor: Bottom of CAD #2
JOB NUMBER: 6615.006.01
DATE: 9/11/09
MONITORS: SM & BB
WEATHER CONDITIONS: Sunny, cool, trace clouds ~ 60°F / 70's in afternoon
WIND: Cool, slight breeze
PRIOR STORM EVENTS: N/A
DREDGE UPDATE: Dredging
TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL

Tides - Hi: 0530; 1754
Lo: 11:12; N/A

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
091108-00-1-2		0822	11'	2'	1.2	N/A	Ebb	150'	00
091108-00-1-5		0824	↓	5'	1.1				
091108-00-1-9		0825	↓	9'	2.6				
			AVERAGE TURBIDITY:						
091108-02-1-2		1040	7'	2'	1.8	N/A	Ebb	200'	02
091108-02-1-4		1042	↓	4'	1.2				
091108-02-1-6		1043	↓	6'	2.0				
			AVERAGE TURBIDITY:						
091108-04-1-2		1300	30'	2'	1.9	N/A	Flood	200'	04
091108-04-1-15		1301	↓	15'	1.2				
091108-04-1-28		1302	↓	28'	0.9				
			AVERAGE TURBIDITY:						
091108-07-1-2		1642	32'	2'	1.7	N/A	Flood	200'	07
091108-07-1-15		1643	↓	15'	1.3				
091108-07-1-30		1644	↓	30'	4.0				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
091108-00-9-2		0849	35'	2'	8.2	N/A	Ebb	200'	00
091108-00-9-17		0851	↓	17'	3.9				
091108-00-9-33		0853	↓	33'	1.9				
			TURBIDITY INCREASE:						
091108-02-9-2		1032	36'	2'	1.8	N/A	Ebb	200'	02
091108-02-9-18		1033	↓	18'	2.0				
091108-02-9-34		1034	↓	34'	1.1				
			TURBIDITY INCREASE:						
091108-04-9-2		1305	7'	2'	2.3	N/A	Flood	200'	04
091108-04-9-4		1306	↓	4'	1.5				
091108-04-9-6		1307	↓	6'	1.4				
			TURBIDITY INCREASE:						
091108-07-9-2		1650	10'	2'	1.2	N/A	Flood	200'	07
091108-07-9-4		1651	↓	4'	1.5				
091108-07-9-8		1652	↓	8'	0.7				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex Companies, LLC

PROJECT: New Bedford Harbor: Bottom of CAD #2
JOB NUMBER: 6615.006.01
DATE: 9/16/08
MONITORS: JM + MB
WEATHER CONDITIONS: Cool, cloudy, 65°F
WIND: light breeze
PRIOR STORM EVENTS: N/A
DREDGE UPDATE: Disposal into CAD @ 1000 hrs
TYPE OF WATER QUALITY MONITORING: (DREDGE) / DISPOSAL

TIDES: Hi = 0901; 2125
Lo = 0224; 1454

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
091608-00-1-2	2695820	0950	35'	2'	1.8	N/A	Ebb	200'	00
091608-00-1-17	815384	0951	↓	17'	1.5				
091608-00-1-33		0952		33'	1.2				
			AVERAGE TURBIDITY:		1.5 NTU				
091608-02-1-2	2695930	1150	23'	2'	8.1	N/A	Ebb	200'	02
091608-02-1-11	816365	1151	↓	11'	9.2				
091608-02-1-21		1152		21'	9.1				
			AVERAGE TURBIDITY:		3.5 NTU				
091608-04-1-2	2695873	1441	6'	2'	10.9	N/A	Ebb	200'	04
091608-04-1-4	815402	1442	↓	4'	10.3				
091608-04-1-5		1443		5'	9.4				
			AVERAGE TURBIDITY:						
091608-06-1-2	2696074	16:20 ~~16:00~~	10'	2	3.0	N/A	Flood	200'	06
091608-06-1-	815433	16:21 ~~16:01~~	10'	5	6.3				
091608-06-1-		16:22 ~~16:02~~	10'	8	6.7				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
091608-00-9-2	2696556	1000	9'	2'	2.4	N/A	Ebb	200'	00
091608-00-9-4	815253	1000	↓	4'	2.2				
091608-00-9-6		1003		6'	2.2				
			TURBIDITY INCREASE:		2.3 NTU				
091608-02-9-2	2696552	1156	10'	2'	1.5	N/A	Ebb	200'	02
091608-02-9-4	815366	1157		4'	1.7				
091608-02-9-8		1158	↓	8'	1.8				
			TURBIDITY INCREASE:		1.7 NTU				
091608-04-9-2	2696548	1430	9'	2'	2.3	N/A	Ebb	200'	04
091608-04-9-4	815311	1431		4'	4.4				
091608-04-9-7		1432	↓	7'	4.1				
			TURBIDITY INCREASE:						
091608-06-9-2	2696485	1616	8'	2'	2.3	N/A	Flood	200'	06
091608-06-9-	815432	1618		4'	5.4				
091608-06-9-		1619	↓	6'	6.5				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex Companies, LLC

PROJECT: New Bedford Harbor: Bottom of CAD #2
JOB NUMBER: 6615.006.01
DATE: 9/18/08
MONITORS: JM + MB
WEATHER CONDITIONS: Windy, cloudy ~ 60°F
WIND: Windy - 10mph
PRIOR STORM EVENTS: N/A
DREDGE UPDATE:
TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL

Down-current

~~UP-CURRENT~~

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
091808-00-1-2	2695789	1140	38'	2'	1.3	N/A	Ebb	200'	00
091808-00-1-16	815295	1141	↓	16'	0.9				
091808-00-1-36		1142	↓	36'	1.2				
			AVERAGE TURBIDITY:						
09180804-1-2	2695792	1536	32'	2'	4.3	N/A	Ebb	200'	04
091808-04-1-16	815361	1537	↓	16'	3.1				
091808-04-1-30		1538	↓	30'	2.2				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

up-current

~~DOWN-CURRENT~~

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
091808-00-9-2	2695342	1150	10'	2'	2.2	N/A	Ebb	200'	00
091808-00-9-4	815058	1152	↓	4'	1.8				
091808-00-9-8		1153	↓	8'	2.3				
			TURBIDITY INCREASE:						
091808-04-9-2	2696291	1545	30'	2'	2.7	N/A	Ebb	200'	04
091808-04-9-	815359	1546	↓	15'	4.1				
091808-04-9-		1547	↓	28'	3.9				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex

PROJECT: 6615.007 New Bedford Harbor - Navigational Dredging @ NBRF
JOB NUMBER: 6615.007.01
DATE: 3/25/09
MONITORS: JER
WEATHER CONDITIONS: SUNNY 40°F Clear, 10-15 Mph winds from NE
WIND: 10-15 mph
PRIOR STORM EVENTS: Gusty winds yesterday
DREDGE UPDATE: First scow filled yesterday First dump today.
TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL
TIDE High: 07:49, 20:02 Low: 01:23, 13:30

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
032509_DI_000_1_03	2696591, 815343	11:25	10ft	2ft	1.38	N/A	Ebb	15ft N of silt curtain	0
032509_DI_000_1_05		11:25		5ft	0.70				
032509_DI_000_1_08		11:25		8ft	1.21				
			AVERAGE TURBIDITY:		1.10				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
032509_DI_010_9_02	2695978, 815546	12:25	8ft	2ft	1.00	N/A	Ebb	15ft S of silt curtain	0
032509_DI_010_9_04		12:25		4ft	0.64				
032509_DI_010_9_06		12:25		6ft	9.12				
			TURBIDITY INCREASE:		NTU AVG. 3.59 → 2.49				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex Companies, LLC

PROJECT: New Bedford Harbor - Navigational Dredging @ NBRF
JOB NUMBER: 6615.007.01
DATE: 3/27/09
MONITORS: JER / JM
WEATHER CONDITIONS: RAIN last night, overcast today
WIND: Very strong 20-25 gusts
PRIOR STORM EVENTS:
DREDGE UPDATE: Continuing Cut 1 @ NBRF
TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL
TIDE High: 0907 21:20 Low: 02:42 14:39

* Comments: After observing above normal readings up-current + predisposal, Apex re-calibrated YSI 6920. Readings appeared normal thereafter.

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
* 032709_DI_000_1_02	2696587, 815334	12:00	7ft	2ft	54.9	N/A	Ebb	15ft N of silt curtain	0
032709_DI_000_1_04		12:03		4ft	55.3				
032709_DI_000_1_05		12:05		5ft	59.1				
			AVERAGE TURBIDITY:						
032709_DI_000_1_02	2696580, 815326	12:20	10ft	2ft	0.2	N/A	Ebb	15ft N of silt curtain	0
032709_DI_000_1_05		12:21		5ft	0.3				
032709_DI_000_1_08		12:23		8ft	0.8				
			AVERAGE TURBIDITY:		0.4				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
032709_DI_000_9_02	2695981, 815346	12:15	9ft	2ft	0.0	N/A	Ebb	15ft S. of silt curtain	0
032709_DI_000_9_04		12:17		4ft	0.1				
032709_DI_000_9_07		12:18		7ft	0.2				
			TURBIDITY INCREASE:		0.1				
032709_DI_000_9_02	2695995, 815380	12:31	9ft	2ft	0.1	N/A	Ebb	15ft S of silt curtain	0
032709_DI_000_9_04		12:33		4ft	0.2				
032709_DI_000_9_07		12:35		7ft	0.7				
			TURBIDITY INCREASE:		0.3				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: New Bedford Harbor - Navigational Dredging @ upper harbor cc boat house

JOB NUMBER: 6615.007.01

DATE: 4/5/09

MONITORS: JM/JR

WEATHER CONDITIONS: sunny, windy trace clouds ~ 40°F

WIND: 10-15 mph east

PRIOR STORM EVENTS: N/A

DREDGE UPDATE: No dredging today (dump sat for a week)

TYPE OF WATER QUALITY MONITORING: DREDGE / (DISPOSAL)

TIDE: (Slack) (Flood) High: 5:02; 17:32 Low: 11:56; 23:41

Dredge Water Quality Monitoring Form

Apex Companies, LLC

UP-CURRENT (Pre-disposal)

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
040509-D1-1-2	2695847	11:40	10'	2	1.59	N/A	slack/flood	15' from silt curtain	No dredge today
040509-D1-1-4	815652	11:47		4	1.71				
040509-D1-1-8		11:52		8	1.35				
			AVERAGE TURBIDITY:		1.55 NTU				
040509-D1-1-2	2695847	11:42	10'	2	0.2	N/A	slack/flood	15'	N/A
040509-D1-1-4	815652	11:43		4	0.5				
040509-D1-1-8		11:44		8	0.6				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

Disposal @ 11:55 AM into CAD 2

DOWN-CURRENT (post-disposal)

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
040509-D1-9-2	2696576	13:00	11'	2	1.32	N/A	Flood	15' from silt curtain	No dredge today
040509-D1-9-5	815416	13:10		5	2.82				
040509-D1-9-9		13:20		9	1.06				
			TURBIDITY INCREASE:		1.93 NTU (Avg)				
(Turbidity increase = 1.93 - 1.55 = 0.18 NTU increase)									
040509-D1-9-2	2696576	13:02	11'	2	0.2	N/A	Flood	15'	N/A
040509-D1-9-5	815416	13:11		5	2.3				
040509-D1-9-9		13:21		9	3.8				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex Companies, LLC

PROJECT: New Bedford Harbor - Navigational Dredging @
JOB NUMBER: 6615.007.01
DATE: 4/8/09
MONITORS: JFR / JM / CM
WEATHER CONDITIONS: 40°F
WIND: 20-25 from the SW
PRIOR STORM EVENTS: RAIN Delivery 2 days
DREDGE UPDATE: No dredging 4/9/09, to resume 4/10/09
TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL
TIDE High: Low:

upstream

UP-CURRENT

Monitoring ID #	~~NORTHING/EASTING~~ LAT LONG	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	41 38 46.1	13:20	9ft	2 ft	3.42	N/A	Slack/ Flood	Disposal 15 ft	0
	070 55 02.9	13:20		5 ft	3.01				
		13:20		7 ft	2.39				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

downstream
turned direction
uncurrent

DOWN-CURRENT

Monitoring ID #	~~NORTHING/EASTING~~ LAT LONG	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	41 38 45.3	1335	10ft.	2 ft	2.05	N/A	Slack/ Flood	At silt curtain	0
	070 55 0.4	1335		5 ft	2.38				
		1335		8 ft	2.88				
			TURBIDITY INCREASE:						
	41 38 40	1358	10 ft	2 ft	1.54	N/A	Slack/ Flood	At silt curtain	0
	070 54 60	1358		5 ft	1.71				
		1358		8 ft	2.69				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: New Bedford Harbor - Navigational Dredging @ New Bedford Plowing Facility

JOB NUMBER: 6615.007.01

DATE: 4/10/09

MONITORS: JEK / JEK

WEATHER CONDITIONS:

WIND:

PRIOR STORM EVENTS:

DREDGE UPDATE:

TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL

TIDE High: Low:

Dredge Water Quality Monitoring Form

Apex Companies, LLC

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	2696590, 815416	14:15	8ft	2 ft	1.01	N/A	Ebb	15 ft	N/A
		14:15		4 ft	0.95				
		14:15		6 ft	1.34				
			AVERAGE TURBIDITY:		1.1				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	41,38,40, 070,54,60	14:35	6ft	2 ft	0.95	N/A	Ebb	15 ft	N/A
		14:35		3 ft	0.87				
		14:35		4 ft	1.31				
			TURBIDITY INCREASE:		1.04				
	2696530, 815550	14:50	11ft	2ft	0.76	N/A	Ebb	15 ft	N/A
		14:50		5.5ft	1.89				
		14:50		9ft	1.38				
			TURBIDITY INCREASE:		1.33				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: New Bedford Harbor - Navigational Dredging @ NBRF

JOB NUMBER: 6616.007.01

DATE: 4/13/09

MONITORS: JER

WEATHER CONDITIONS:

WIND:

PRIOR STORM EVENTS:

DREDGE UPDATE:

TYPE OF WATER QUALITY MONITORING: DREDGE / ~~[illegible]~~

TIDE High: 11:16, 23:36 Low: 04:28, 16:18

Dredge Water Quality Monitoring Form

Apex Companies, LLC

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	2701537 815055	14:20	5ft	2ft	0.67	N/A	Ebb	200ft	4
		14:20		3ft	0.97				
		14:20		4ft	1.49				
			AVERAGE TURBIDITY:		1.04				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	2700876 815165	14:45	6ft	2ft	1.46	N/A	Ebb	200ft	4
		14:45		3ft	2.27				
		14:45		4ft	1.51				
			TURBIDITY INCREASE:		1.75				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: New Bedford Harbor - Navigational Dredging @ NBRF

JOB NUMBER: 6616.007.01

DATE: 4/14/09

MONITORS: JER/JEK

WEATHER CONDITIONS:

WIND:

PRIOR STORM EVENTS:

DREDGE UPDATE:

TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL

TIDE High: Low:

Dredge Water Quality Monitoring Form

Apex Companies, LLC

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	2696002, 815431	17:00	6ft	2 ft	1.84	NA	Flood	15 ft	N/A
		17:00		3 ft	7.60				
		17:00		4 ft	1.46				
			AVERAGE TURBIDITY:		3.63				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	2696590, 815416	17:30	9ft	2 ft	3.11	NA	Flood	15ft	N/A
		17:30		5 ft	2.09				
		17:30		7 ft	1.96				
			TURBIDITY INCREASE:		2.39				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: New Bedford Harbor - Navigational Dredging @ ~~NB~~ Gifford St.

JOB NUMBER: 6615.007.01

DATE: 4/21/09

MONITORS: EJR

WEATHER CONDITIONS:

WIND:

PRIOR STORM EVENTS:

DREDGE UPDATE:

TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL

TIDE High: Low:

Dredge Water Quality Monitoring Form

Apex Companies, LLC

Dump Time 10:50AM

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	2696496, 815561	10:14	11ft	2ft	2.38	N/A	Ebb	15ft	0
		10:14		6ft	2.33				
		10:14		9ft	1.93				
			AVERAGE TURBIDITY:		2.21				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	2695981, 815438	11:00	7ft	2ft	6.51	N/A	Ebb	15ft	0
		11:00		3.5ft	3.07				
		11:00		5ft	5.54				
			TURBIDITY INCREASE:		5.05				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex Companies, LLC

PROJECT: New Bedford Harbor - Navigational Dredging @ Gifford St
JOB NUMBER: 8615.007.01
DATE: 4/22/09
MONITORS: JER
WEATHER CONDITIONS:
WIND:
PRIOR STORM EVENTS:
DREDGE UPDATE:
TYPE OF WATER QUALITY MONITORING: (DREDGE) / (DISPOSAL)
TIDE High: Low:

Dump Time @ 08:20

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	2696534 815509	0815	12ft	2	1.7	N/A	Ebb	Disposal 15ft	0
		0815		6	2.0				
		0815		10	1.4				
			AVERAGE TURBIDITY:		1.7				
	2688216, 816526	1335	8ft	2	2.2	N/A	Flood	Dredging 200ft	2
		1335		4	1.7				
		1335		6	2.8				
			AVERAGE TURBIDITY:		2.23				
	2688264, 816760	13:50	7ft	2	2.1	N/A	Flood	Dredging 200ft	2
		13:50		4	1.3				
		13:50		5	1.4				
			AVERAGE TURBIDITY:		1.6				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

additional up-current location

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	2695979, 815541	0828	12ft	2	4.3	N/A	Ebb	Disposal 15ft	0
		0828		6	4.5				
		0828		10	3.7				
			TURBIDITY INCREASE:		4.07				
	2687447, 816561	14:10	6ft	2	1.4	N/A	Flood	Dredging 200ft	2
		14:10		3	2.0				
		14:10		4	3.1				
			TURBIDITY INCREASE:		2.17				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Gifford St/South Terminal

Dredge Water Quality Monitoring Form

Apex Companies, LLC

PROJECT: New Bedford Harbor - Navigational Dredging @

JOB NUMBER: 8615.007.01

DATE: 4/23/09

MONITORS: CMD

WEATHER CONDITIONS:

WIND:

PRIOR STORM EVENTS:

DREDGE UPDATE:

TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL

TIDE High: Low:

Dump C 07:35

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	41°38' 45.5" 70° 55' 03.2"		12ft	2	3.2	N/A			0
				6	1.8				
				10	1.5				
			AVERAGE TURBIDITY:		1.83				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	41° 38' 39.9" 070° 55' 02.6"		12ft	2	1.8	N/A			0
				6	2.0				
				10	2.2				
			TURBIDITY INCREASE:		2.0				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex Companies, LLC

PROJECT: New Bedford Harbor - Navigational Dredging @ Gifford St / South Terminal
JOB NUMBER: 6616.007.01
DATE: 4/24/09
MONITORS:
WEATHER CONDITIONS:
WIND:
PRIOR STORM EVENTS:
DREDGE UPDATE:
TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL
TIDE High: Low:

Dump Time @ 09:25

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	2696565, 815460	0835	12ft	2	1.6	N/A	Ebb	15ft	0
		0835		6	1.6				
		0835		10	1.1				
			AVERAGE TURBIDITY:		1.43				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	2695951, 815514	0935	8ft	2	1.5	N/A	Ebb	15ft	0
		0935		4	1.8				
		0935		6	1.9				
			TURBIDITY INCREASE:		1.73				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: New Bedford Harbor - Navigational Dredging @ Gifford St / South Terminal

Dredge Water Quality Monitoring Form

JOB NUMBER: 8615.007.01

DATE: 4/26/09

MONITORS: JER

WEATHER CONDITIONS:

WIND:

PRIOR STORM EVENTS:

DREDGE UPDATE:

TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL

TIDE High: Low:

Dump Time @ 12:45

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	2696555, 815424	1225	8ft	2	0.85	N/A	Ebb	15ft	N/A
		1225		4	0.80				
		1225		6	0.85				
			AVERAGE TURBIDITY:		0.833				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	2696112, 815663	1305	6ft	2	1.0	N/A	Ebb	15ft	N/A
		1305		3	1.5				
		1305		4	1.6				
			TURBIDITY INCREASE:		1.37				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex Companies, LLC

PROJECT: New Bedford Harbor - Navigational Dredging @
JOB NUMBER: 6615.007.01
DATE: 5/4/09
MONITORS: CMD
WEATHER CONDITIONS:
WIND:
PRIOR STORM EVENTS:
DREDGE UPDATE:
TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL
TIDE High: Low:

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
		1130	10ft	1.5	7.1	N/A			N.A
		1130		4	0.97				
		1130		9	1.0				
			AVERAGE TURBIDITY:		3.02				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
			11ft	3	2.7	NA			NA
				6	0.1				
				9	0.87				
			TURBIDITY INCREASE:		1.22				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex Companies, LLC

PROJECT: New Bedford Harbor - Navigational Dredging @ Gifford St
JOB NUMBER: 9615.007.01
DATE:
MONITORS: SEP
WEATHER CONDITIONS:
WIND:
PRIOR STORM EVENTS:
DREDGE UPDATE:
TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL
TIDE High: Low:

Dump Time 11:50

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	2696505, 815523	11:45	9ft	2	2.3	NA	Ebb	Disposal 75ft	N/A
		11:45		5	1.5				
		11:45		7	1.3				
			AVERAGE TURBIDITY:		1.7				
	2687140, 816400	16:45	5ft	2	2.5	N/A		Dredge 200ft	4
		16:45		3	2.7				
		16:45		4	2.3				
			AVERAGE TURBIDITY:		2.5				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	2696001, 815563	12:01	10ft	2	1.4	NA	Ebb	Disposal 75ft	NA
		12:01		5	1.2				
		12:01		8	2.5				
			TURBIDITY INCREASE:		1.8				
	2686910, 816474	16:58	6ft	2	13	NA		Dredge 200ft	4
		16:58		3	14				
		16:58		4	16				
			TURBIDITY INCREASE:		14.3				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: New Bedford Harbor - Navigational Dredging @ South Terminal

JOB NUMBER: 6616.007.01

DATE: [illegible]

MONITORS: JEG.

WEATHER CONDITIONS:

WIND:

PRIOR STORM EVENTS:

DREDGE UPDATE:

TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL

TIDE High: Low:

Dredge Water Quality Monitoring Form

Apex Companies, LLC

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	3rd piling South of Apex pk nail at South boundary of Schuster prop.	1500	10ft	2	11	N/A	Flood	200ft	
		1500		5	13				
		1500		8	15				
			AVERAGE TURBIDITY:		13				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	Third Cleat North of Schuster prop. boundary fence.	1520	18ft	2	1.9	N/A	Flood	200ft	
		1520		9	1.8				
		1520		16	4.5				
			TURBIDITY INCREASE:		2.73				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex Companies, LLC

PROJECT:	New Bedford Harbor - Navigational Dredging @ Tonnesson Park
JOB NUMBER:	6615.007.01
DATE:	5/13/09
MONITORS:	JER / GCD
WEATHER CONDITIONS:	
WIND:	
PRIOR STORM EVENTS:	
DREDGE UPDATE:	
TYPE OF WATER QUALITY MONITORING:	DREDGE / DISPOSAL
TIDE	High: Low:

Up & Down Same Position (No other outlet) during dredging

Dump Time @ 13:36

UP-CURRENT / Down-Current (SAME)

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	2692827, 814866	1037	31'	2	1.7	N/A	Flood	200ft	1
		1037		16	1.2				
		1037		29	1.1				
			AVERAGE TURBIDITY:		1.33				
			AVERAGE TURBIDITY:						
	2696532, 815465	1330	10ft	2	1.8	N/A	Ebb	15 ft Disposal	N/A
		1330		5	1.3				
		1330		8	1.0				
			AVERAGE TURBIDITY:		1.37				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
	2696040, 815593	1350	13ft	2	1.4	N/A	Ebb	15ft Disposal	N/A
		1350		7	1.4				
		1350		11	1.6				
			TURBIDITY INCREASE:		1.47				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

PROJECT:	New Bedford Harbor - Navigational Dredging @
JOB NUMBER:	6615.007.01
DATE:	5/14/09
MONITORS:	EIC
WEATHER CONDITIONS:	
WIND:	
PRIOR STORM EVENTS:	
DREDGE UPDATE:	
TYPE OF WATER QUALITY MONITORING:	DREDGE / DISPOSAL
TIDE High:	Low:

Dump Time @ 08:35

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	2695994, 815492	0820	10 ft	2	0.20	N/A	Flood	25 ft	N/A
		0820		5	1.0				
		0820		8	0.60				
			AVERAGE TURBIDITY:		0.60				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	2696544, 815417	0845	10 ft	2	0.5	N/A	Flood	15 ft	N/A
		0845		5	2.5				
		0845		8	3.8				
			TURBIDITY INCREASE:		2.27				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

PROJECT: New Bedford Harbor - Navigational Dredging @ Union Wharf
JOB NUMBER: 8615.007.01
DATE: 5/16/09
MONITORS:
WEATHER CONDITIONS:
WIND:
PRIOR STORM EVENTS:
DREDGE UPDATE:
TYPE OF WATER QUALITY MONITORING: DREDGE DISPOSAL
TIDE High: Low:

Two Down Current locations Taken

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	2692082, 817859	12:30	20ft	2	0.52	N/A	Flood	Dredge 200 ft	2
		12:30		9	1.65				
		12:30		18	4.09				
			AVERAGE TURBIDITY:		2.09				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
		13:15	6ft	2	0.27	N/A	Flood	200 ft	2
		13:15		4	0.81				
		13:15		5	0.75				
			TURBIDITY INCREASE:		0.61				
	2692385, 817660	1325	23ft	2	0.48	N/A	Flood	200 ft	2
		1325		10	0.65				
		1325		21	0.70				
			TURBIDITY INCREASE:		0.61				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: New Bedford Harbor - Navigational Dredging @ Gifford St. (G1)
JOB NUMBER: 6615.007.01
DATE: 5/20/09
MONITORS:
WEATHER CONDITIONS:
WIND:
PRIOR STORM EVENTS:
DREDGE UPDATE:
TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL
TIDE High: Low:

Dredge Water Quality Monitoring Form

Apex Companies, LLC

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	2687551, 816571	1400	6ft	2	5.95	N/A	Flood	200ft	6
		1400		3	6.95				
		1400		4	52.0				
			AVERAGE TURBIDITY:		21.6				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	2688188, 816578	1420	9ft	2	4.38	N/A	Flood	200ft	6
		1420		5	1.23				
		1420		7	3.55				
			TURBIDITY INCREASE:		3.19				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

Apex Companies, LLC

PROJECT: New Bedford Harbor - Navigational Dredging @
JOB NUMBER: 6615.007.01
DATE: 5/22/09
MONITORS: JR and JM
WEATHER CONDITIONS: Sunny, 70°F, clear
WIND: 5mph
PRIOR STORM EVENTS: N/A
DREDGE UPDATE:
TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL
TIDE High: 06:50 Low:

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
052209-D1-1-2	2696530	0800	11'	2'	1.25	N/A	Ebb	5'	00
052209-D1-1-5	815461	0801		5'	6.73				
052209-D1-1-9		0802		9'	8.44				
			AVERAGE TURBIDITY:						
Disposal @ 8:05 AM									
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
052209-D1-9-2	2696007	08:15	12'	2'	0.60	N/A	Ebb	5'	00
052209-D1-9-	815544	08:17		6'	0.05				
052209-D1-9-		08:18		10'	0.29				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: 6615 New Bedford Harbor - Navigational Dredging @ LINBERG MARINE

JOB NUMBER: 6615.007.01

DATE: 5/28/09

MONITORS: JK / MB

WEATHER CONDITIONS:

WIND:

PRIOR STORM EVENTS:

DREDGE UPDATE:

TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL

TIDE High: 11:55, Low: 0530 : 1449 17:11

Dredge Water Quality Monitoring Form

Apex Companies, LLC

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	818006, 2693407	1013 1013 1013	18ft	2 ft 9 ft 16 ft	0.80 0.64 1.84	N/A	Flood	< 200 ft from dredge	< 1
			AVERAGE TURBIDITY:						
	2696681 815506	1400 1400 1400	12ft	2 ft 6 ft 10 ft	0.[illegible] 1.55 1.10	N/A	Ebb	Tied to silt curtain	N/A Disposal
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	2693690 817838	1025 1025 1025	16ft	2 ft 8 ft 14 ft	1.60 2.11 1.85	N/A	Flood	<200 ft from dredge	< 1
			TURBIDITY INCREASE:						
	2695989, 815375	1445 1445 1445	10ft	2 ft 5 ft 8 ft	1.22 0.65 3.27	N/A	Ebb	Tied to silt curtain	N/A Disposal
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: 6615 New Bedford Harbor - Navigational Dredging @ Linberg Marine
JOB NUMBER: 5615.007.01
DATE: 6/4
MONITORS: JEE
WEATHER CONDITIONS:
WIND:
PRIOR STORM EVENTS:
DREDGE UPDATE:
TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL
TIDE High: Low:

Dredge Water Quality Monitoring Form

Apex

Atlantic dredging @ Linberg Marine

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	2693365, 817998	1435	18ft	2	1.4	N/A	Flood	←	<15ft from silt curtain ~~[illegible]~~ ←4
		1435		9	1.8				
		1435		16	1.6				
			AVERAGE TURBIDITY:		1.6				
	2695984, 815501	1620	12ft	2	2.2	N/A	Flood	<15 from curtain	Disposal
		1620		6	1.4				
		1620		10	2.1				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	2693747, 817884	1452	12ft	2	1.4	N/A	Flood	<15 ft	4
		1452		6	3.1				
		1452		10	6.1				
			TURBIDITY INCREASE:						
	2696542, 816460	1655	13ft	2	4.2	N/A	Flood	<15 ft from curtain	Disposal
		1655		7	1.8				
		1655		11	3.4				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: 6605 New Bedford Harbor - Navigational Dredging @ LINBERG MARINE

JOB NUMBER: 0615.007.01

DATE: 6/16/09

MONITORS: JER

WEATHER CONDITIONS:

WIND:

PRIOR STORM EVENTS:

DREDGE UPDATE:

TYPE OF WATER QUALITY MONITORING: (DREDGE) / DISPOSAL

TIDE High: 07:41, 2003 Low: 01:20, 12:42

Omega Water Quality Monitoring Form

Apex Companies, LLC

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	2693349 818016	1405	19ft	2	1.5	N/A	Flood	<15 ft from curtain	<1
		1405		10	1.1				
		1405		17	1.8				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	2693626, 817905	1430	13ft	2 ft	2.4	N/A	Flood	<15 ft from silt curtain	<1
		1430		6 ft	6.9				
		1430		11 ft	2.0				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: 6615 New Bedford Harbor - Navigational Dredging @ Disposal
JOB NUMBER: 6615.007.01
DATE: 6/12
MONITORS: JER
WEATHER CONDITIONS:
WIND:
PRIOR STORM EVENTS:
DREDGE UPDATE:
TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL
TIDE High: 11:48, 23:59 Low: 05:03, 17:02

Dredge Water Quality Monitoring Form

Apex Companies, LLC

Disposal

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	2695988, 815498	8:40	11ft	2 ft	2.2	N/A	Flood	Tied to silt curtain	N/A
		8:40		5 ft	2.0				
		8:40		9 ft	5.0				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	2696518, 815512	0915	12ft	2 ft	2.5	N/A	Flood	Tied to silt curtain	N/A
		0915		6 ft	2.1				
		0915		10 ft	4.9				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: 6615 New Bedford Harbor - Navigational Dredging @ Warren Alexander - South

JOB NUMBER: 6615.007.01

DATE: 6/17/09

MONITORS: MB

WEATHER CONDITIONS:

WIND:

PRIOR STORM EVENTS:

DREDGE UPDATE:

TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL

TIDE High: 2:14, 14:46 Low: 9:58, 21:00

Dredging @ Warren Alexander South

Dredge Water Quality Monitoring Form

Apex Companies, LLC

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	2692093, 818052	15:25	20ft	2 ft	2.68	N/A	Ebb	< 200 ft from dredge	2
		14:25		10 ft	2.90				
		15:25		18 ft	2.92				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	2692020, 818005	15:40	20ft	2 ft	5.60	N/A	Ebb	< 200 ft from dredge	2
		15:40		10 ft	2.74				
		15:40		18 ft	3.80				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredge Water Quality Monitoring Form

PROJECT:	New Bedford Harbor - Navigational Dredging @
JOB NUMBER:	6615.007.01
DATE:	061809
MONITORS:	MLG
WEATHER CONDITIONS:	COOL CLOUDY 60°
WIND:	5-10 Knots southwest
PRIOR STORM EVENTS:	
DREDGE UPDATE:	
TYPE OF WATER QUALITY MONITORING:	DREDGE / (DISPOSAL)
TIDE High:	Low:

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION (NOSC)	NUMBER OF HOURS DREDGING
061809-20'	2692082	0830	20'	2	.68			50'	
061809-10'		0835		9	1.22				
061809-20'	817869	0840		18	.71				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN (NOSC)	NUMBER OF HOURS DREDGING
061809-DC	2692261	0910	23'	2'	.58			50'	
061809-DC		0915		12.5'	1.61				
061809-DC	817632	0925		21'	1.72				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: 6615 New Bedford Harbor - Navigational Dredging @ Old North Wharf (North Bridge)

Dredge Water Quality Monitoring Form

JOB NUMBER: 6615.007.01

DATE: 6/22

MONITORS:

WEATHER CONDITIONS:

WIND:

PRIOR STORM EVENTS:

DREDGE UPDATE:

TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL

TIDE High: 8:01, 16:24 Low: 01:50, 13:20

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	2693532, 818082	11:19	17ft	2ft	2.29	N/A	Ebb	~200 ft from dredge	1
		11:15		9ft	0.32				
		11:16		15ft	1.80				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	2693488, 818090	11:35	18ft	2ft	0.90	N/A	Ebb	~200 ft from dredge	1
		11:35		9ft	1.26				
		11:35		16ft	0.85				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: 6615 New Bedford Harbor - Navigational Dredging @ Clifford St. (G2)
JOB NUMBER: 6615.007.01
DATE: 6/24
MONITORS: JEP
WEATHER CONDITIONS:
WIND:
PRIOR STORM EVENTS:
DREDGE UPDATE:
TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL
TIDE High: 9:47, 22:09 Low: 03:36, 15:13

Dredge Water Quality Monitoring Form

APEX Companies, LLC

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	2687124, 816392	1010	5ft	2 ft	4.23	N/A	Ebb	< 200 ft from dredge	
		1010		3 ft	2.85				
		1010		4 ft	6.55				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	2687451, 816412	1025	7ft	2 ft	10.94	N/A	Ebb	< 200 ft from dredge	
		1025		4 ft	8.72				
		1025		5 ft	12.33				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: 605 New Bedford Harbor - Navigational Dredging @ Coffin St (G-1)
JOB NUMBER: 6616.007.01
DATE: 7/2/09
MONITORS:
WEATHER CONDITIONS:
WIND:
PRIOR STORM EVENTS:
DREDGE UPDATE:
TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL
TIDE High: 04:40, 17:10 Low: 10:09, 23:49

Dredge Water Quality Monitoring Form

Apex Companies, LLC

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	2087527, 816470	16:45	12ft	2ft	0.65	N/A	Flood	<200 ft from bridge	1
		16:45		6ft	1.88				
		16:45		10ft	4.30				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	2087121, 816415	17:15	11ft	2ft	5.58	N/A	Flood	<200 ft from bridge	1
		17:15		6ft	4.89				
		17:15		9ft	5.23				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: 6615 New Bedford Harbor - Navigational Dredging @
JOB NUMBER: 6615.007.01
DATE: 7/8/07
MONITORS: JER
WEATHER CONDITIONS:
WIND:
PRIOR STORM EVENTS:
DREDGE UPDATE:
TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL
TIDE High: 9:20, 21:59 Low: 02:52, 14:37

Dredge Water Quality Monitoring Form

Apex Companies, LLC

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	2696529, 815466	11:55 11:55 11:55	12ft	2 ft 6 ft 10 ft	2.2 1.8 1.8	N/A	Ebb	< 200 ft	N/A - Disposal
			AVERAGE TURBIDITY:						
	2697848, 814584	14:33 14:33 14:33	9ft	2 ft 5 ft 9 ft	3.9 3.2 3.7	N/A	Ebb	< 200 ft	2
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	2696040, 815316	12:15 12:15 12:15	14ft	2 ft 7 ft 12 ft	2.0 1.6 1.9	N/A	Ebb	< 200 ft	N/A Disposal
			TURBIDITY INCREASE:						
	2697225, 814583	14:40 14:40 14:40	12ft	2 ft 6 ft 10 ft	16 NTU 20 NTU 18 NTU	N/A	Ebb	< 200 ft	2
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: 6615 New Bedford Harbor - Navigational Dredging @ Packer Marine
JOB NUMBER: 6615.007.01
DATE: 7/10/09
MONITORS: JCL
WEATHER CONDITIONS:
WIND:
PRIOR STORM EVENTS:
DREDGE UPDATE:
TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL
TIDE High: 1036, 22:49 Low: 04:02, 16:01

Dredge Water Quality Monitoring Form

Apex Companies, LLC

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	2697438, 814452	0930	18ft	2 ft	0.30	N/A	Flood	<200 ft from dredge	1
		0930		9 ft	1.22				
		0930		16 ft	0.68				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	2697663 814524	1015	16ft	2 ft	1.02	N/A	Flood	≈200 ft from dredge	1
		1015		8 ft	1.15				
		1015		14 ft	0.98				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: 6615 New Bedford Harbor - Navigational Dredging @ C-1 Gifford St.
JOB NUMBER: 6615.007.01
DATE: 7/15/09
MONITORS: JFR
WEATHER CONDITIONS:
WIND:
PRIOR STORM EVENTS:
DREDGE UPDATE:
TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL
TIDE High: 1:42, 15:24 Low: 07:06, 20:08

Dredge Water Quality Monitoring Form

Apex Companies, LLC

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	816454, 2687223	1358	6ft	2 ft	1.6	N/A	Flood	<200 ft from dredge	<1
		1358		3 ft	2.0				
		1358		4 ft	2.3				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	816413, 2687594	1405	8ft	2 ft	4.7	N/A	Flood	<200 ft from dredge	<1
		1405		4 ft	5.2				
		1405		6 ft	6.8				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: 6615 New Bedford Harbor - Navigational Dredging @ Warren Alexander South

JOB NUMBER: 6615.007.01

DATE: 7/17/09

MONITORS:

WEATHER CONDITIONS:

WIND:

PRIOR STORM EVENTS:

DREDGE UPDATE:

TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL

TIDE High: 03:36, 16:07 Low: 09:07, 22:44

Dredge Water Quality Monitoring Form

APEX

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	2697401, 814498	1346	19ft	2ft	1.46	N/A	Flood	<200ft from dredge	2
		1346		9ft	1.82				
		1346		17ft	3.11				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	2697641, 814482	1405	17ft	2ft	2.61	NA	Flood	~200 ft from dredge	2
		1405		8ft	0.96				
		1405		15ft	1.21				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: 6615 New Bedford Harbor - Navigational Dredging @ South Terminal
JOB NUMBER: 6615.007.01
DATE: 7/22/09
MONITORS:
WEATHER CONDITIONS:
WIND:
PRIOR STORM EVENTS:
DREDGE UPDATE:
TYPE OF WATER QUALITY MONITORING: (DREDGE) / DISPOSAL
TIDE High: 0836, 2100 Low: 0227, 1407

Dredge Water Quality Monitoring Form

Apex Companies, LLC

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME (1335)	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	2689034, 816181	1335	19ft	2ft	0.62	N/A	Ebb	≤200 ft from dredge	< 1
		1335		9ft	1.89				
		1335		17ft	5.27				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME (1400)	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	2688796, 816234	1400	21ft	2ft	2.84	NA	Ebb	≤200 ft from dredge	< 1
		1400		10ft	2.35				
		1400		19ft	3.71				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: 6015 New Bedford Harbor - Navigational Dredging @ South Terminal

JOB NUMBER: 6615.007.01

DATE: 7/23/09

MONITORS:

WEATHER CONDITIONS:

WIND:

PRIOR STORM EVENTS:

DREDGE UPDATE:

TYPE OF WATER QUALITY MONITORING: (DREDGE) / DISPOSAL

TIDE High: 9:28, [redacted] 21:51 Low: 03:14, 15:05

Dredge Water Quality Monitoring Form

Apex Companies, LLC

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	2688892, 876242	1530	22ft	2ft	2.16	NA	Ebb SLACK?	<200ft	<1
		1530		11ft	3.40				
		1530		20ft	6.89				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	2688596, 876326	1540	21ft	2ft	3.09	N/A	Ebb SLACK?	<200ft	<1
		1540		10ft	2.53				
		1540		19ft	3.48				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: 6615 New Bedford Harbor - Navigational Dredging @ South Terminal

JOB NUMBER: 5615.007.01

DATE: 7/28/09

MONITORS:

WEATHER CONDITIONS:

WIND:

PRIOR STORM EVENTS:

DREDGE UPDATE:

TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL

TIDE High: 1:18, 13:53 Low: 6:38, 20:01

Dredge Water Quality Monitoring Form

Apex Companies, LLC

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	816145, 2688807	0855	22ft	2ft	4.55	N/A	Flood	<200ft	<1
		0855		10ft	4.28				
		0855		20ft	5.03				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	816399, 2688456	0910	14ft	2 ft	5.61	N/A	Flood	<200ft	<1
		0910		7ft	3.28				
		0910		12ft	4.23				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: 6615 New Bedford Harbor - Navigational Dredging @ Gifford ST Cal

JOB NUMBER: 6615.007.01

DATE: 8/12/09

MONITORS:

WEATHER CONDITIONS:

WIND:

PRIOR STORM EVENTS:

DREDGE UPDATE:

TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL

TIDE High: 11:27, 12:24 Low: 5:42, 18:25

Dredge Water Quality Monitoring Form

Apex Companies, LLC

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	816380, 2687522	13:40	11 ft	2 ft	2.73	N/A	Flood	<200	<1
		13:40		5 ft	2.94				
		13:40		9 ft	3.03				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	816373, 2687136	14:30	8 ft	2 ft	4.30	N/A	Flood	<200	<1
		14:30		4 ft	4.36				
		14:30		6 ft	4.87				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: 6615 New Bedford Harbor - Navigational Dredging @ SOUTH TERMINAL

JOB NUMBER: 6615.007.01

DATE: 8/13/09

MONITORS:

WEATHER CONDITIONS:

WIND:

PRIOR STORM EVENTS:

DREDGE UPDATE:

TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL

TIDE High: 1:17, 13:47 Low: 6:28, 19:31

Dredge Water Quality Monitoring Form

Apex Companies, LLC

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	816152, 2688962	17:48	21ft	2ft	0.75	N/A	Ebb	~200 ft from dredge	2
		17:48		10ft	0.84				
		17:48		19ft	2.11				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	816253, 2688671	18:05	20ft	2ft	1.84	N/A	Ebb	~200 ft from dredge	2
		18:05		10ft	2.02				
		18:05		18ft	2.84				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: 6615 New Bedford Harbor - Navigational Dredging @ PARCEL

JOB NUMBER: 6615.007.01

DATE: 8/17/09

MONITORS:

WEATHER CONDITIONS:

WIND:

PRIOR STORM EVENTS:

DREDGE UPDATE:

TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL

TIDE High: 05:31, 18:02 Low: 11:00,

Dredge Water Quality Monitoring Form

Apex Companies, LLC

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	814459, 2697627	10:10	12ft	2ft	0.37	N/A	Ebb	<200ft	2
		10:10		6ft	0.67				
		10:10		10ft	1.25				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	814482, 2697425	10:25	18ft	2ft	2.01	N/A	Ebb	<200f	2
		10:25		9ft	1.87				
		10:25		16ft	2.32				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PACKER MARINE

PROJECT: 6615 New Bedford Harbor - Navigational Dredging @ ~~[illegible]~~

JOB NUMBER: 9615.007.01

DATE: 8/20/09

MONITORS:

WEATHER CONDITIONS:

WIND:

PRIOR STORM EVENTS:

DREDGE UPDATE:

TYPE OF WATER QUALITY MONITORING: DREDGE / DISPOSAL

TIDE High: ~~[illegible]~~ Low:

8:18, 20142 2:01, 18:59

Dredge Water Quality Monitoring Form

Apex Companies, LLC

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	814583, 2697355	1425	18ft	2ft	3.15	N/A	Flood	<200 ft from dredge	4
		1425		9ft	2.47				
		1425		16ft	1.21				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	814529, 2697589	1445	16ft	2ft	2.26	N/A	Flood	<200 ft from dredge	4
		1445		8ft	2.89				
		1445		14ft	3.21				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

PROJECT: 6615 New Bedford Harbor - Navigational Dredging @ SOUTH TERMINAL
JOB NUMBER: 6815.007.01
DATE: 8/25/09
MONITORS:
WEATHER CONDITIONS:
WIND:
PRIOR STORM EVENTS:
DREDGE UPDATE:
TYPE OF WATER QUALITY MONITORING: (DREDGE) / DISPOSAL
TIDE High: 12:28, Low: 5:12, 18:02

Dredge Water Quality Monitoring Form

Apex Companies, LLC

UP-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	TYPE OF WQM & DISTANCE FROM LOCATION	NUMBER OF HOURS DREDGING
	~~816219~~, 816308, 2688520	~~16:46~~ 16:46	17ft	2ft	6.01	N/A	Ebb	~200. ft from dredge	<1
				8ft	5.26				
				15ft	5.58				
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						
			AVERAGE TURBIDITY:						

DOWN-CURRENT

Monitoring ID #	NORTHING/ EASTING	TIME	TOTAL WATER DEPTH (ft)	SAMPLE DEPTH (ft)	TURBIDITY (NTUs)	GPS FILE NAME	TIDAL STAGE	DISTANCE FROM DREDGE/SILT CURTAIN	NUMBER OF HOURS DREDGING
	816219, 2688795	17:00	21ft	2ft	2.89	N/A	Ebb	~200 ft from dredge	< 1
		17:00		10ft	3.14				
		17:00		19ft	3.67				
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						
			TURBIDITY INCREASE:						

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

APPENDIX E

"Memorandum: Sampling and Analysis Plan for New Bedford Harbor Development Commission, New Bedford Harbor, New Bedford and Fairhaven, Massachusetts, Application #2007-2709"

(January 12, 2012)

by United States Army Corps of Engineers

CENAE–R–PT-MAS 12 January 2012

MEMORANDUM FOR: Brian Valiton, Project Manager, CENAE-R-PEA

SUBJECT: Sampling and Analysis Plan for New Bedford Harbor Development Commission, New Bedford Harbor, New Bedford and Fairhaven, Massachusetts, Application #2007-2709.

1. In response to your request, I have developed a sampling plan for the above project. The applicant is proposing to increase the area in New Bedford Harbor for CAD cells by approximately **36 acres**. CAD cells will be individually excavated in these areas and their depths will depend on the depth to bedrock. The surficial material will be mechanically dredged and set aside for disposal in the CAD cell while the underlying parent material, an unknown volume of silt, clay and sand, will be mechanically dredged and disposed of at Rhode Island Sound Disposal Site (**RISDS**).

2. Please note that the "Regional Implementation Manual for the Evaluation of Dredged Material Proposed for Disposal in New England Waters" (RIM) is now final and took effect on May 6, 2004. The RIM, as well as requirements for electronic submission of data, may be downloaded from the website **http://www.nae.usace.army.mil/Regulatory/Dredging/RegionalImplementationManual.pdf**

Additionally, the deadline for all laboratories to submit Laboratory Quality Assurance Plans (LQAPs) was **May 6, 2006. After this deadline, all data reports from labs that DO NOT have an approved LQAP on record at the Army Corps of Engineers WILL NOT be accepted.** Applicants and their agents should verify that their laboratory and any sub-contracting laboratory has, or is working towards, a valid LQAP before retaining their services.

3. New Bedford Harbor is an industrial harbor with many outfalls and past spills; in particular, PCBs from an upstream factory. Surficial sediments within the harbor have been previously found to be unsuitable for unconfined open water disposal based upon the results of biological testing.

4. **Forty-four cores** should be taken from the area to be dredged according to the attached plan. Cores will be taken to a depth 20 feet below mud line or to refusal. The sediment cores will be kept intact and not transferred into jars. The cores should be inspected for stratification. If the cores show significant stratification, in the opinion of the sampling crew, notes should be made of the depth and thickness of each layer.

At least two samples for chemical analysis will be taken per core. If a sediment core appears homogeneous, six samples will be taken. The top 10' of the core will be cut into five 2' sections and the sixth sample will be taken from

the bottom of the core (within the last foot). Each of these 6 sections will be chemically analyzed. If the core appears to be non-homogenous, with a transition zone between the top and bottom layers, then two samples will be taken. One sample will be taken a foot above the transition zone and the other sample a foot below the transition zone. If there appears to be more than one transition zone within the core, then the samples will be taken at the transition zone closest to the surface.

All sediments being held for testing should be stored in accordance with the requirements of Table 8-2 in Evaluation of Dredged Material Proposed for Ocean Disposal, Testing Manual, 1991.

5. Please provide coordinates for each core location in latitude and longitude, NAD 83 decimal minutes. Required horizontal accuracy of each sample location is 3 meters or less. This accuracy can be achieved with a WAAS-enabled standard boat-mounted or hand-held GPS unit. The accuracy at each sample location shall be reported along with the coordinates. Accuracy can be improved by collecting data at a sampling location for a longer period of time.

6. Each core layer should be individually analyzed for sediment grain size. The analyses should use the Wet Sieve method using sieves numbers 4, 10, 40, and 200.

7. Bulk sediment chemistry analyses should be done on each core layer sample according to the "Regional Implementation Manual for the Evaluation of Dredged Material Proposed for Disposal in New England Waters" (April 2004). The test parameters should be chromium, copper and zinc. The reporting limits should be 0.5 ppm for chromium and copper and 1.0 ppm for zinc. The RIM recommends analytical methods 6010B, 6020, 7190 and 7191 for chromium, methods 6010B, 6020, and 7210 for copper, and methods 6010B, 6020, 7950 for zinc. These analytical methods are recommended but can be replaced by other methods that will give the required reporting limits.

8. The 2004 RIM also introduced new quality control requirements. Quality Control Summary Tables must be completed and included with each data submission. These tables are found in Appendix II of the RIM and are also available on the RIM website.

9. Beginning October 1, 2004, all sediment data was required to be submitted electronically in the electronic data deliverable (EDD) format available on the RIM website. EDD's may be e-mailed or mailed on CD. Hard copy data submission is still required, along with the electronic data submission. Electronic files in a printer-friendly, easy-to-read format (e.g.,

PDF, MS Word) may be substituted for hard copy submission.

10. Please note the following modification to the 2004 RIM: Any analytes not detected shall be reported as the reporting limit and qualified with a U. Do not report non-detects as the method detection limit (MDL).

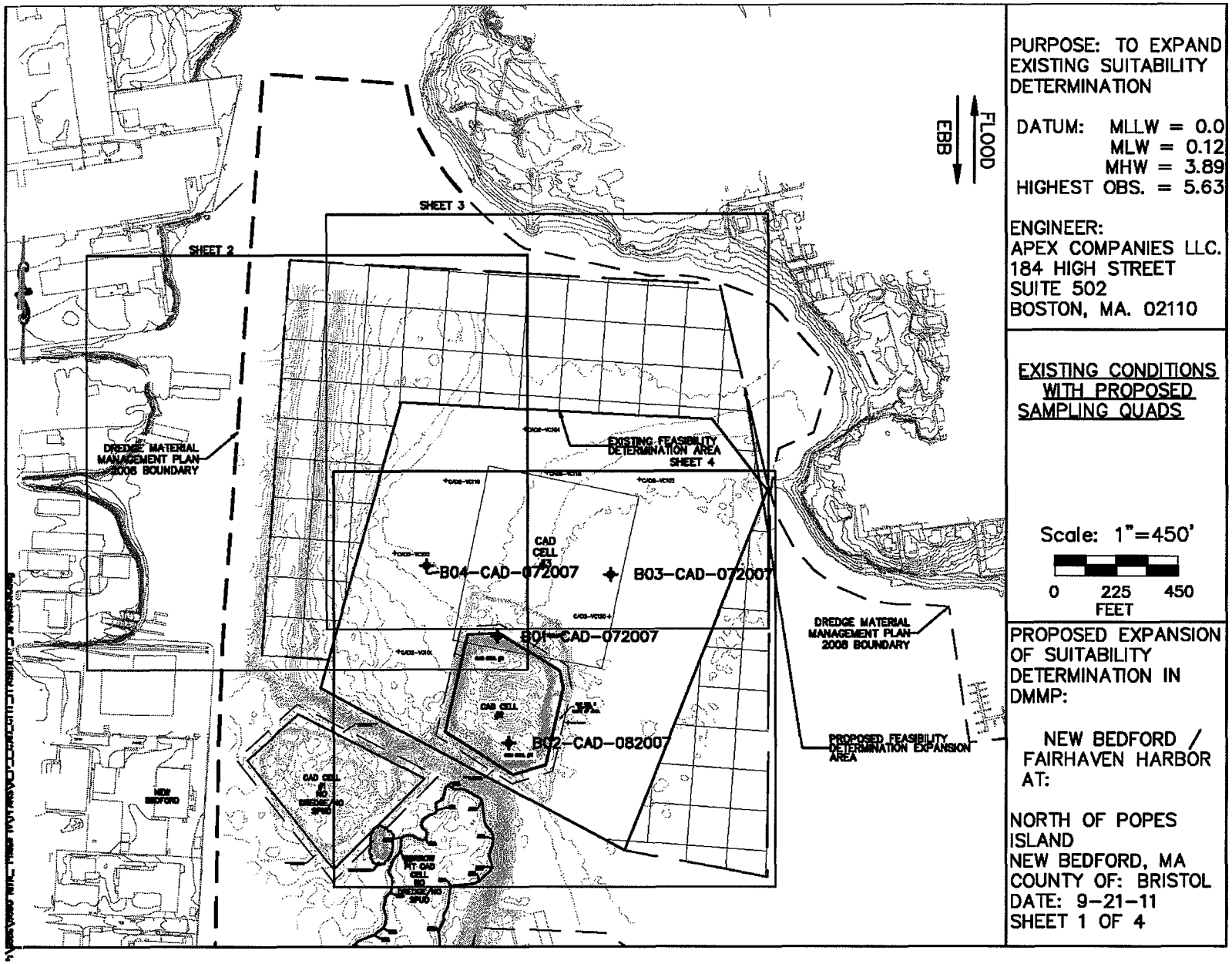
11. Copies of the draft of this sampling plan were sent to the State DEP, US EPA and US NMFS for their review. The EPA responded to say that they concur. No response was received from the NMFS within the 10-day response period so their concurrences may be assumed.

12. If you, the applicant or the testing laboratory have any questions, feel free to contact me at 978-318-8660.

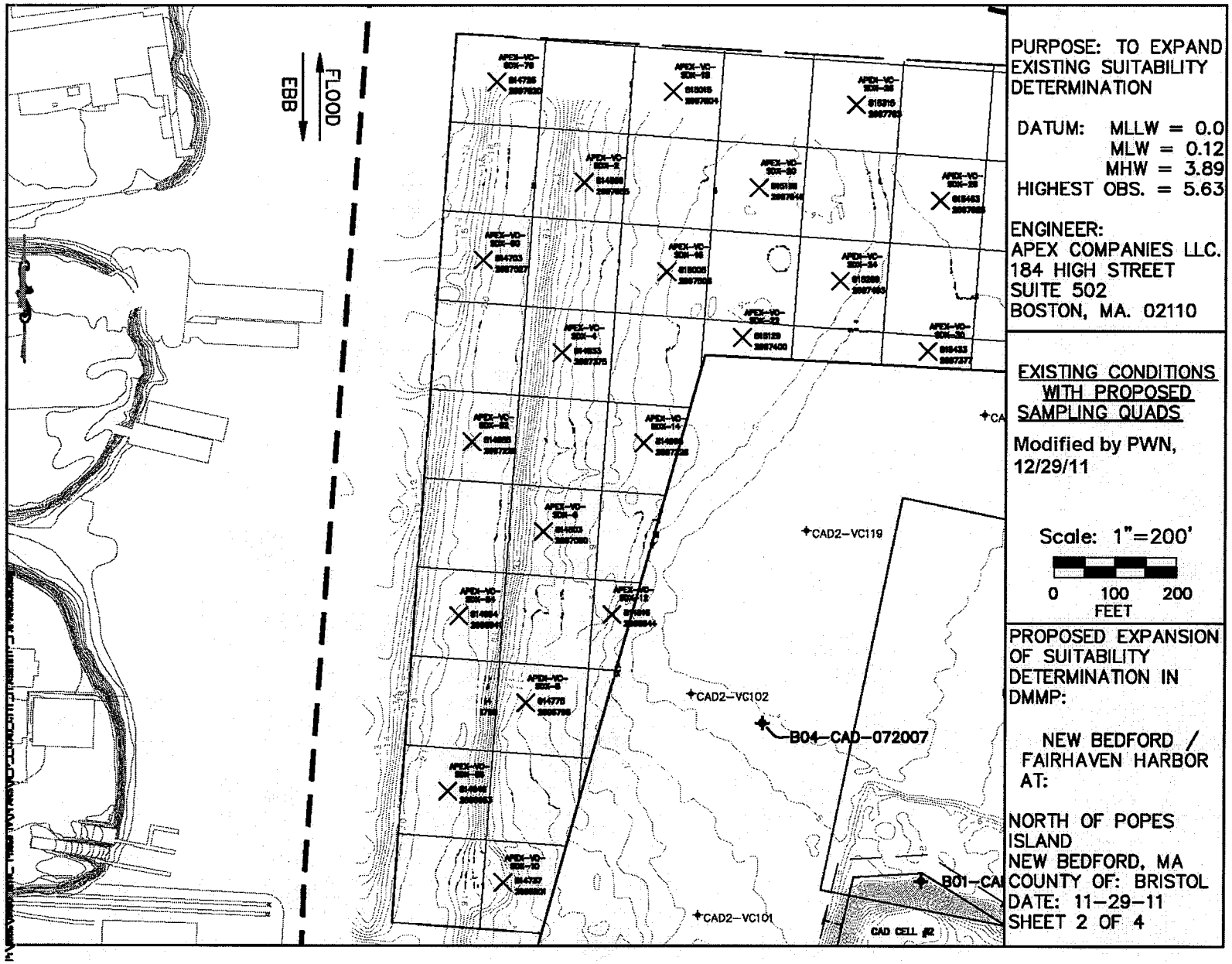
Phillip Nimeskern

PHILLIP NIMESKERN
Project Manager
Marine Analysis Section

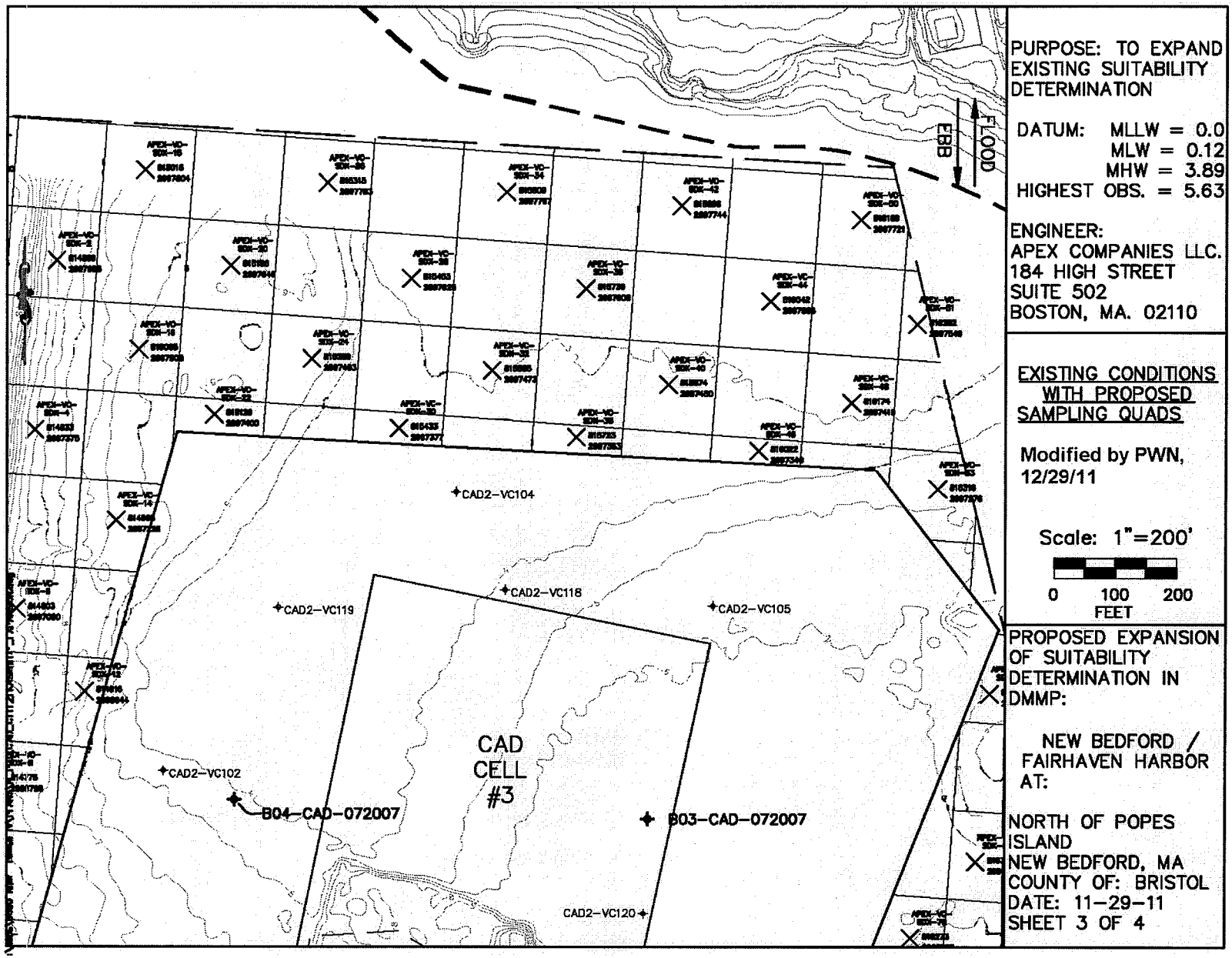
CENAE-R-PT
SUBJECT: Sampling Plan for New Bedford Harbor Development Commission, New Bedford and Fairhaven, MA, Application #2007-2709.



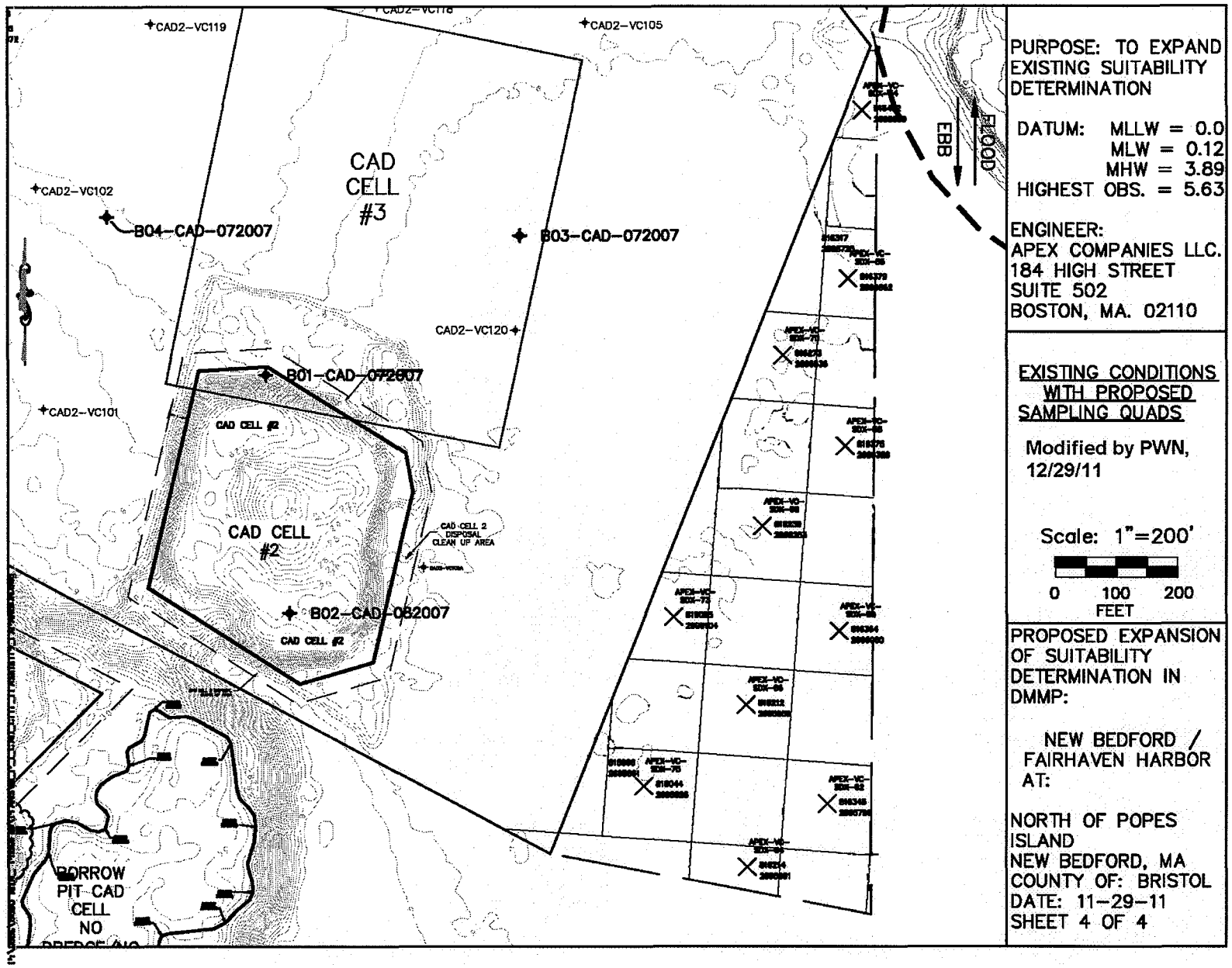
CENAE-R-PT
SUBJECT: Sampling Plan for New Bedford Harbor Development Commission, New Bedford and Fairhaven, MA, Application #2007-2709.



CENAE-R-PT
SUBJECT: Sampling Plan for New Bedford Harbor Development Commission, New Bedford and Fairhaven, MA, Application #2007-2709.



CENAE-R-PT
SUBJECT: Sampling Plan for New Bedford Harbor Development Commission, New Bedford and Fairhaven, MA, Application #2007-2709.



Edward Pickering

From: Christopher Morris
Sent: Tuesday, March 06, 2012 4:54 PM
To: Edward Pickering
Subject: FW: SAP New Bedford Harbor Development Commission 2007-2709 (UNCLASSIFIED)

Christopher Morris
Apex Companies, LLC
O) 617-728-0070 M) 617-840-0145

-----Original Message-----
From: Christopher Morris
Sent: Thursday, February 09, 2012 3:49 PM
To: Nimeskern, Phillip W NAE
Subject: RE: SAP New Bedford Harbor Development Commission 2007-2709 (UNCLASSIFIED)

Phillip,

I sorry if I was unclear in the previous email; for homogenious samples Apex wishes to collect 4 samples from the 0 to 4-foot depth in each core and every 2-foot section below that to refusal or 20 feet. We would collect the samples as the SAP perscribes for samples which are not homogenious.

Chris

Christopher Morris
Apex Companies, LLC
O) 617-728-0070 M) 617-840-0145

_____
From: Nimeskern, Phillip W NAE [Phillip.W.Nimeskern@usace.army.mil]
Sent: Thursday, February 09, 2012 3:37 PM
To: Christopher Morris
Cc: Chet Myers; Guza-Pabst.Olga@epamail.epa.gov; Valiton, Brian E NAE
Subject: RE: SAP New Bedford Harbor Development Commission 2007-2709 (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Christopher,

Thank you for following through and sending me this email, as I had a different idea of what you were proposing.

For homogenous sediment cores, the 12 January 2012 SAP called for five 2' thick samples in the top 10', with an additional sample from the bottom of the core. You are proposing four 1' thick samples in the top 4' of a core, less than half of the depth called for in the SAP. I am concerned that, if the edge of pre-industrial / post-industrial horizon is not within the top 4', we won't be able to determine the horizon and you will have to resample and retest.

I reviewed the data for the 16 June 2008 Suitability Determination for this project and note that we found the horizon to be 1 to 2 feet below the sediment surface. Therefore, the

alternate vertical sampling you propose should be able to find the horizon in these adjacent areas. However, I recommend that you store core material from below 4', either as solid cores or as 1' thick samples, in case we can't determine the horizon from the four 1' samples.

I assume you will sample the non-homogenous cores as per the 12 January 2012 SAP.

Phillip W. Nimeskern
US Army, Corps of Engineers
696 Virginia Road
Concord, MA 01742-2751
(978) 318-8660
FAX: (978) 318-8303

-----Original Message-----
From: Christopher Morris [mailto:CMorris@apexcos.com]
Sent: Tuesday, February 07, 2012 12:46 PM
To: Nimeskern, Phillip W NAE
Cc: Chet Myers
Subject: RE: SAP New Bedford Harbor Development Commission 2007-2709 (UNCLASSIFIED)

Phillip,

Thank you for clarifying the number of samples to be taken. As per our previous telephone conversation in January of 2012, Apex intends to collect 1 sample per foot of recovery for the first four feet so that we might minimize the volume of material deemed unsuitable for offshore disposal, and then follow the sampling protocol as described in paragraph 4 of the January 12,
2012 Sampling and Analysis Plan for New Bedford Harbor Development Commission, New Bedford Harbor, New Bedford and Fairhaven, MA Application #2007-2709. Could you please reply to this email confirming the alternate vertical sampling frequency is acceptable and meets the intent of the aforementioned SAP.

With Kind Regards,

Christopher Morris
Apex Companies, LLC
O) 617-728-0070 M) 617-840-0145

-----Original Message-----
From: Nimeskern, Phillip W NAE [mailto:Phillip.W.Nimeskern@usace.army.mil]
Sent: Monday, January 30, 2012 6:08 PM
To: Christopher Morris
Subject: RE: SAP New Bedford Harbor Development Commission 2007-2709 (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Hello,

I have re-counted the cores on the sampling plans and get the number "43".
Please follow the plan and not the description in the text.

Phillip W. Nimeskern
US Army, Corps of Engineers
696 Virginia Road
Concord, MA 01742-2751
(978) 318-8660
FAX: (978) 318-8303

-----Original Message-----
From: Christopher Morris [mailto:CMorris@apexcos.com]
Sent: Monday, January 30, 2012 5:16 PM
To: Nimeskern, Phillip W NAE
Subject: SAP New Bedford Harbor Development Commission 2007-2709

Hi Phillip,

I am conducting the final preparation for our field crew prior to them completing the collection of samples in New Bedford Harbor. In the text of the SAP the Corps is requesting 44 vibracores however only 43 cores are depicted on the plan. Could you please advise me on how you would like the NBHDC and Apex to to proceed?

Thank you

Chris

<http://www.apexcos.com/>

Christopher Morris

Apex Companies, LLC

184 High Street, Suite 502

Boston, MA 02210

O) 617-728-0070 M) 617-840-0145

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APPENDIX F

"Standard Operating Procedure for Soil Boring and/or Monitoring or Observation Well Drilling, Formation Sampling, and Borehole Abandonment in Unconsolidated Formations"

(12/15/11)

by Apex Companies LLC

STANDARD OPERATING PROCEDURE FOR SOIL BORING AND/OR MONITORING OR OBSERVATION WELL DRILLING, FORMATION SAMPLING AND BOREHOLE ABANDONMENT IN UNCONSOLIDATED FORMATIONS (12/15/11)

Apex Companies LLC
184 High Street Suite 502
Boston, MA 20110

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to describe the considerations and procedures, and to establish the guidelines for drilling (soil borings, wells, or piezometers) and formation sampling activities in unconsolidated formations. There are several drilling techniques available which include hollow-stem auger, cable tool, hydraulic rotary, cased-hole rotary, and air rotary. Formation (sediment/soil) sample collection include disturbed (drill cuttings), intact (split-spoon), and undisturbed (Shelby tube or Denison-core). Borehole abandonment (closure) procedures will also be addressed in this SOP.

The objective of drilling is to collect accurate subsurface information and to prepare a borehole for potential completion as a well or piezometer. Consequently, the lithologic data is the all important, most essential information that can be collected. The lithologic data characterizes subsurface conditions, describes hydrogeologic coefficients qualitatively and/or quantitatively, and identifies optimum locations for screen zones if wells are constructed.

Data can be obtained through the physical examination and testing of formation samples, as well as knowledge regarding ground-water levels. Thus, drill fluid mix, fluid loss, rate of drilling, lengths of split-spoon and Shelby-tube/Denison-core recovery, etc. must be monitored by the on-site hydrogeologist or geologist.

2.0 SITE LOCATION- NAVIGATION/SETUP

Prior to barge setup in a marine boring scenario a member of Apex Companies LLC personnel with the aid of a secondary vessel will

geo-locate and mark two spots (using buoys and block and tackle appropriate for the location's tidal range) on a north/south orientation. Barge crew will then navigate to these locations and drive pile stays such that the moon pool of the barge is centered between the two buoyed locations. The moon pool location for the boring rig will then be verified using a survey grade GPS for accuracy prior to starting the boring.

3.0 DRILLING TECHNIQUE- SELECTION

Verify that the drilling technique is the one specified in the investigation work plan, and that the drilling equipment mobilized by the driller is in good condition and proper working order. Do not permit the driller to use a drilling rig that appears to be substandard, in disrepair, etc., and/or is questionable as to whether or not the rig has the capabilities to accomplish the goals of the drilling program. The drilling rig must be capable of:

a. Penetration of all anticipated subsurface materials and formations at a desired rate, and construction of a borehole of desired diameter (for the anticipated well, if applicable, including the placement of a gravel or sand pack through a tremie pipe and necessary formation sealing material such as bentonite or cement).

b. Identification of lithology for development of a geologic log of all unconsolidated formations and materials penetrated, including physical characteristics and visual description of color, grain sizes, sorting and mineralogy.

c. Collection of samples of aquifer fluids during the drilling process and prior to well construction, while at the same time minimizing potential for cross-contamination. The method used should prevent cross-contamination between surface soils and ground water or between different hydrogeologic units.

d. Collection of intact and/or undisturbed soil samples from the center line or sidewall of the borehole. This objective requires the drilling to be halted while soil samples are taken from the bottom or side of the incomplete borehole.

e. Completion of the borehole into a well (monitoring or observation) or piezometer during the initial construction process (i.e., constructing a well or piezometer as the

borehole is drilled, or constructing a well or piezometer in the borehole immediately after the drilling tools are removed).

f. Implementation of borehole geophysical logging (when applicable and possible) to enable more accurate vertical and horizontal extrapolation of borehole data to the lithology of the hydrogeologic system.

g. Completion of a well or piezometer, if applicable, in the borehole following a time lapse for interpretation of geologic or geophysical data from the borehole.

4.0 DRILLING TECHNIQUE- DESCRIPTION

a. Hollow-Stem Auger - This drilling method is rapid and extremely effective in most cohesive sediments but less so in loose sandy material. Penetration may be up to 150 feet below land surface (BLS) depending on the size of the rig, drilling conditions, and the diameter of the auger flight; however, depths up to 250 feet BLS have been achieved under compatible conditions. A major advantage of this technique is that normally no fluids are introduced into the formation. If the auger flights can be removed and the integrity of the borehole maintained, then electrical and radiation (e.g., gamma, neutron, etc.) geophysical logs can be run. If the auger flights must remain in the borehole, then only radiation geophysical logs can be run. Casing, screen, and sampling devices can then be lowered through the hollow stem by removing the 'removable plug at the bottom of the auger flights, and gravel packing and cementing can be accomplished within the hollow stem. However, this can be difficult especially below the water table. Auger flight outside diameters (OD) range from 5 inches (in.) to 12 in. The diameter of a well that can be constructed inside the hollow stem is limited, however, to about 4 in.

b. Cable Tool (Percussion) - This drilling method is slow because the borehole is advanced by lifting and dropping a heavy string of drilling tools. Cuttings accumulate in the drill casing and are removed by a sand bailer. A steel casing is driven in as the hole is deepened. Cable-tool rigs can be used in unconsolidated sediment and bedrock to depths of hundreds or thousands of feet and often employ telescoping techniques for drilling deep boreholes. Electrical geophysical logs

cannot be run through the steel cased borehole, but radiation logs (e.g., gamma, neutron, etc.) can be run. Well casing and screen can be installed within the cased hole after which the outer casing is pulled back (removed). Because the boring is cased as it is being drilled, cross-contamination between various depths is practically eliminated. The method provides an excellent means to collect good, representative formation samples.

c. Hydraulic Rotary - This drilling method uses a rotating bit to drill (advance) the borehole. Drill cuttings are removed using a recirculating drilling fluid (mud or water). Although setting up the drilling equipment is slow, the drilling process is reasonably fast. In the mud-rotary method, drilling mud forms a cake on the borehole wall which prevents excessive loss of fluid to the formation being drilled. The hydrostatic pressure combined with the weight and density of the mud slurry keeps the hole open. This allows the drill rods to be removed from the borehole and geophysical logs (electric and radiation) to be run in the open borehole.

   In reverse hydraulic rotary drilling, the drilling fluid moves downward through annular space and then upward inside the drill pipe. If the drilling fluid does not contain mud, then sufficient water flow is required as make-up water because the borehole wall is not sealed; therefore, significant water loss can occur to the formation being drilled. The borehole is held open by hydrostatic pressure only. A serious obstacle to this drilling method occurs when the static water level is less than 15 feet below land surface because of insufficient hydrostatic head difference between the borehole and ·the water table. However, the problems of excessive water loss and shallow depths to water may be overcome by using mud as the drilling fluid.

   In mud-rotary drilling, the drilling fluid (mud) moves downward through the drill pipe and then upward through the annular space. Therefore, the borehole is held open by hydrostatic pressure and the mud cake lining the wall of the borehole. The mud-rotary method can be used to construct moderate to deep wells in unconsolidated (and consolidated material), while the reverse rotary technique can be used to construct moderate to deep wells in unconsolidated materials. The principal disadvantage may be the difficulty in removing

mud cake from the formation at the screened zone. Extensive well development may be required to remove the mud cake.

d. Cased-Hole Rotary - Several new rotary drilling techniques have been developed in which a steel casing is advanced with an air-rotary or mud-rotary drill. This technique is highly desirable for use in exploratory drilling at monitoring sites because water and soil samples may be collected under conditions which preclude contamination from shallower depths. Furthermore, this technique is extremely effective in boulder or cavernous zones which would inhibit or preclude drilling using other techniques. Drilling results are comparable to cable-tool drilling but with greatly enhanced speeds. In all the cased-hole techniques, the main benefit is that the only portion of the borehole which is open is at the bottom of the drill casing; thus, no soil or water from shallower depths can move down and impact the depth drilled and/or sampled. Electrical geophysical logs cannot be run through the steel cased borehole; however, radiation logs (e.g., gamma, neutron, etc.) can be run.

   Presently, there are three cased-hole rotary techniques which include:

   i. The drill-thru casing hammer technique in which the casing is advanced by percussion with a casing hammer or vibratory driver similar to the method used in a borehole drilled by the air-rotary method. The casing hammer can also pull out the casing (air drilling only).
   ii. The Odex™ Drilling System (European system) which "pulls" the casing using a fixture attached to an air-hammer type drill bit (air drilling only).
   iii. The Barber™ Drilling System in which drilling is done with a top-head drive and a rotary table that spins casing into the ground. Casing can be fitted with a carbide "shoe" to cut boulders and an air hammer can be used above the bit. Air or mud rotary can be used to lift cuttings.

   Two potential problems may be encountered using the cased-hole rotary technique which includes: 1) "sand heave" when drilling stops (which can be quickly drilled or bailed out) and 2) possible aeration of water in the cased borehole if volatiles are being tested (which can be overcome by pumping or bailing the standing water out before sampling). The minimum drill

casing diameter is 6 inches and depth is limited to approximately 450 feet.

e. Air Rotary - This drilling method uses a rotating bit to drill, and high-velocity compressed air to remove cuttings from the borehole. A pneumatic down-hole hammer is often used to add percussion to the rotary drilling action. This drilling method is very fast and, although it is most suitable for penetrating hard bedrock, it can be used in unconsolidated formations. The borehole may be cased .or uncased depending on geologic conditions. If an open borehole is drilled, then electrical and radiation (e.g., gamma, neutron, etc.) geophysical logs can be run. If a cased borehole is drilled, then only radiation geophysical logs can be run.

   Four potential problems may be encountered when using the air-rotary technique:

   i. When a prolific aquifer is tapped, the compressed air may not be able to lift the water to the surface.
   ii. Aeration of water in the borehole (and finished well) immediately prior to sampling can interfere with a number of inorganic and organic water quality parameters.
   iii. Low yield water entry zones may not be identified because the air pressure prevents water from entering the borehole. Care should be taken to prevent over drilling of the borehole.
   iv. Air rotary drilling can induce the migration of volatile organics to the surface or adjacent structures causing potential aesthetic or health and safety concerns.

   If the air-rotary technique is used then the following special procedures will be implemented:

   i. The type of air compressor and lubricating oil will be documented on an appropriate field form and in the field notebook and a I-pint sample of the oil will be retained for characterization in the event organic compounds are detected in a well sample.
   ii. An air line oil filter will be required and changed per manufacturer's recommendations during operation with documentation of this maintenance on an appropriate field form and in the field notebook. More frequent oil filter changes will be made if oil is visibly detected in the filtered air.

iii. The use of any additive will be prohibited, except approved water (e.g., potable water) for dust control and cuttings removal.

5.0 DECONTAMINATION

Proper decontamination in accordance with regulatory guidelines must be clearly documented in the field notebook.

6.0 PROCEDURE FOR DRILLING

a. Document all drilling-related activities (e.g., starting, stopping, footage, problems, decontamination, etc.) on the daily log form and in the field notebook. Record dates and times of activities, and names of Apex Companies LLC personnel providing oversight.

b. Monitor and record drill fluid mix, speed of rotation, pressure on the drill fluid, rate of drilling, and length of drill rods or casing in the borehole.

c. Confirm that the drill rods and core barrel are straight, or discontinue drilling.

d. Pay particular attention to the advancement of the boring because differences in the rate of drilling may be indicative of differences in subsurface geologic conditions (e.g., sand and gravel versus clay).

e. Maintain a continuous dialogue with the driller to track and keep informed of all drilling activities (e.g., the speed of the drill and drilling pressure, difficult and easy drilling conditions, etc.).

f. Collect formation samples as described below in Section 7.0. Sample jars must be labeled appropriately (e.g., project number and name, site location, boring number, date, sample interval, blow counts, and initials of Apex Companies LLC personnel collecting sample).

g. Record geologic information in the geologic log form and in the field notebook.

h. Handle and ship split-spoon sample jars carefully to avoid breakage and handle and ship tubes or cores carefully to prevent disturbance.

7.0 PROCEDURE FOR FORMATION SAMPLING

a. Intact formation sampling will be implemented using split-spoon samplers (which are driven), Shelby-tube samplers (which are pushed), or Denison-core samplers (which are rotated) depending on the drilling technique employed. Formation samples will be retained in suitable size (e.g., 1-pint or 0.5-pint) jars for physical descriptions and potential physical and chemical analysis. The appropriately labeled jars and tubes will be stored in a safe place to avoid breakage, agitation, and freezing. Intact formation samples will be collected as described in the work plan at specified intervals (e.g., at 5-foot increments below land surface) and at each major change in subsurface materials. Hydrogeologic information will be recorded on a geologic log form and in the field notebook. Detailed descriptions of the type(s) of intact sample(s) collected, sampling intervals and conditions, and objective(s) of the sample collection will be provided in the work plan.

b. Disturbed formation samples (drill cuttings) will be examined continuously throughout the entire depth of the borehole. If applicable to the study and/or stated in the work plan, borehole cuttings will be collected from the circulating auger flights which lift cuttings to land surface (hollow-stem auger technique), from the sand bailer (cable-tool technique), from the recirculating drilling fluid (mudflume) which transports cuttings to land surface (mud rotary and related techniques), or from the compressed air used to carry cuttings to land surface (air-rotary and related techniques). Formation samples will be retained in appropriate size (e.g., 1-pint or 0.5-pint), properly labeled jars and stored in a safe place to avoid breakage, agitation, and freezing. Hydrogeologic data will be recorded on a geologic log form and in the field notebook.

c. The soil cores from the wells drilled at the site are used for lithologic identification. The first 18 inches of soil for each borehole will be collected intact using a split-spoon sample, Shelby-tube sampler, or Denison-core sampler. Split spoon samples may be collected continuously from boreholes for

cluster wells; single well and/or piezometer boreholes may be split-spooned throughout drilling or at specified intervals or changes in lithology. The conditions for sampling will be specified in the work plan.

d. Before collecting and retaining soil and/or sediments collected with the split-spoon sampler, the top several inches will be removed from the sampler and discarded to eliminate any sediment that may have caved into the bottom of the borehole.

e. Sediment sampling equipment such as split-spoon samplers, spatulas, etc. (but not including Shelby-tube or Denison-core samplers, which area not re-usable) will be decontaminated by steam cleaning and/or a non-phosphate, laboratory-grade and distilled/deionized wash followed by a distilled/deionized water rinse. Decontamination of sediment sampling equipment will take place prior to the collection of the first sample and following the collection of each subsequent sample.

8.0 BOREHOLE ABANDONMENT OR CLOSURE

a. Upon the completion of the investigation, a determination will be made as whether to maintain the borehole (for a well or piezometer) or to close it (i.e., abandon and seal it). If the client and Apex Companies LLC agree to abandon the borehole, then the state will be notified and a request will be presented for borehole abandonment. Upon state approval to seal the borehole, appropriate state borehole abandonment forms will be completed, if required. Following state approval, the abandonment of any borehole (or boring) will be in accordance with local, state and/or Federal regulations.

b. For each abandoned borehole, the procedure will be documented on an appropriate field form or in the study notebook. Documentation may include, where appropriate, the following:
   i. Borehole designation.
   ii. Location with respect to the replacement borehole, if replaced (e.g., 30 ft north and 40 ft west of Borehole B-1). A location sketch should be prepared.
   iii. Open depth prior to grouting and any other relevant circumstances (e.g., formation collapse).
   iv. Drill casing left in the borehole by depth, size, and composition.
   v. A copy of the geologic log.

vi. A revised diagram of the abandoned borehole using a supplemental geologic log form.

vii. Additional items left in hole by depth, description, and composition (e.g., lost tools, bailers, etc.).

viii. A description and daily quantities of grout used to compensate for settlement.

ix. The date of grouting.

x. The level of water or mud prior to grouting and the date and time measured.

xi. Any other state or local well abandonment reporting requirements.

END OF PROCEDURE

APPENDIX G

Geotechnical Boring Log Form

BORING LOG

Date:			
Project:		Project No:	X:
Location:			Y:
Elevation at grade:	Datum:	MLLW	
Casing Type: Steel	Boring Depth:		Boring No:
Casing Diameter:	Drill Rig:		
Drill Co:	Method:		Sheet: 1 of 1
Driller:	Log By:		

Depth below surface grade (ft)	RQD	Penetration/ Recovery	Blows per 6" / Drill Min. per Foot	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%	Elevation (MLLW)
				EXAMPLE: Black Organic SILT, trace fine sand, trace fine gravel.	
	Notes/ Comments:		1). Numbers in "Depth below mudline (ft)" column represent the depth below mudline of the bottom of the respective split-spoon, core run, or drill tool advancement. 2). Numbers in "Elevation (MLLW)" column represe the elevation of the bottom of the respective split-spoon, core run, or drill tool.		
	Refusal:				
	Elevation of Bedrock:				

APPENDIX H

Marine Sediment Sampling with a Vibracoring System (Submersible)

Standard Operating Procedure

(12/09/11)

by Apex Companies LLC

MARINE SEDIMENT SAMPLING with a VIBRACORING SYSTEM (SUBMERSIBLE)

Standard Operation Procedure (12/09/11)

Apex Companies LLC
184 High Street Suite 502
Boston, MA 20110

This standard operating procedure document should be used as a guideline for field operations using a Vibracoring rig from a marine platform. It shall outline the handling of all sediment samples with regard to proper scientific standards and practices, with an emphasis on protecting the health and safety of crew and equipment.

1.0 EQUIPMENT AND SUPPLIES

1.1 Rig and Platform:

A mobile vibracoring system consisting of a 25 ft. Pontoon boat with an outboard motor, a Gravity Environmental 3 phase electric head vibracoring system(comparable to a Rossfelder P-3 system), 3000/3500 watt generator, Honda EU 2000; generator(for electronics, gps, laptop, etc.), 1500 lb. winch with a minimum of 100 ft. of Fulton 7/32” galvanized winch cable and hook with a minimum 5600 lb. rated capacity, a 10 ft. and a 8 ft. long 4 in. diameter steel core barrels with welded threads for a threaded core nose. Tools for the assembly of the system and the removal of core tubing consists of a ratchet wrench, channel locks, heavy mallet, large brushes, hack saw, a roll of stainless steel sheet metal (for construction of core catchers), and two very large pipe wrenches (4” min. jaw opening).

1.2 Sampling gear

Sample gear consists of a 10 ft. polycarbonate (Lexan) core tube and/or polypropylene sleeves (depending on sampling requirements), steel snips (for core catcher and sleeves), Duct Tape, long piece of smooth rebar (for banging the head end of the Lexan tube out in the event

the tube sticks). For position tracking: a Hypack enabled laptop with a Hypack dongle, a survey grade GPS routed through the laptop into the acquisition software, all appropriate cabling for the GPS to hook into the laptop, log books, dry write pencils/pens, Sharpe black permanent markers, sample jars/sleeves based on sample plan, sample bowls, spoons, and slicing tools for core processing, three point anchoring system: two bow, one aft (for maintaining station). All supplies and outer wear used by the crew to keep themselves and their equipment safe, clean, and in working condition.

2.0 PROCEDURE

2.1 Navigation

Using a survey grade Trimble (or similar) GPS system with a sub meter accuracy, and a Hypack equipped laptop with a survey map and DXF sample coordinates loaded in, locate the sample station.

2.1.1 Use the triple anchoring method to maintain proper station keeping:

- Navigate the boat to the sample location; in light winds using a forked moor/double bow* anchor system will be sufficient.
- Proceed 20+ feet windward of your target location.

*Using two anchors set approximately 45° apart (or wider angles up to 90°). To set anchors in this way, first one anchor is set in the normal fashion. Then, offset the boat’s position still driving into the wind, a second anchor is set approximately a half-scope away from the first on a line perpendicular to the wind. After this second anchor is set, the scope on the first is taken up until the vessel is lying between the two anchors and the load is taken equally on each cable.

- In very strong winds a third anchor is highly recommended, this is completed by using the same method above but lagging 10-20 feet leeward of the target, tossing the aft anchor, then using the bow lines to pull the vessel back on station.
- Once on station, cleat all lines to maintain position.

- Once securely on point take all correcting measurements if applicable; be sure tide reading has been taken, take a water depth reading using a survey/marked pole, a lead/sounding line, or a fathometer.

2.2 Begin Sampling

2.2.1 Vibracore (VC) Assemblage:

- Load a steel barrel into the vibrator clamp; apply two smooth layers of Duct Tape on the end of the barrel.
- Close the loose half of the clamp and secure using stainless steel hex bolts, tightened securely.
- Insert Lexan tube into core barrel until it butts against the vibrator head. Depending on barrel length, use hack saw to cut Lexan tube to 3 inches greater than the length of the steel barrel.
- If sample plan calls for poly sleeves, cut appropriate length and fold in half lengthwise to allow for insertion down the full length of the Lexan tube, avoid bunching. Fold 2 inches around the exposed tube and continue with instructions below.
- Insert precut core catcher inside Lexan tube so that it’s tight against the diameter of the barrel and unlikely to dislodge from the nose during penetration.
- Using the aforementioned pipe wrenches, screw on and tighten the core barrel nose.
- Plug control box into the small VC plug and the power cable into the 3500 watt generator.
- Start 3500 watt generator; the Honda should already be running, powering the laptop and GPS.
- Remove moon pool cover, with one crew member holding the VC head and winch cable, and one crew member bracing the nose and operating the winch.
- Begin to lift the entire assembly vertical, bracing movement throughout the procedure until the nose is centered on the moon pool.

2.2.2 Penetration Phase

- Before submerging the unit, a total length should be taken from the flat top of the vibrating head to the nose cone, and noted for later calculation.
- After water depth has been sufficiently recorded, begin lowering the unit (as a final safety note, while the VC is suspended, give each of the four lag bolts a good tightening clockwise, and verify that the cable tie shackle is screwed to the shackle).
- Begin lowering the VC unit until the nose contacts the bottom. STOP lowering and take a measurement from the waterline to the flat top of the VC head. Using a smudge marker, mark the target penetration point somewhere visible on the winch cable.
- As a note, during the penetration phase lowering speed should be kept to a minimum to ensure soil liquefaction and to be sure a vertical insertion is made.
- Continue to maintain a taught cable.
- Begin vibration with the max setting for the unit, continue penetration until, the target penetration has been reached or the refusal point is reached (ie; barrel is partially buried and penetration has stopped). Do not penetrate further than the length of the core barrel.

2.2.3 Recovery Phase

- Once full penetration has been achieved, shut down the vibration motor.
- Begin retrieving the unit using the hoist. If initial extraction fails, use the vibratory head for a short duration.
- Once barrel is above the bottom, raise unit as fast as possible to avoid loss of sample.
- When the head has been raised to the full height allowable for the A-frame, use a strap around the base of the barrel to grip the pipe while lowering it to the deck. NEVER put your body below a raised load.

- Slowly pivot the head down towards the aft deck, being mindful of clearing the moon pool BEFORE the unit reaches horizontal.
- Once the VC unit is on the deck, begin removing the nose cone and core catcher.
- Use channel locks, mallet, etc. to pull the Lexan tube out of the steel pipe. Gently slide the barrel out and place it on the deck.
- Begin clean up and refit for preparation for the next location.

2.3 Sample Handling

Sampling plans often call for a number of different handling procedures, listed below are the most common procedures Apex encounters. All the following sampling methods assume a lab is receiving the sample and cross contamination should be of utmost concern. Most important to sample handling especially when labs are involved is adhering to a strict naming convention. This convention should be clearly identifiable on the sample containers, the field logs, and the individual lab’s chain of custody. ***In all sampling methods common data collection protocol should be adhered to. The key points of data to be sure to log are: time, date, project number, client, GPS location, a tide corrected penetration estimate, and the length of sample recovery.***

2.3.1 Cut and Cap Method

Lexan tubes can be cut to encapsulate the sample with both ends taped and capped; poly tube samples are used often when samples are taken immediately after recovery to a lab for analysis.

- Remove the Lexan tube, making sure to keep track where the top and bottom of the sample are.
- Cap the bottom end of the sample, then the top.
- Be sure to place the sample on the deck away from work spaces and ideally in an upright orientation.

- Label the top using indelible ink by showing arrows pointing towards the top.
- Fully log all water depth, corrected penetration and recovery data, and label the sample with the naming convention.

2.3.2 Poly Bag Sampling

- Remove the polypropylene bag from the Lexan tube.
- Support the sample weight to avoid the bag bending and mixing the sediment layers.
- Cut open the bag and sample the sediment.
- Fully log all water depth data, corrected penetration and recovery, and label the sample with the naming convention.

2.3.3 Composite Sampling

When an average is needed across multiple sample locations, a composite method is used to combine and jar/bag these samples for lab analysis.

- Once sample has been removed by one of the above methods, the tube or bag should be cut in half lengthwise.
- Samples of the targeted sediments stipulated in the sample plan should be taken and placed in a clean stainless steel mixing bowl.
- This procedure should be repeated at all locations set forth in the sampling plan for composite and for all distinct samples recovered (unless instructed otherwise).
- Once all locations have been collected, they should be mixed and put into a lab supplied sampling containers in the quantity outlined in the sampling plan.
- Log and label; in the log be sure to note which locations (full name, see section 2.3.5) are composited in which composite sample.

2.3.4 Field identification

The field identification method is used, when just geologic descriptions are needed and samples are not meant for lab analysis. When only geological descriptions are needed, samples are classified and logged for their composition, length, location, and discrete stratification.

- In the case of Lexan tubes, the sample should be removed and laid flat on the deck of the sampler craft.
- Ideally one crew member will generate a written record and assist the other crew member who will be doing the cutting and classifying of the sample.
- Standard sample data, penetration, recovery, etc. should be logged.
- The classifying crew member should split either the tube or poly bag lengthwise.
- A cutting instrument should be used to evenly cut the core in half.
- Using survey tape, each sediment layer is classified; the modified Burmeister System or other project specific method should be used when logging the sample and measuring for thickness.
- Classification should be made from top to bottom.
- Standard sediment classification methods should be followed throughout the procedure.
- Once full classification and logging are done, sample is to be placed back to its original location to avoid contamination of future sample areas.
- Photograph all cores with identifier (sample name or number) for later use.

2.3.5 Sample Labeling

- Label either with the full sample name or a highly identifiable truncated version of the full name which should be noted in the log as the full name. All labels should be made with black permanent marker, clearly and legibly.

- Label Format Examples:
  SURVEYOR_LOCATION_DATE_PURPOSE_SAMPLE/STATION NUMBER
  ie; APEX_CAD3_120911_PRE/PLAN_VC29
- **The above is the strict naming convention that should appear on all lab chains of custody.**
- An example of an acceptable truncated version of the above would be: CAD3_VC29 or 120911_VC29, the log should always clarify if the name is truncated and clearly state what the full name is.

3.0 Health and Safety and Environmental Compliance

3.1 Personal Protection Clothing and Equipment

- Safety glasses or face shields
- Poly-coated Tyvek or Saranex jump suits
- Double gloves (Nitrile inner gloves and Nitrile outer gloves)
- Steel-toed rubber boots
- Life jacket, under jump suit (to avoid contaminating it)

This equipment and clothing is recommended to minimize exposure to hazardous material.

3.2 Field crew personnel should keep hydrated

APPENDIX I

Vibracoring Log Form

VIBRACORING LOG

Date:		
Project:	Project No:	X:
Locatio		Y:
Elevation at grade:	Datum: MLLW	
Casing Type: Steel	Boring Depth:	Boring No:
Casing	Drill Rig:	
Drill	Method:	Sheet: 1 of 1
Driller:	Log By:	

Depth below surface grade (ft)	Penetration/ Recovery	Interval	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%	Elevation (MLLW)
			EXAMPLE: Black Organic SILT, trace fine sand, trace fine gravel.	
	Notes/ Comments:	1). Numbers in "Depth below mudline (ft)" column represent the depth below mudline of the bottom of the respective split-spoon, core run, or drill tool advancement. 2). Numbers in "Elevation (MLLW)" column represent the elevation of the bottom of the respective split-spoon, core run, or drill tool.		
	Refusal:			

APPENDIX J

2011 Water Quality Monitoring Form

Dredge Water Quality Monitoring Form

PROJECT:
JOB NUMBER:
DATE:
MONITORS:
WEATHER CONDITIONS:
WIND:
PRIOR STORM EVENTS:
DREDGE UPDATE:
TYPE OF WATER QUALITY MONITORING:

UP-CURRENT

TIME:
GPS FILE NAME:
NORTHING:
TIDAL STAGE:
NUMBER OF HOURS OF DREDGING:
DISTANCE FROM DREDGE/SILT CURTAIN:
EASTING:
WATER DEPTH:

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES

AVERAGE TURBIDITY:

DOWN-CURRENT

TIME:
GPS FILE NAME:
NORTHING:
TIDAL STAGE:
NUMBER OF HOURS OF DREDGING:
DISTANCE FROM DREDGE/SILT CURTAIN:
EASTING:
WATER DEPTH:

Monitoring ID #	TIME	DEPTH (ft)	AVE TURBIDITY (NTUs)	NOTES

AVERAGE TURBIDITY:

TURBIDITY INCREASE*:

* Turbidity Increase = Down-Current Average Turbidity - Up-Current Average Turbidity

Dredging - If silt curtains are NOT used:		Dredging - If silt curtains ARE used:	
Up-current Site Turbidity	Permissible Turbidity Increase	Up-current Site Turbidity	Permissible Turbidity Increase
< 10	Reference plus 20 NTUs	< 10	Reference plus 20 NTUs
11 – 20	Reference plus 15 NTUs	11 – 20	Reference plus 15 NTUs
21 – 30	Reference plus 10 NTUs	> 21	Reference plus 30% of reference
> 31	Reference plus 30% of reference		

Monitoring shall be conducted once every 2 hours, during dredging operations on Water Quality Monitoring Days. Water quality monitoring will be performed 3 times per week during the first week of dredging and twice per week thereafter (no silt curtains used) or once per week thereafter (silt curtains used).

During Disposal Event:	
Up-current Site Turbidity	Permissible Turbidity Increase
< 10	Reference plus 40 NTUs
11 – 25	Reference plus 30 NTUs
26 – 50	Reference plus 15 NTUs
> 51	Reference plus 30% of reference

Water Quality Monitoring for Dredge Disposal Events will be performed during the first two disposal events and approximately every third disposal event thereafter, or as dictated by the Field Operations Lead based upon both weather conditions and information from the previous monitoring events

Sediment Traps:

Sediment Traps will be retrieved and re-deployed once per week during dredge and disposal operations

Labelling Instructions for Sediment Traps

ST-(Date)-NBH-(Location)
For example, ST-070108-NBH-01 is the trap retrieved from location #1 on July 1, 2008.

Labeling Instructions For Dredge Operations:

Date (e.g. 061308 = June 13, 2008)
Number of hours dredging (e.g. 00 = prior to dredging, 06 = After 6 hours of dredging)
Up-current = 1; Down-current = 9
Depth in feet (eg. 5, 15, 25, etc.)

For example, 052008-04-9-25 is the monitoring event on May 20 after 4 hours of dredging in the down-current direction at 25 feet in the water column. These three values recorded at the three depths shall then be averaged, such that a single, representative turbidity value is calculated for the up-current location and the down-current location.

Labeling Instructions For Disposal Operations:

Date (e.g. 061308 = June 13, 2008)
D = disposal event
Number of disposal event for the day (e.g. 2 = 2nd disposal event for the day)
Minutes after disposal event (e.g. 090 = 1 hour 30 minutes after the disposal event)
Up-current = 1; Disposal Location = 5; Down-current = 9
Depth in feet (eg. 5, 15, 25, etc.)
For example, 052008-D1-010-5-25 is the monitoring event on May 20 for the first disposal event of the day, 10 minutes after the disposal event at the disposal location 25 feet in the water column.