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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Prepared For:
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City of New Bedford, MA
Town of Fairhaven, MA

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MA Department of Environmental Protection
MA Department of Environmental Management
MA Division of Marine Fisheries
MA Board of Underwater Archaeology
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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

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

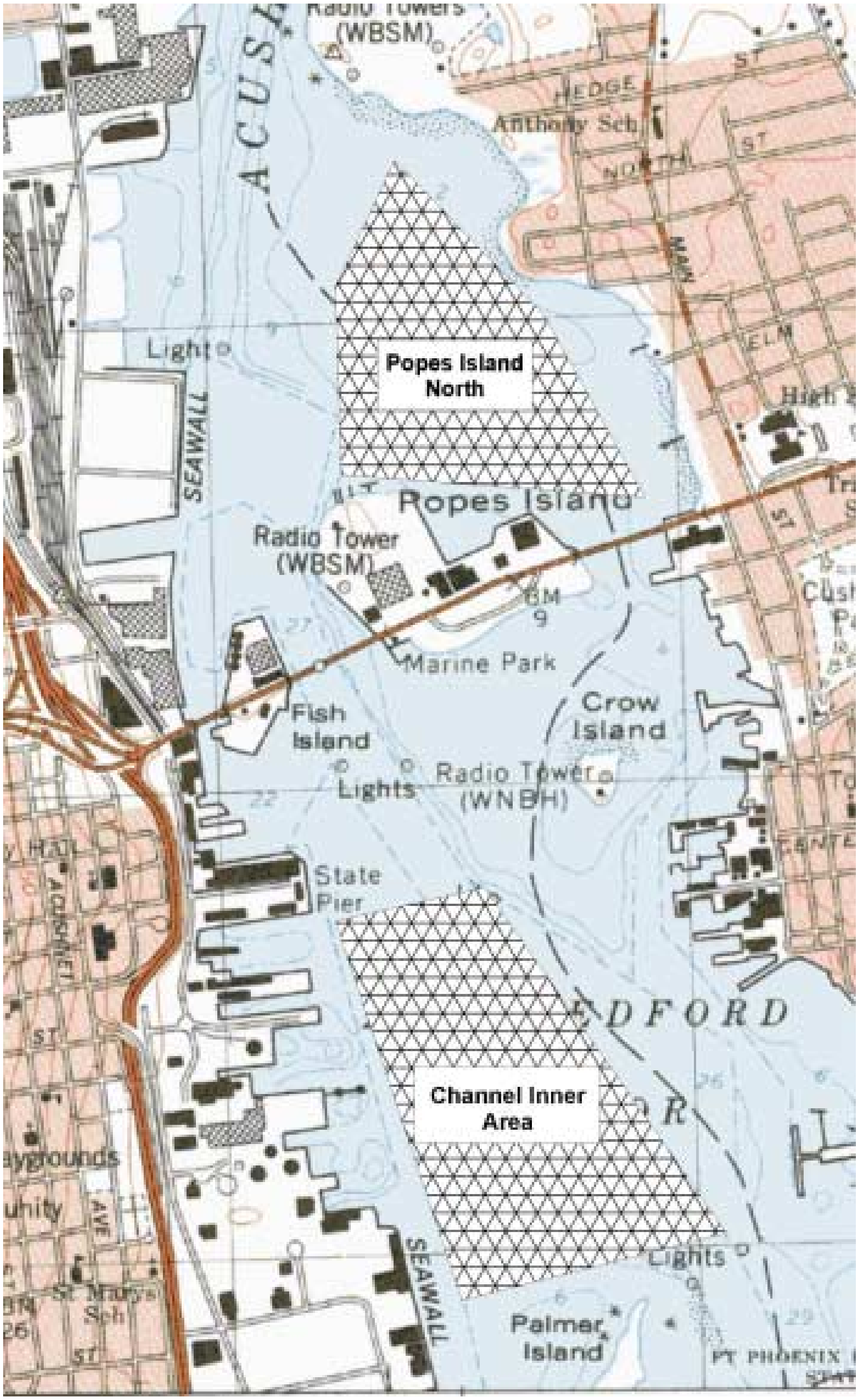

Figure 1-1. Proposed preferred alternatives CI and PIN CAD cell areas in New Bedford/ Fairhaven Harbor

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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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.

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

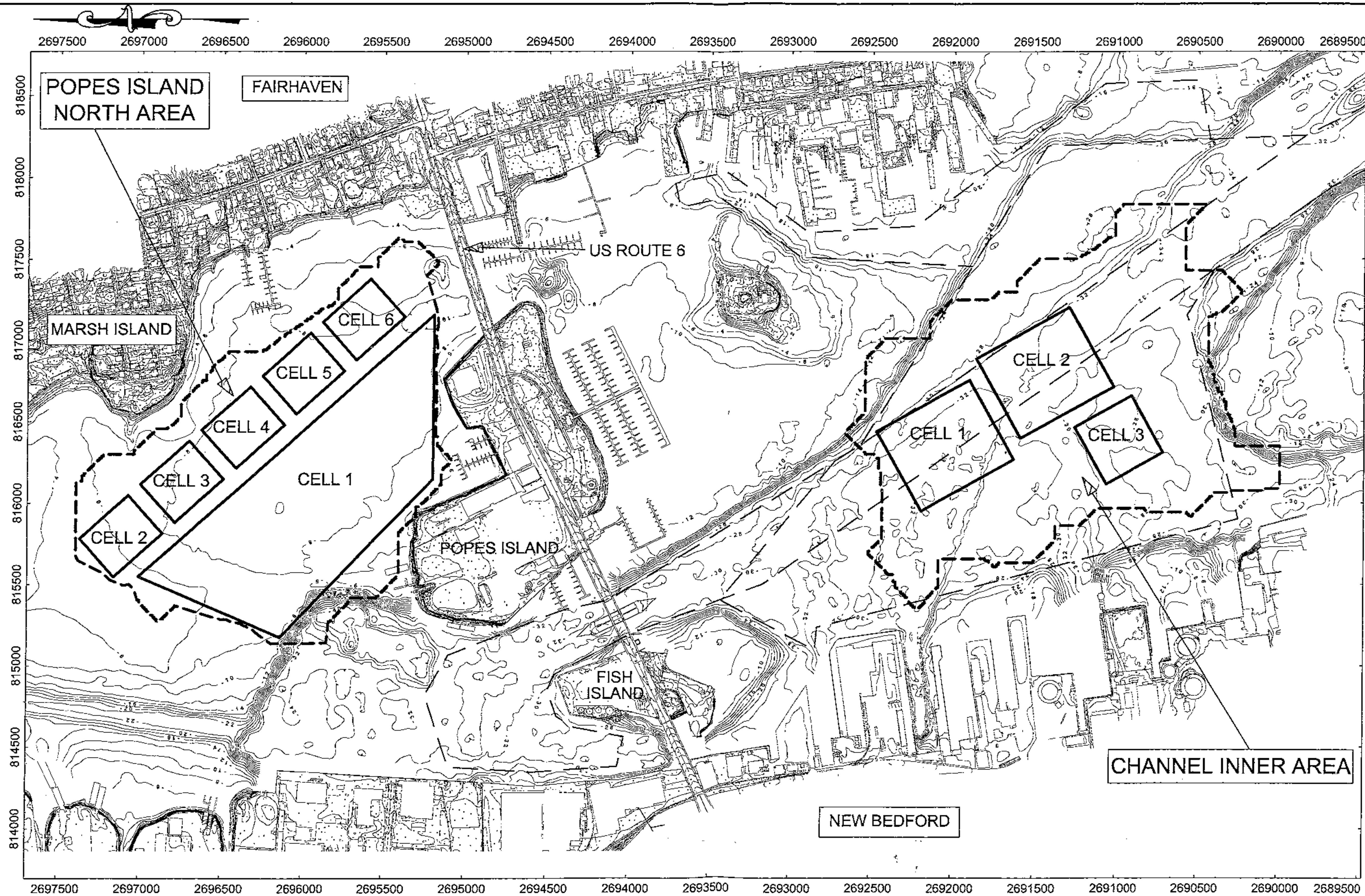
The geophysical program used data from the four additional Phase II borings to recalibrate the existing bedrock profile model for greater confidence (Apex, 2003). Initial depth-to-bedrock information was re-run using the final models from 2001 as a starting point. Based on the comparisons between the 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

CZM

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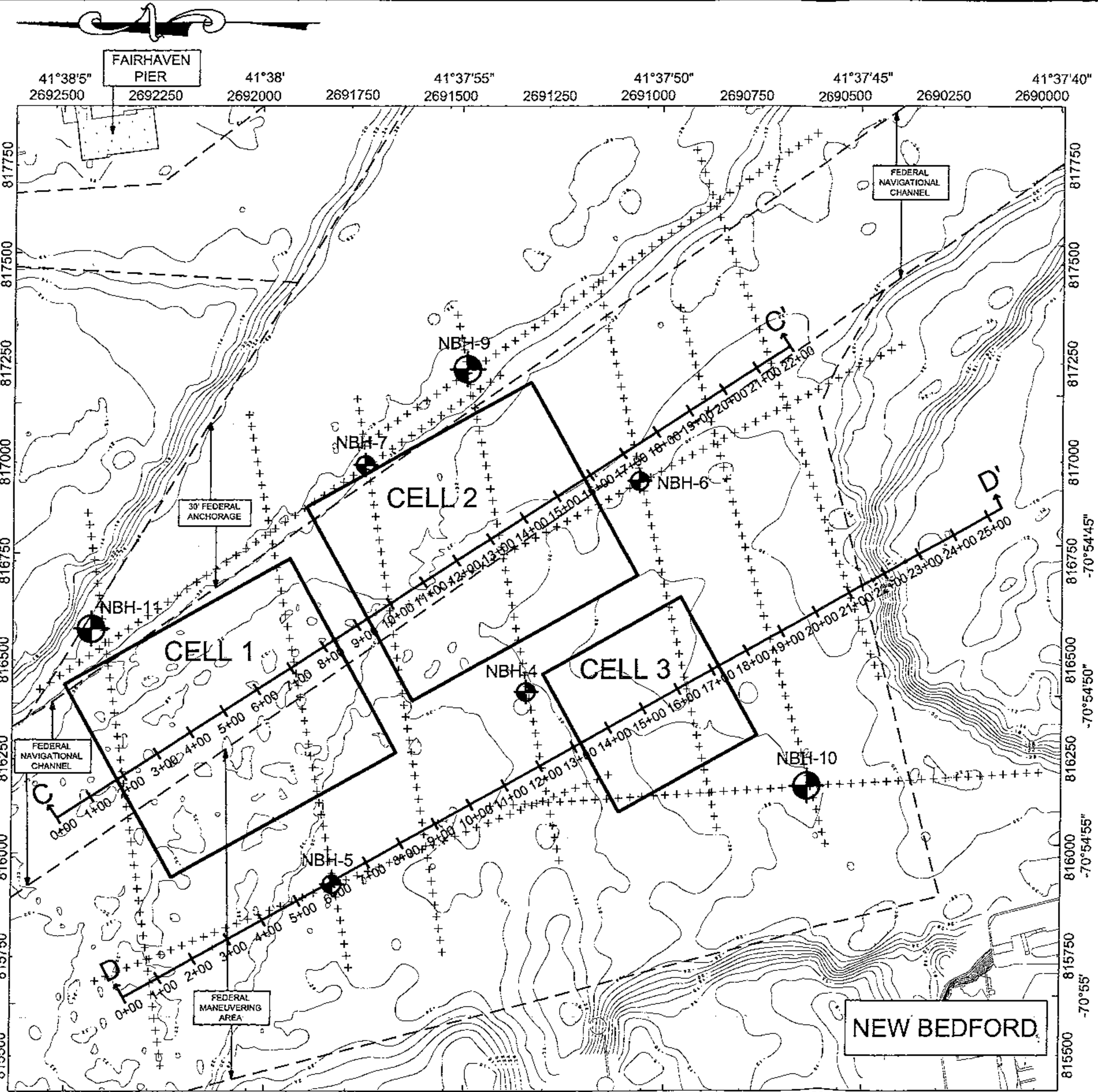
Architects/Engineers/Planners
225 Foxborough Boulevard
Foxborough, Massachusetts 02035

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



CHANNEL INNER
CAD CELL CONFIGURATION
SUBSURFACE PROFILE AND EXPLORATION LOCATION PLAN

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 — 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

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Architects/Engineers/Planners
225 Foxborough Boulevard
Foxborough, Massachusetts 02035

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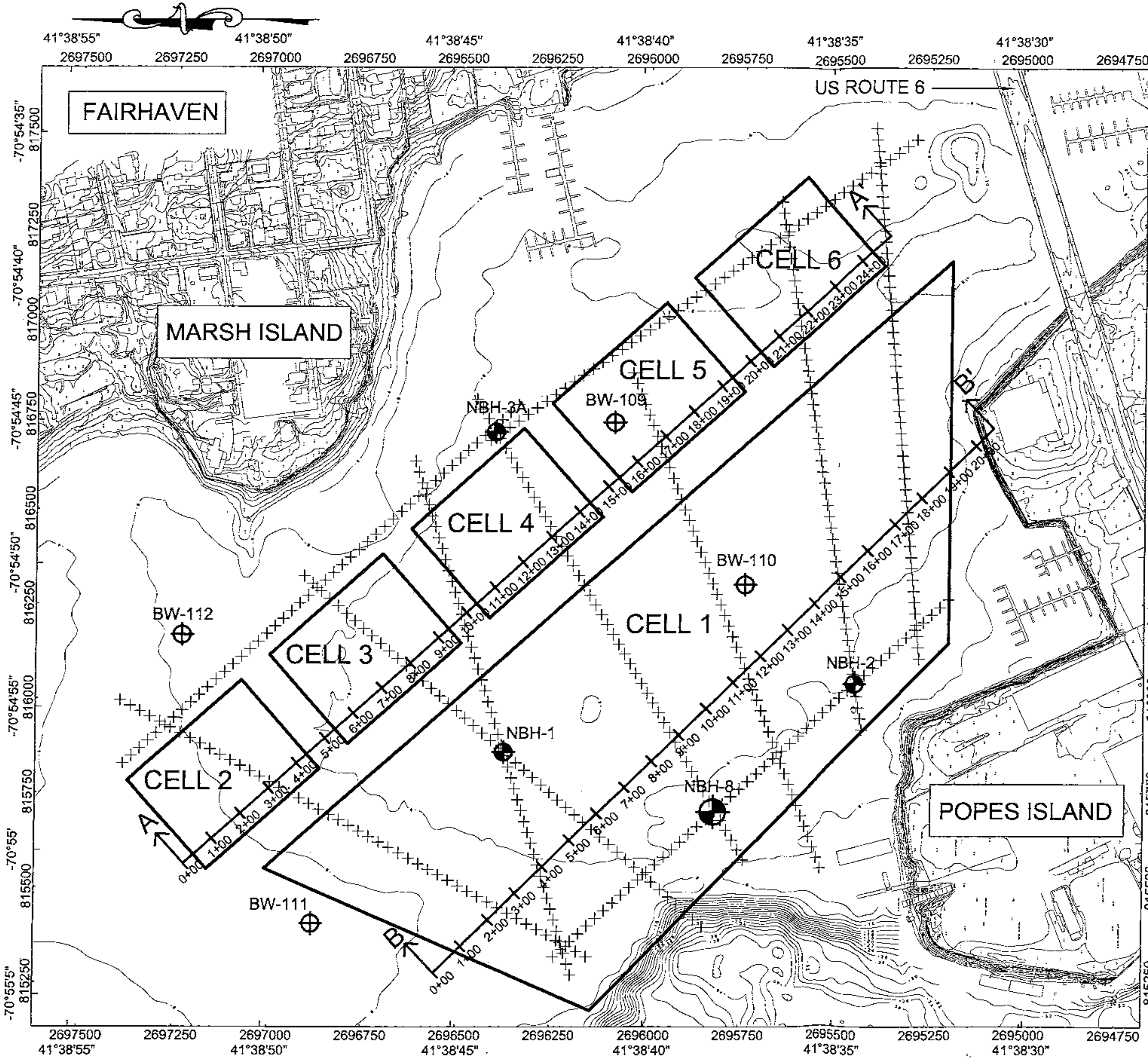
FIGURE 3-2. CHANNEL INNER CAD CELL CONFIGURATION
SUBSURFACE PROFILE AND EXPLORATION LOCATION PLAN

PROJECT NO.: 16454	
DESIGNED BY: ---	
DRAWN BY: ---	
CHK'D BY:	
DATE: 05/02/03	
SCALE: AS NOTED	



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' 0+00 1+00 2+00 3+00 4+00 PROFILE LOCATION WITH STATIONING

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

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.

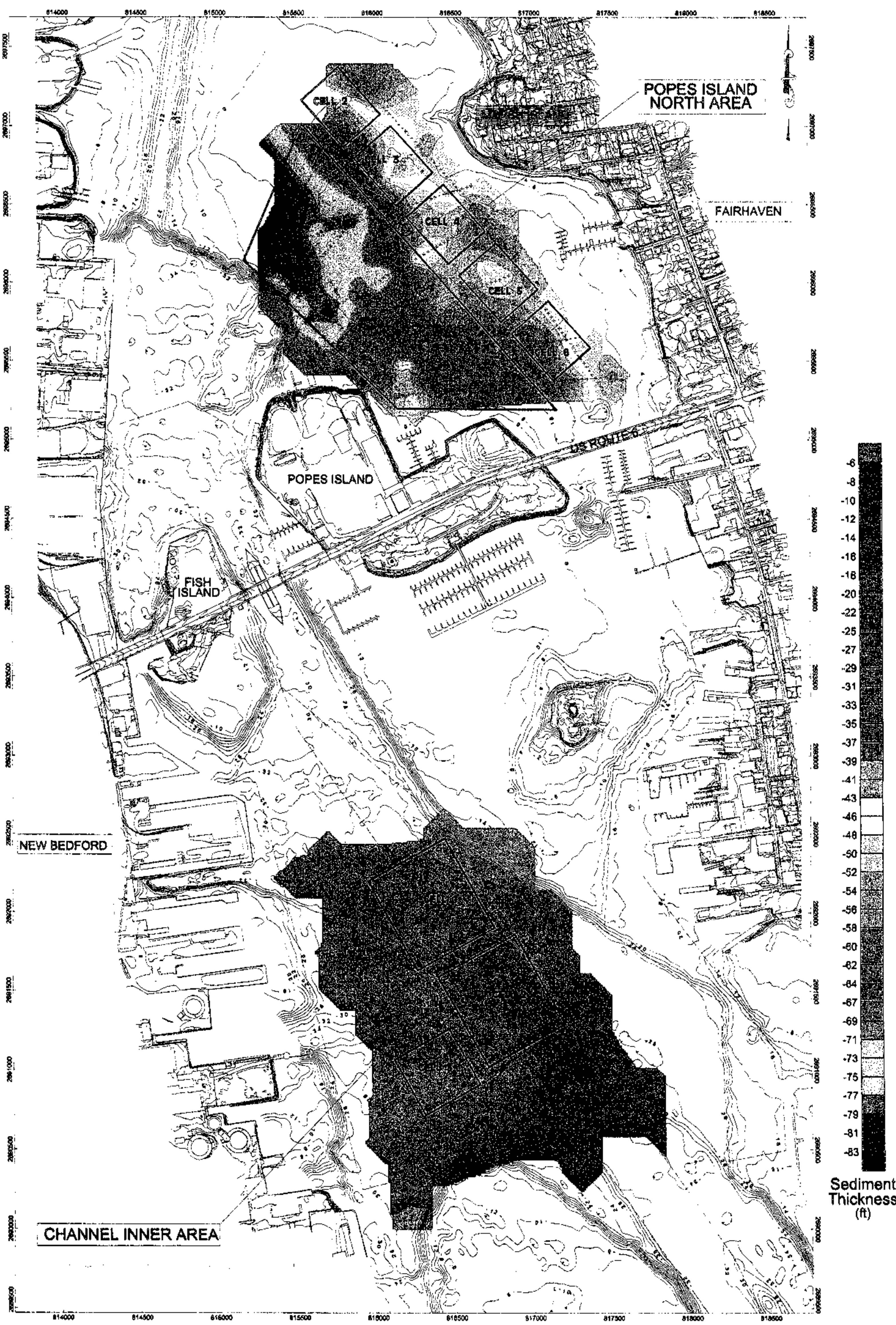
The PIN site typically exhibited shallower water and deeper sediment depths. In the PIN site, accommodation for five moderate volume dredge projects, ±50,000 cy each, as well as a large volume dredge project, ±1,800,000 cy, fits well with revealed subsurface conditions. The relatively shallow sediment 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:

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
- PROPOSED CAD CELL CONFIGURATION

FIGURE 6 - SEDIMENT THICKNESS MAP
CHANNEL INNER & POPES ISLAND NORTH AREAS
SEISMIC REFRACTION - REVISED MODEL

REV.	DESCRIPTION	BY	DATE
1.	POSSIBLE CAD CONFIGURATION	TDM	08/08/03

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

PROJECT NO: 16454
DESIGNED BY:
DRAWN BY:
CHK'D BY:
DATE: 06/02/03
SCALE: AS NOTED

Maguire Group Inc.
Architects / Engineers / Planners
225 Foxborough Boulevard
Foxborough, Massachussetts 02035

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

NEW BEDFORD/FAIRHAVEN HARBOR DMMP FEIR

FIGURE 3-5. CHANNEL INNER BEDROCK SURFACE PLAN

PROJECT NO.: 16454
DESIGNED BY:
DRAWN BY:
CHK'D BY:
DATE: 06/02/03
SCALE: AS NOTED

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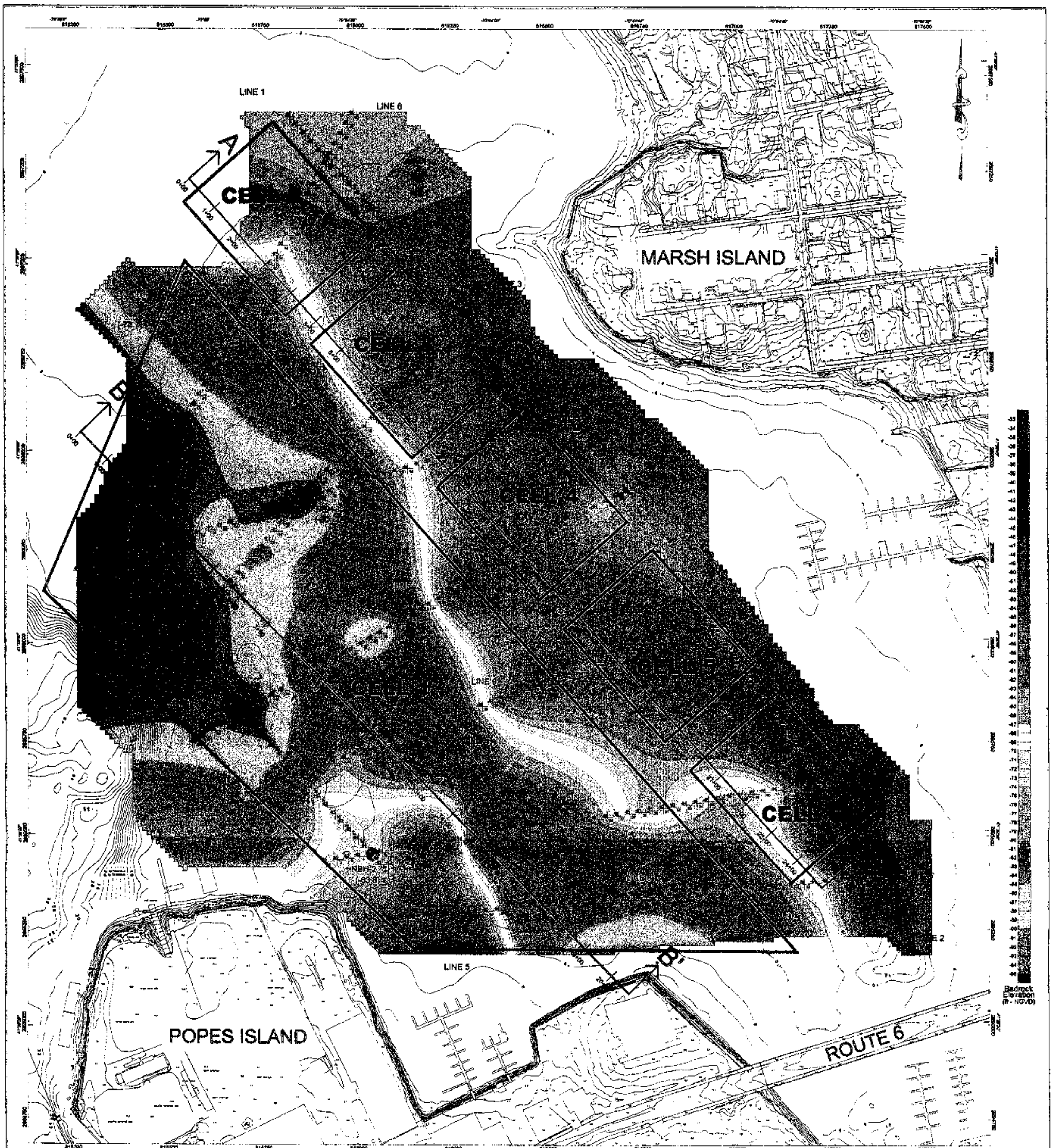
MARK	DATE	DESCRIPTION



LEGEND

- SEISMIC CALIBRATION BORING
- ESASCO BORING (APPROXIMATE LOCATION)
- HYDROPHONE LOCATION (PHONE NUMBER & BEDROCK ELEVATION)
- 1' BATHYMETRIC CONTOUR
- PROPOSED CAD CELL EXTENTS
- PROFILE 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.

SCALE 0 150 300 450 FEET

NEW BEDFORD/FAIRHAVEN HARBOR DMMP FEIR

FIGURE 3-6. POPES ISLAND NORTH BEDROCK SURFACE PLAN

PROJECT NO. 10454
DESIGNED BY:
DRAWN BY:
CHK'D BY:
DATE 06/02/03
SCALE AS NOTED

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PAGE 3-46

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.

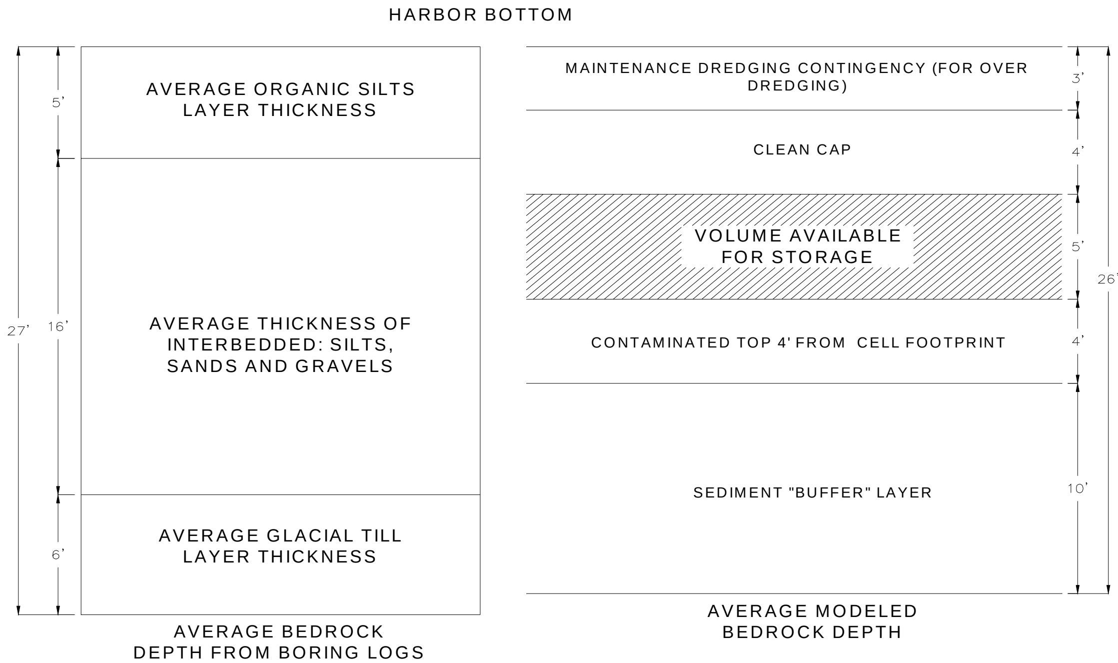


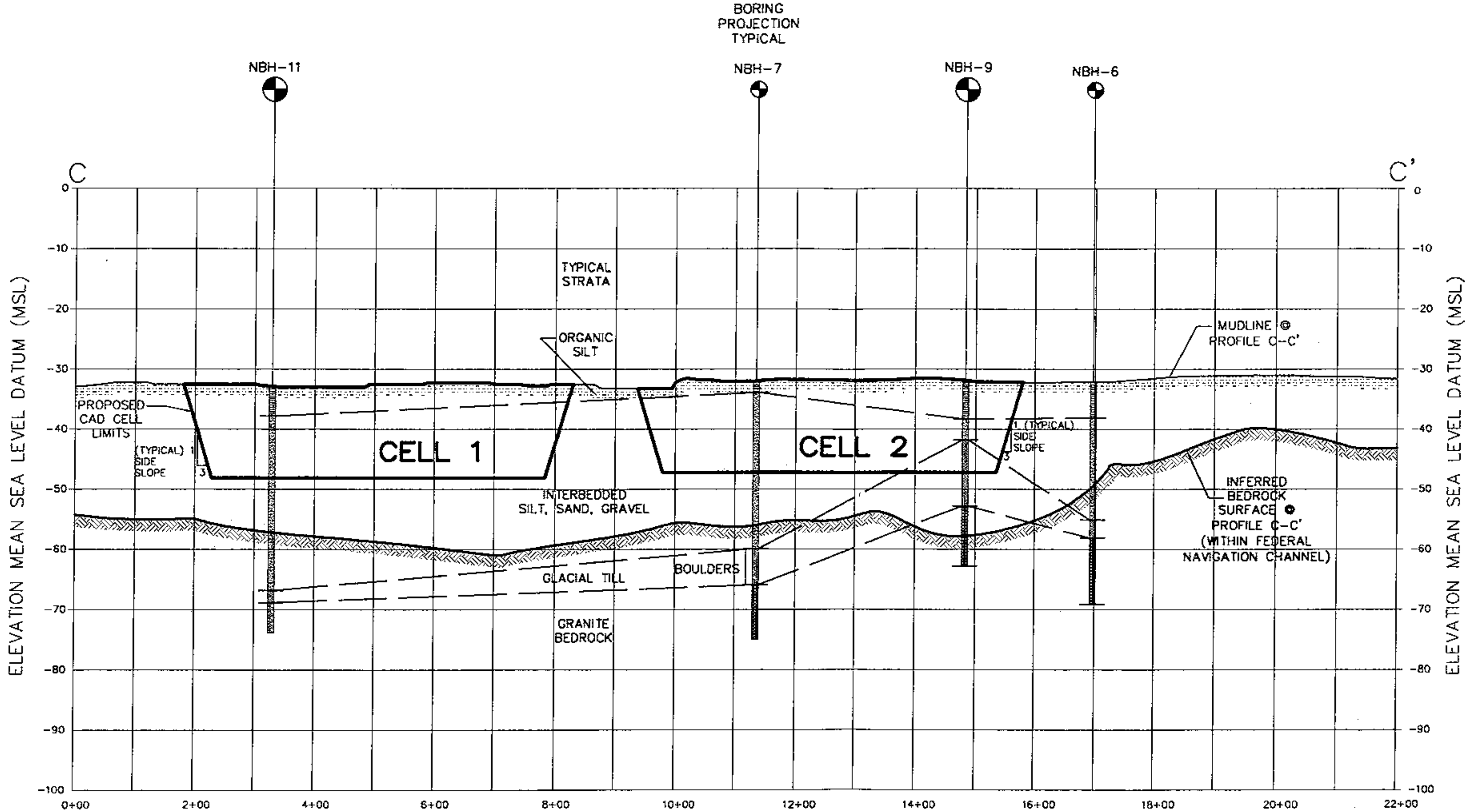
Figure 3-7. Breakdown of the division of available storage capacity and average geological cross section as seen in the borings conducted in the CI area.

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-C^1) (Figure 3-8) and proposed CAD cell 3 (D-D^1) (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

CZM

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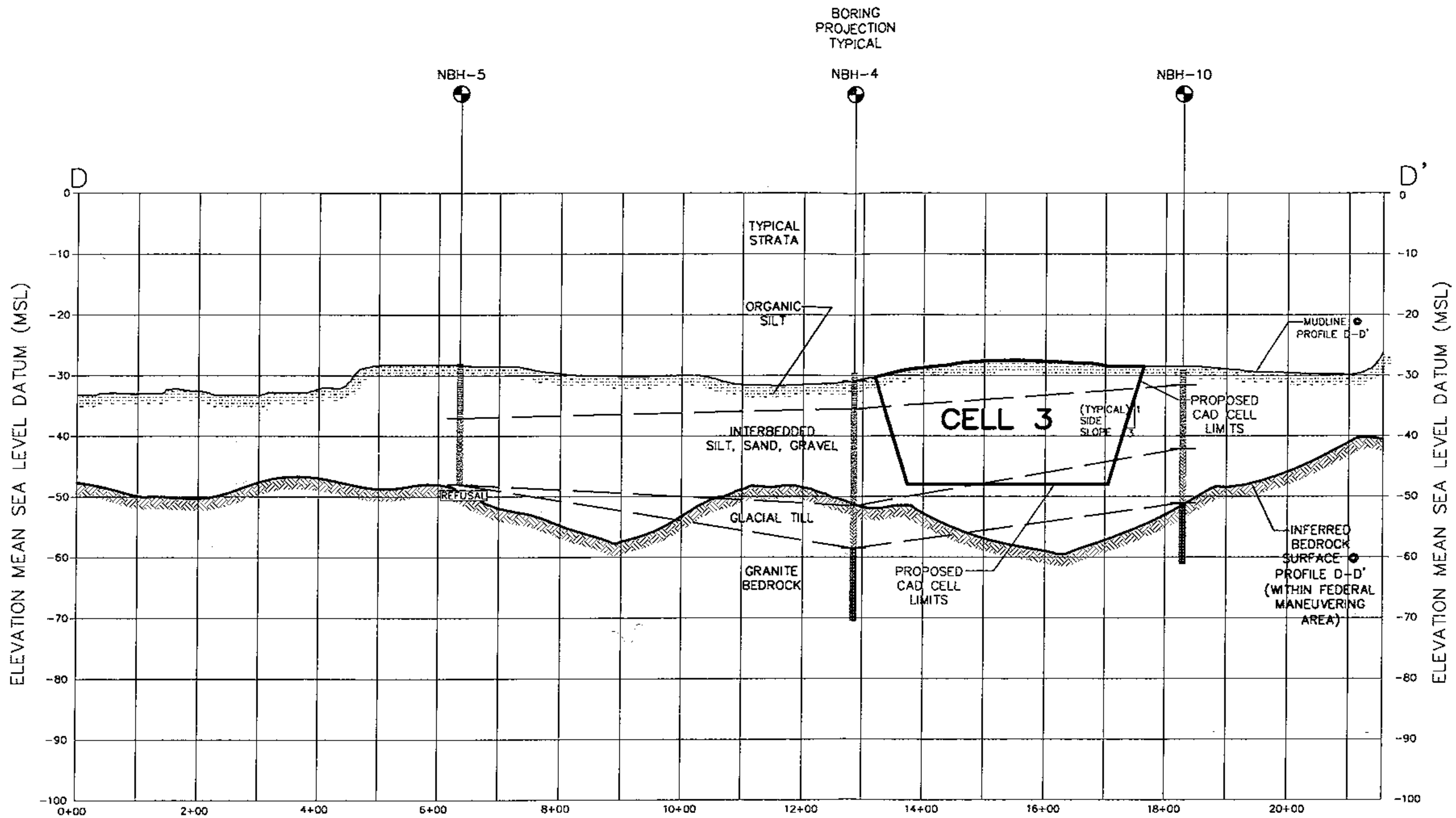
FIGURE 3-8. CHANNEL INNER SUBSURFACE PROFILE C-C'

PROJECT NO.: 18454
DESIGNED BY: ---
DRAWN BY: ---
CHK'D BY:
DATE: 06/02/03
SCALE: AS NOTED



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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Foxborough, Massachusetts 02035

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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

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)**

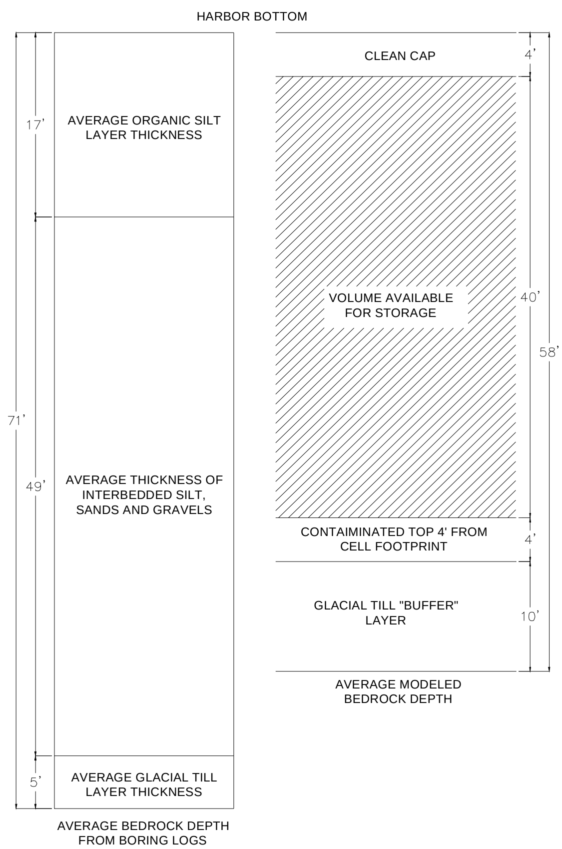


Figure 3-10. Breakdown of the division of available storage capacity and an average geological cross section from the borings conducted in the PIN area.

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

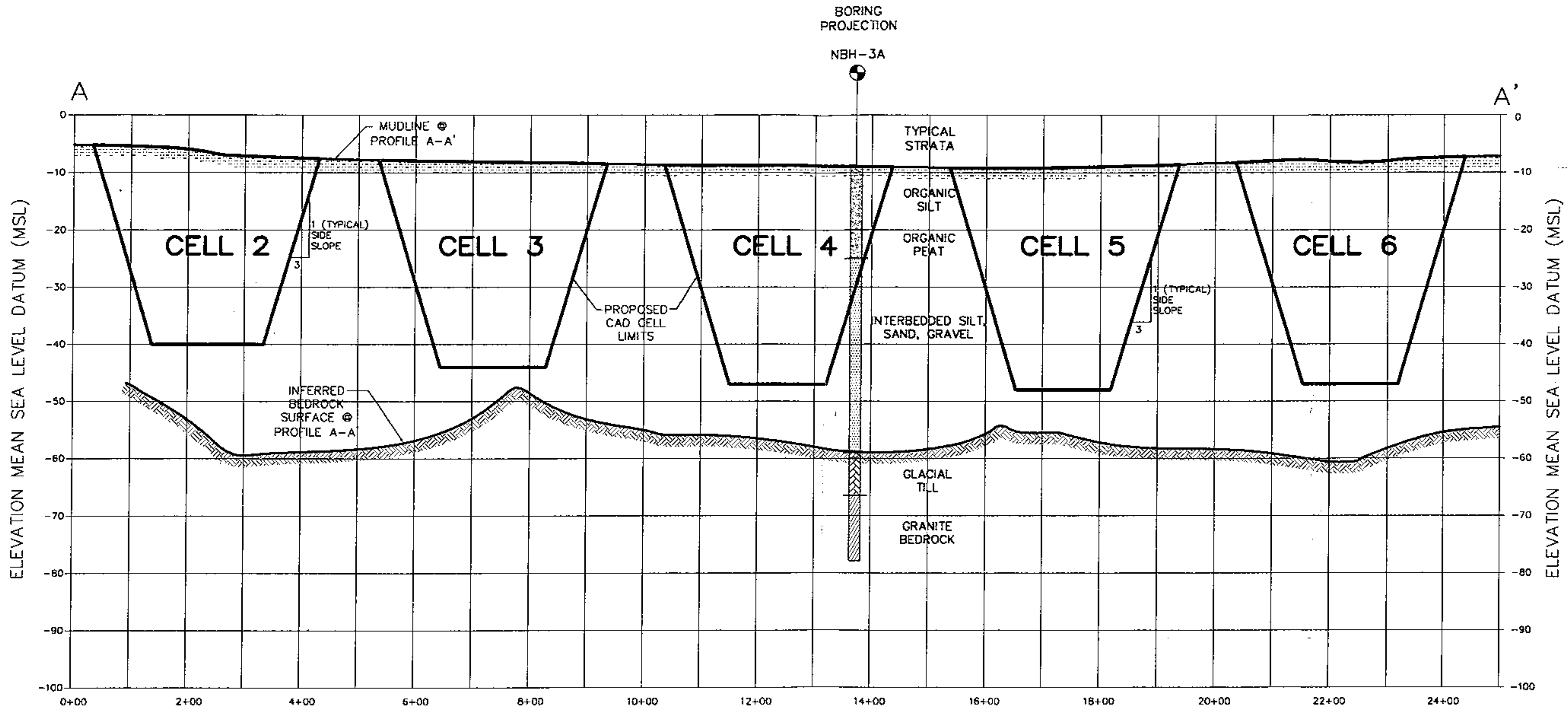
3.3.2.1 Channel Inner

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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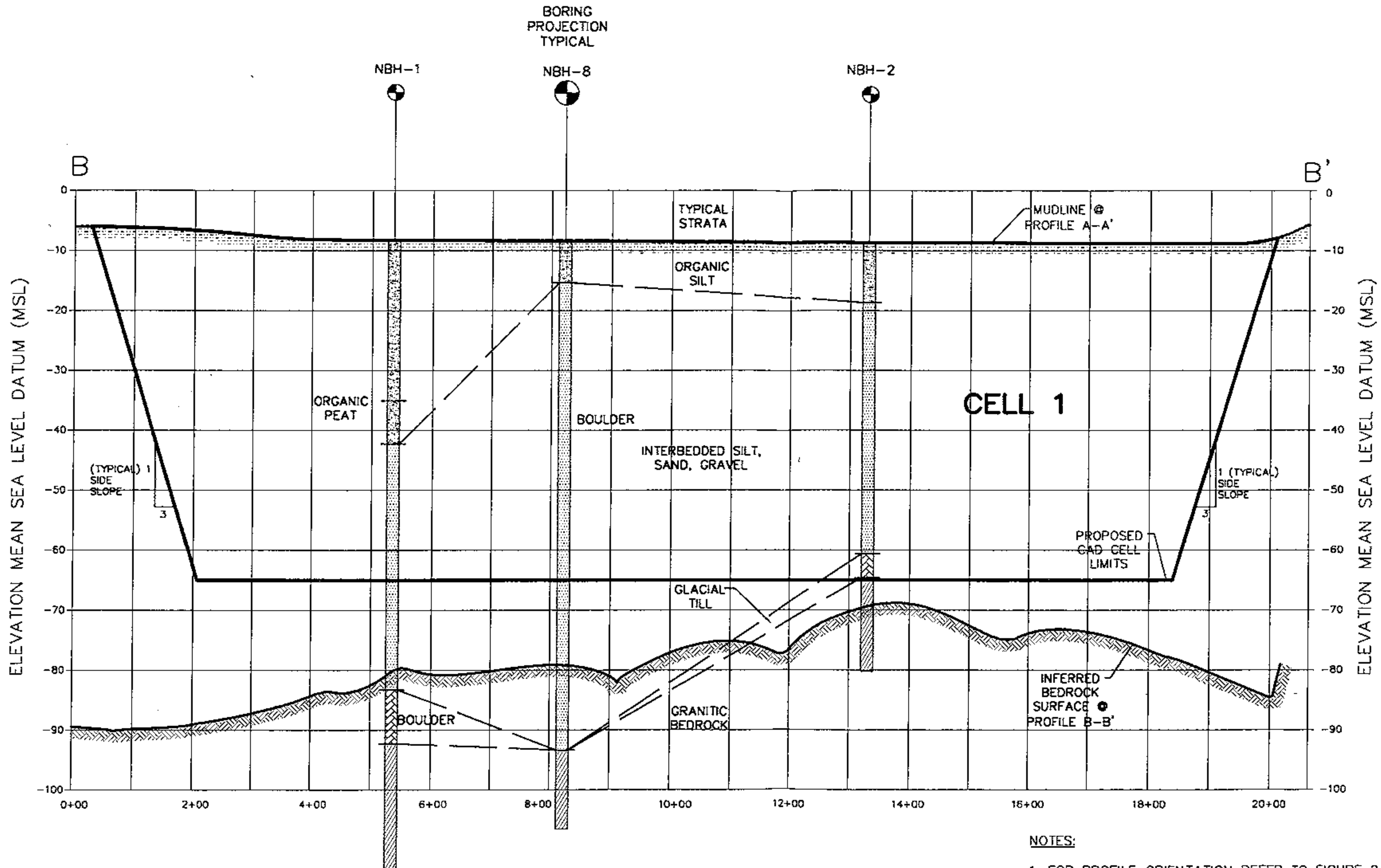
FIGURE 3-11. POPES ISLAND NORTH SUBSURFACE PROFILE A-A'

PROJECT NO.: 16454	
DESIGNED BY: ---	
DRAWN BY: ---	
CHK'D BY:	
DATE:	06/02/03
SCALE: AS NOTED	



PROFILE STATIONING IN FEET

LEGEND:

NBH-1 PHASE I PROJECT BORING LOCATIONS

NBH-8 PHASE II PROJECT BORING LOCATIONS

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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Foxborough, Massachusetts 02035

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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

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).

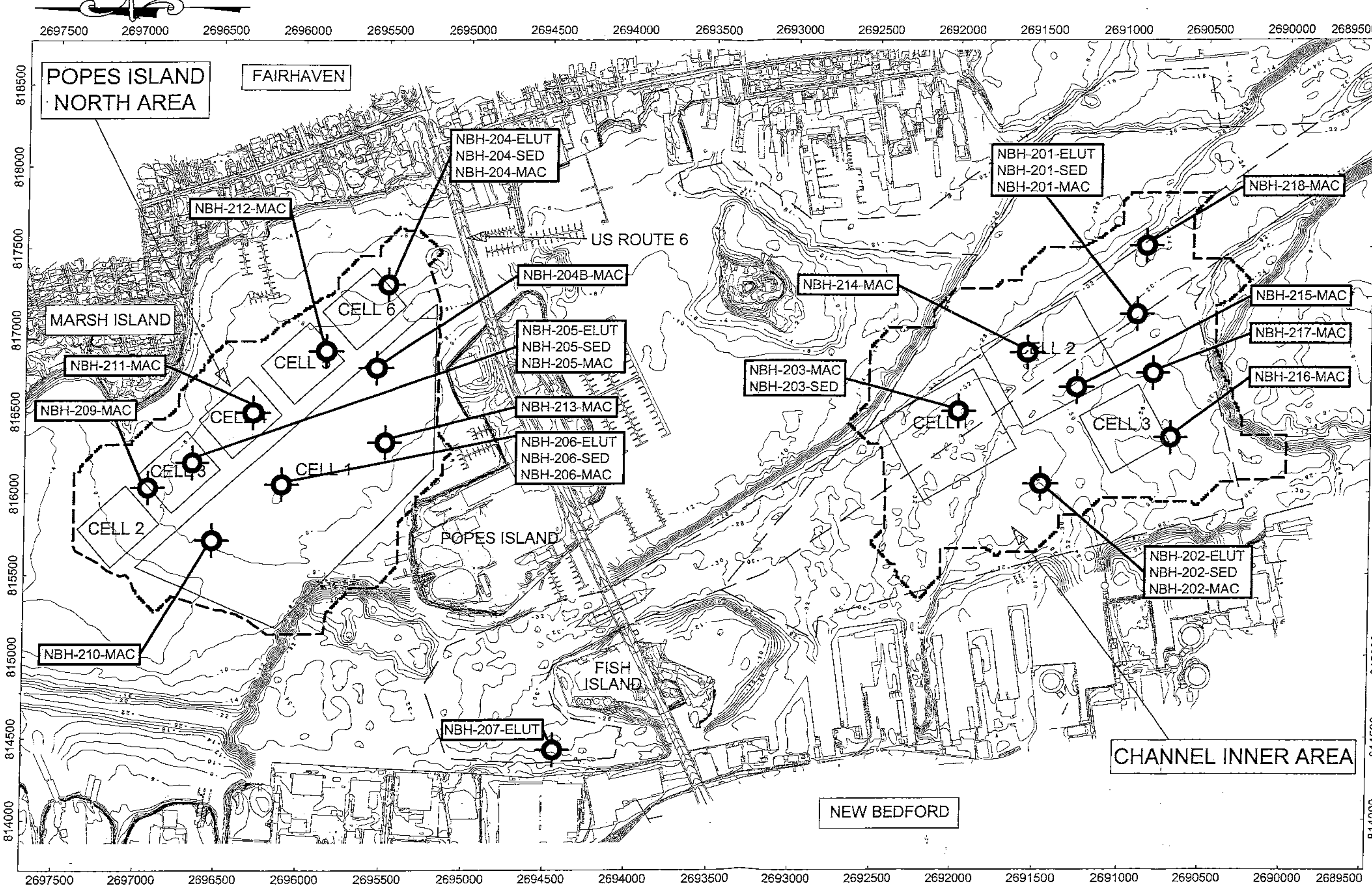
One set of surficial sediment data were collected in the CAD sites for chemistry at intervals using metals as indicator parameters to screen for a subsequent comprehensive suite of laboratory analyses (Maguire, 2003). Comprehensive laboratory analyses for PAHs, pesticides, dioxins, and PCBs were then 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 <u>Chemical</u>

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



SURFICIAL SEDIMENT SAMPLING LOCATIONS AT CHANNEL INNER AND POPES ISLAND NORTH CAD CELL SITE ARES

0 600 1200 1800

SCALE: 1"=600' FEET

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 & ABBREVIATIONS

SAMPLING LOCATION

W-ELUT = ELUTRIATE
WATER = SURFACE WATER

NEW BEDFORD/FAIRHAVEN HARBOR DMMP FEIR

FIGURE 3-14. SURFICIAL SEDIMENTARY SAMPLING LOCATIONS AT CHANNEL INNER AND POPES ISLAND NORTH CAD CELL SITE AREAS

CZM

Maguire Group Inc.
Architects/Engineers/Planners
225 Foxborough Boulevard
Foxborough, Massachusetts 02035

PROJECT NO.: 16454
DESIGNED BY: ---
DRAWN BY: ---
CHK'D BY:
DATE: 06/02/03
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 µg/kg	39	BZ#66 µg/kg	4.2
	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.

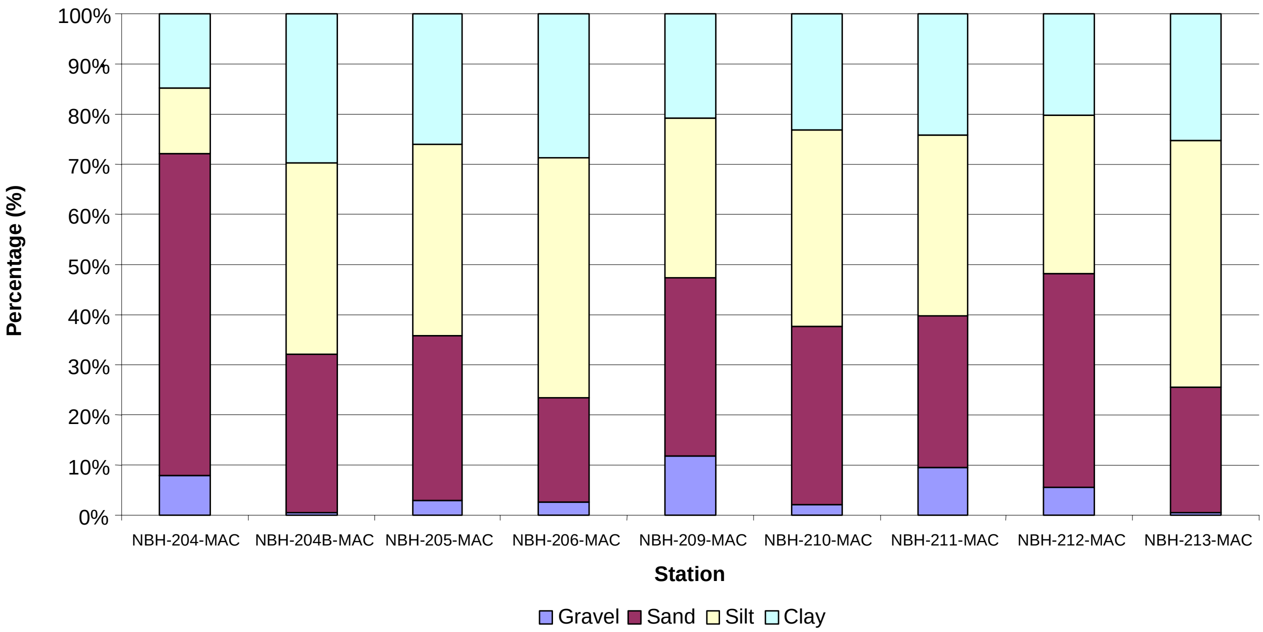


Figure 3-15. Sediment Composition at Channel Inner from grab samples.

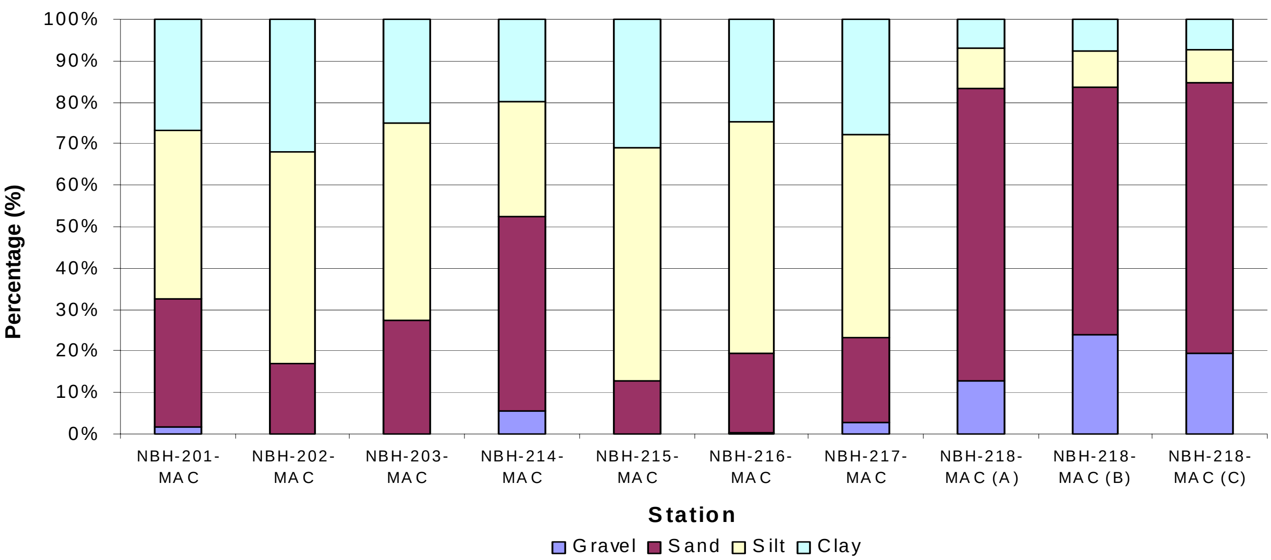


Figure 3-16. Sediment composition at Popes Island North from grab samples

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

<u>3.5.5.1 Chemistry</u>

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.

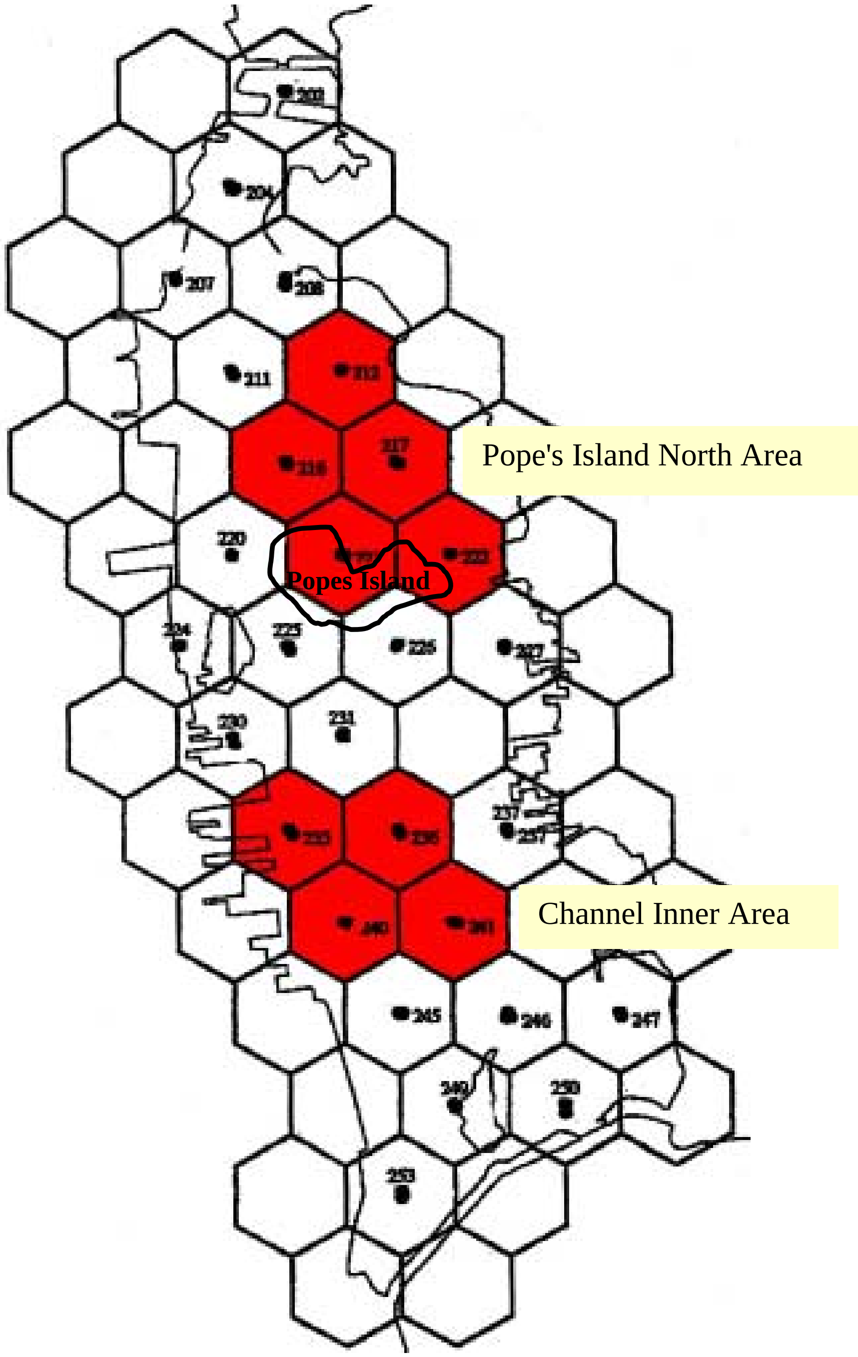


Figure 3-17. Map showing station numbering system for New Bedford Harbor Long Term Benthic Monitoring (USACE), Section 2. Areas highlighted in red are those previously sampled by the USACE in the vicinity of the proposed CAD cell locations.

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.

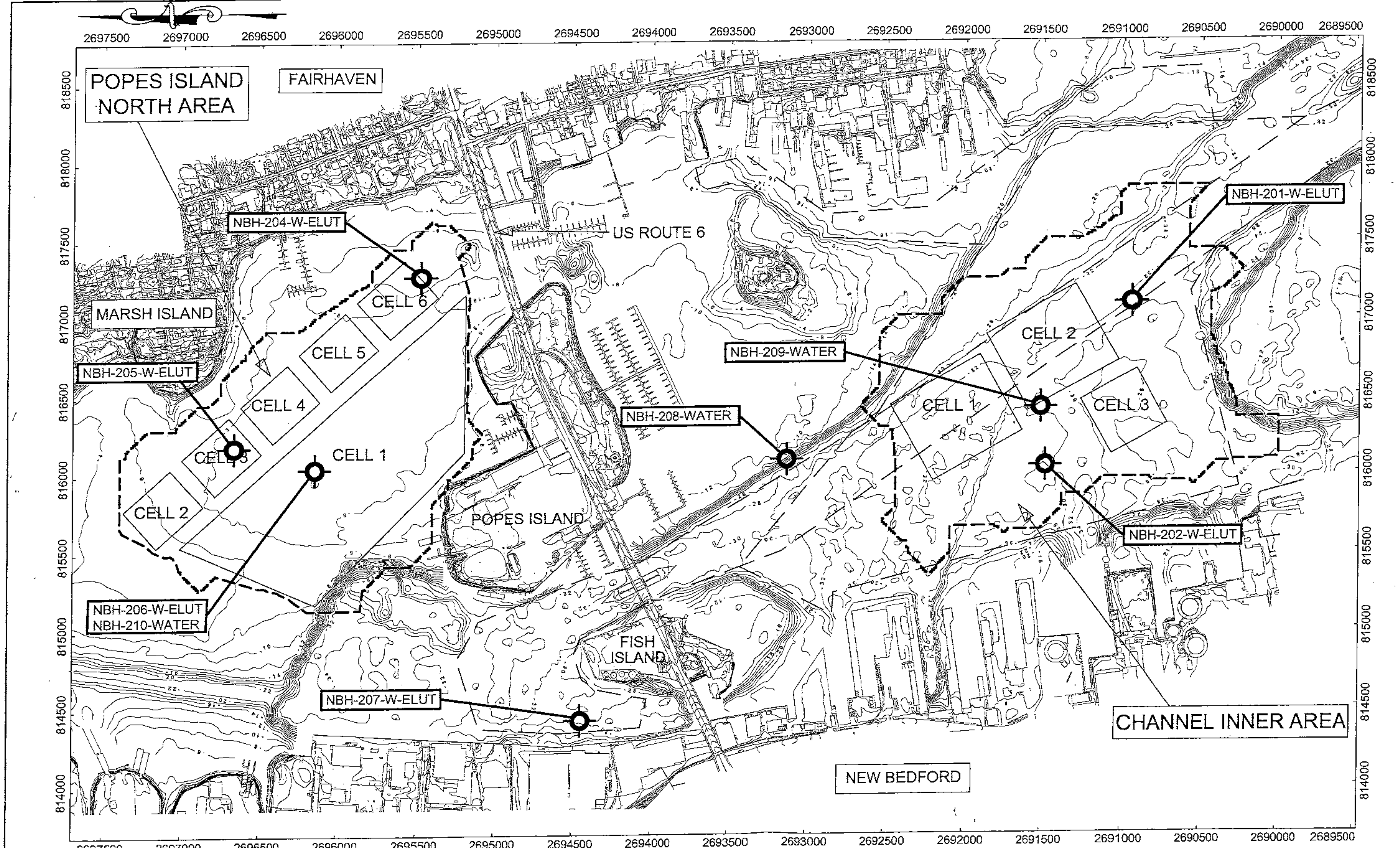
3.8.2 Description of Surface Water Study

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						



SURFACE WATER SAMPLING LOCATIONS AT CHANNEL INNER AND POPE ISLAND NORTH CAD CELL SITE AREAS

0 600 1200 1800

SCALE: 1"=600' FEET

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 & 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

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.

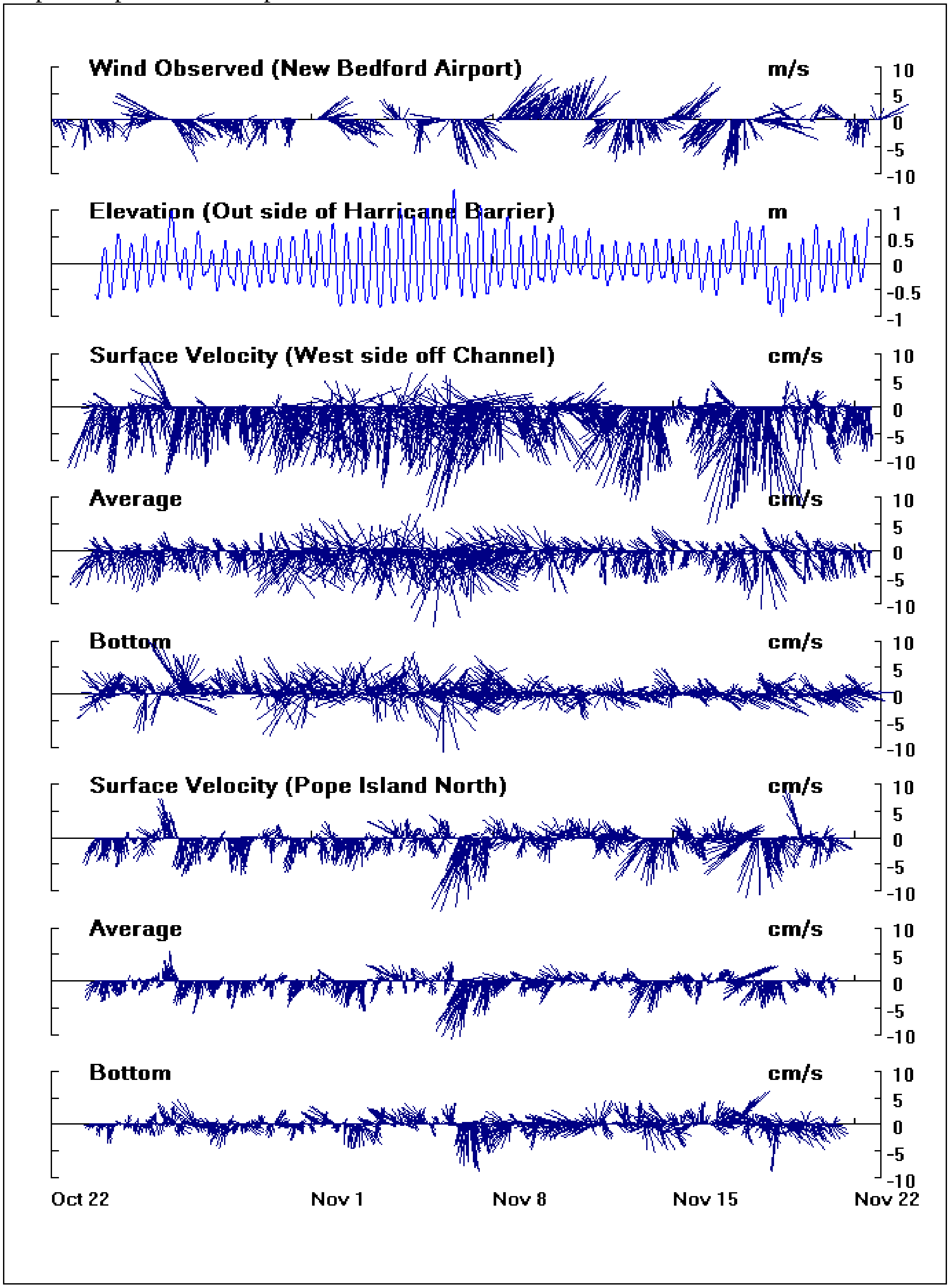


Figure 3-20. Time series stack plot of observed wind, elevation and velocity data.

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.

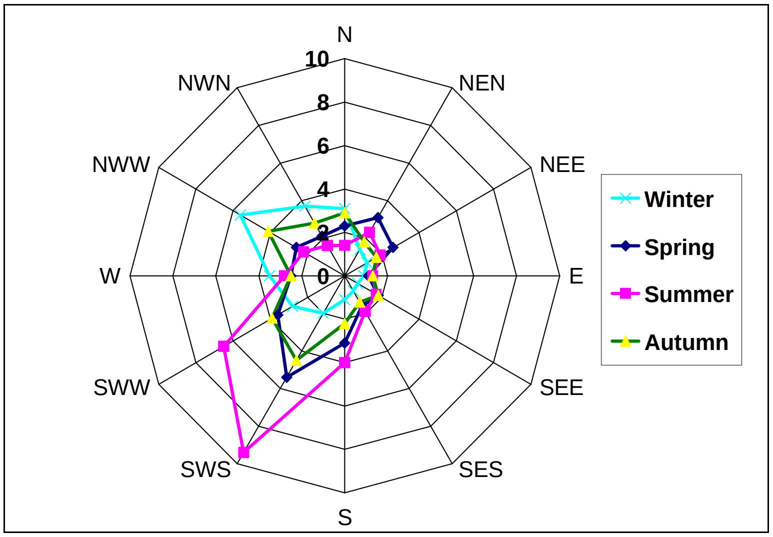


Figure 3-21. Probability of wind direction of the four seasons.

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.

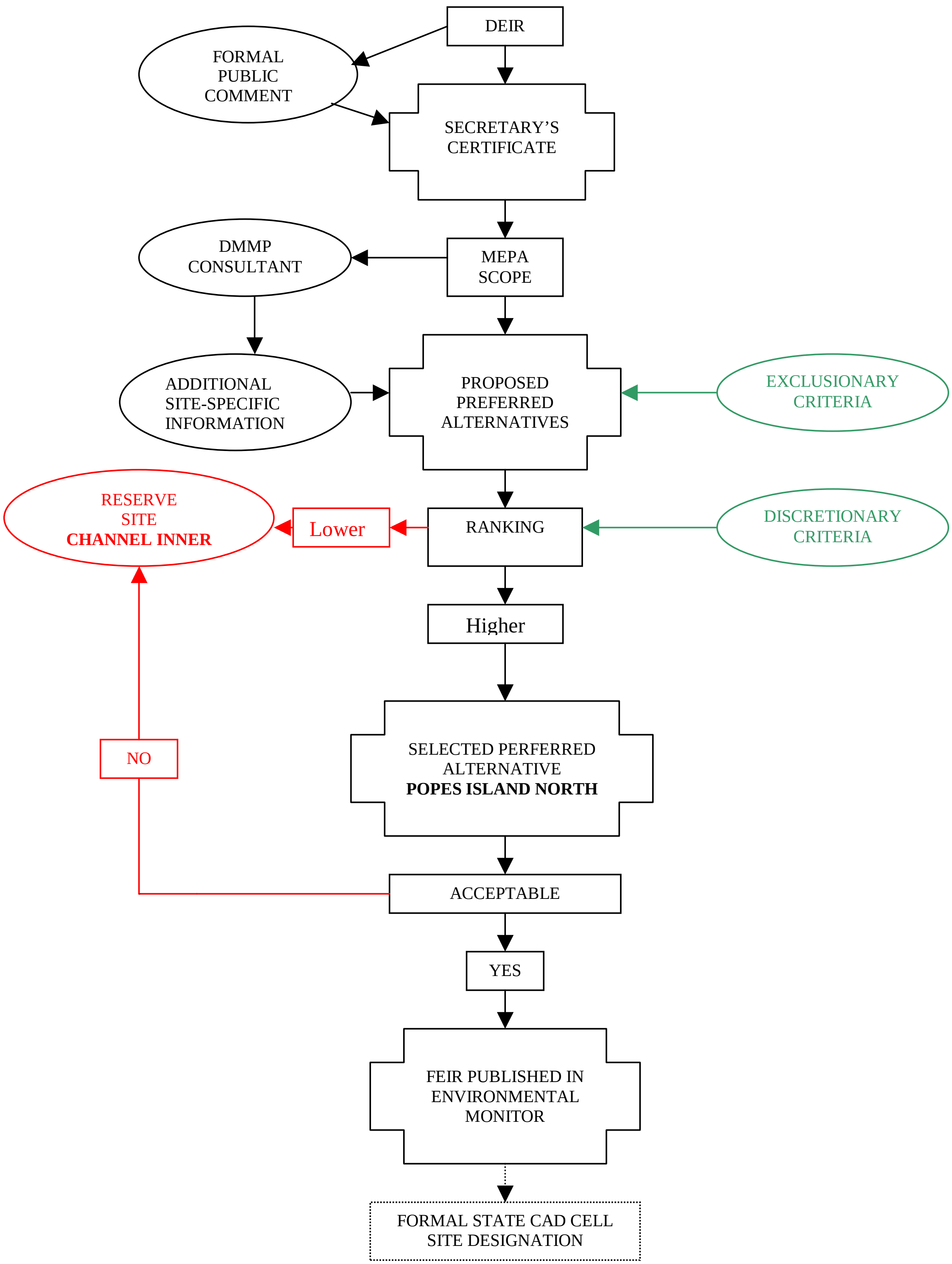


Figure 4-1. New Bedford/Fairhaven DMMP Preferred Alternative Screening Process

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: <u>Route;</u> The most practical route for tugs and barges for transit to and from the dredging area and disposal site. <u>Distance;</u> The distance based on the practical route was calculated from the head of navigation of the proposed dredging project. <u>Logistics;</u> 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***	Species abundance, density, diversity, and evenness, recolonization potential	Avoid, minimize, mitigate adverse impacts
- Shellfish beds	Habitat type, quality, heterogeneity, recovery potential, time of year issues	
- Nursery and Spawning Potential	Amount, type, benefits, impacts, recovery potential, distance, time of year issues	
- Finfish	abundance, benefits, impacts, recovery potential, time of year issues	
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:

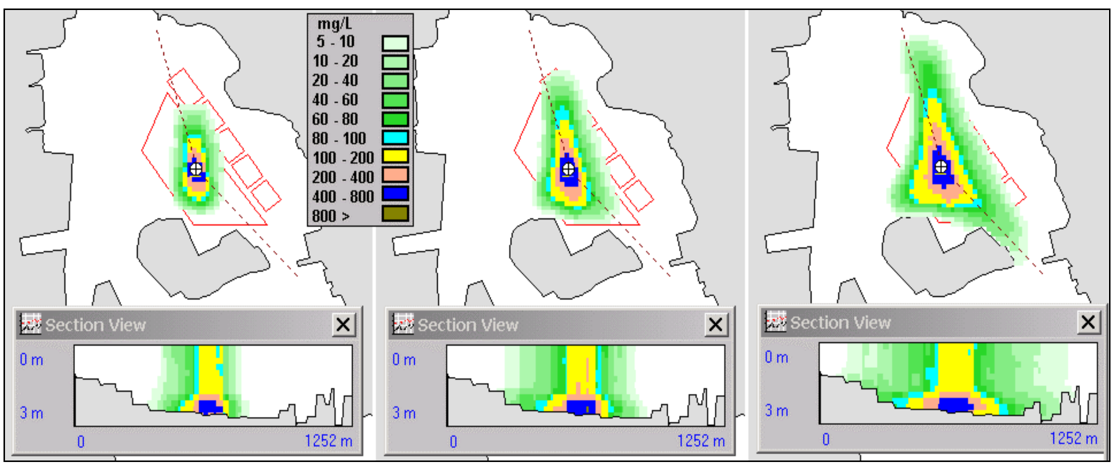
- Horizontal and vertical views of TSS concentration distribution
- Acreage of the area exceeding various concentration levels
- Sediment mass balance

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.

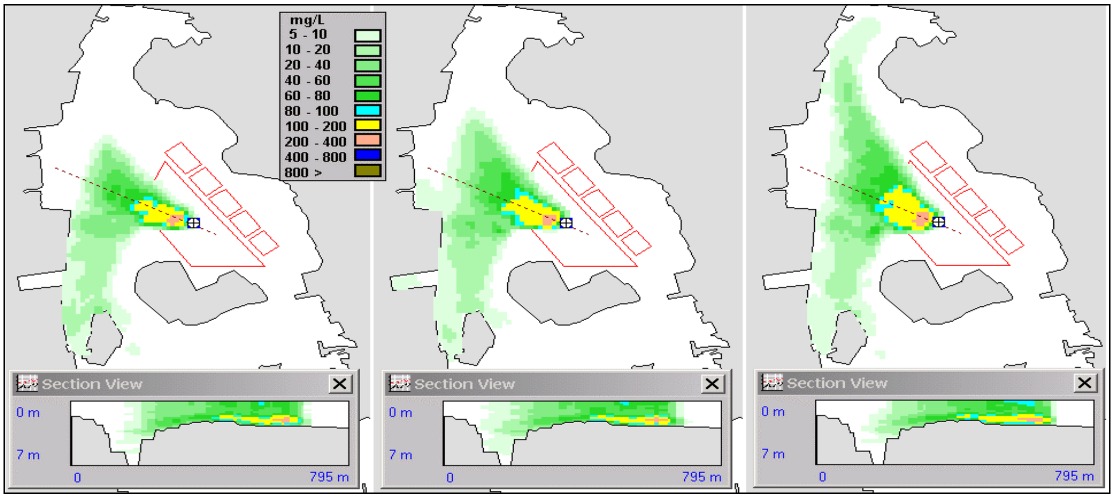
For the neap tides only condition (1st row), all TSS distributions appeared to be centered in the dredge site. Overall sediment plume sizes correspond to the tide strength. For the NWW wind cases, all sediment plumes trail to the lee side of the wind direction, whereas the opposite is found for the SWS 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.

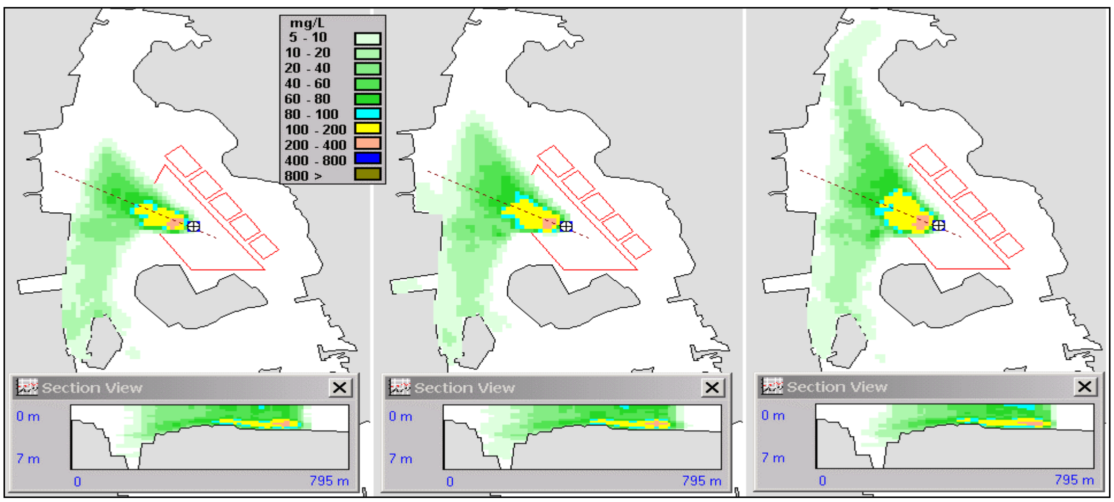
Figure 5-2 presents the mass of the fine fractions of sediment remaining in the water column after all settling has occurred. When the system reaches a quasi-steady state, the sediment mass introduced by dredging equals the mass that settles out, so the fraction of sediment that remains waterborne becomes 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.

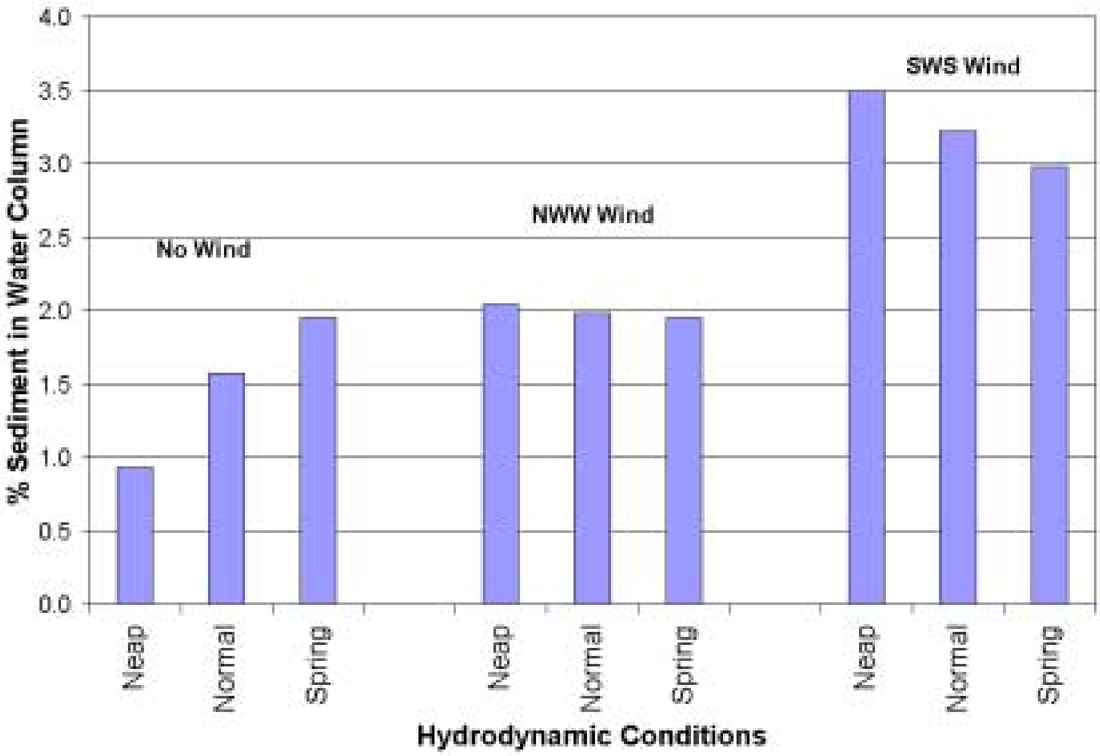


Figure 5-2. Sediment fractions in water column for various hydrodynamic conditions

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

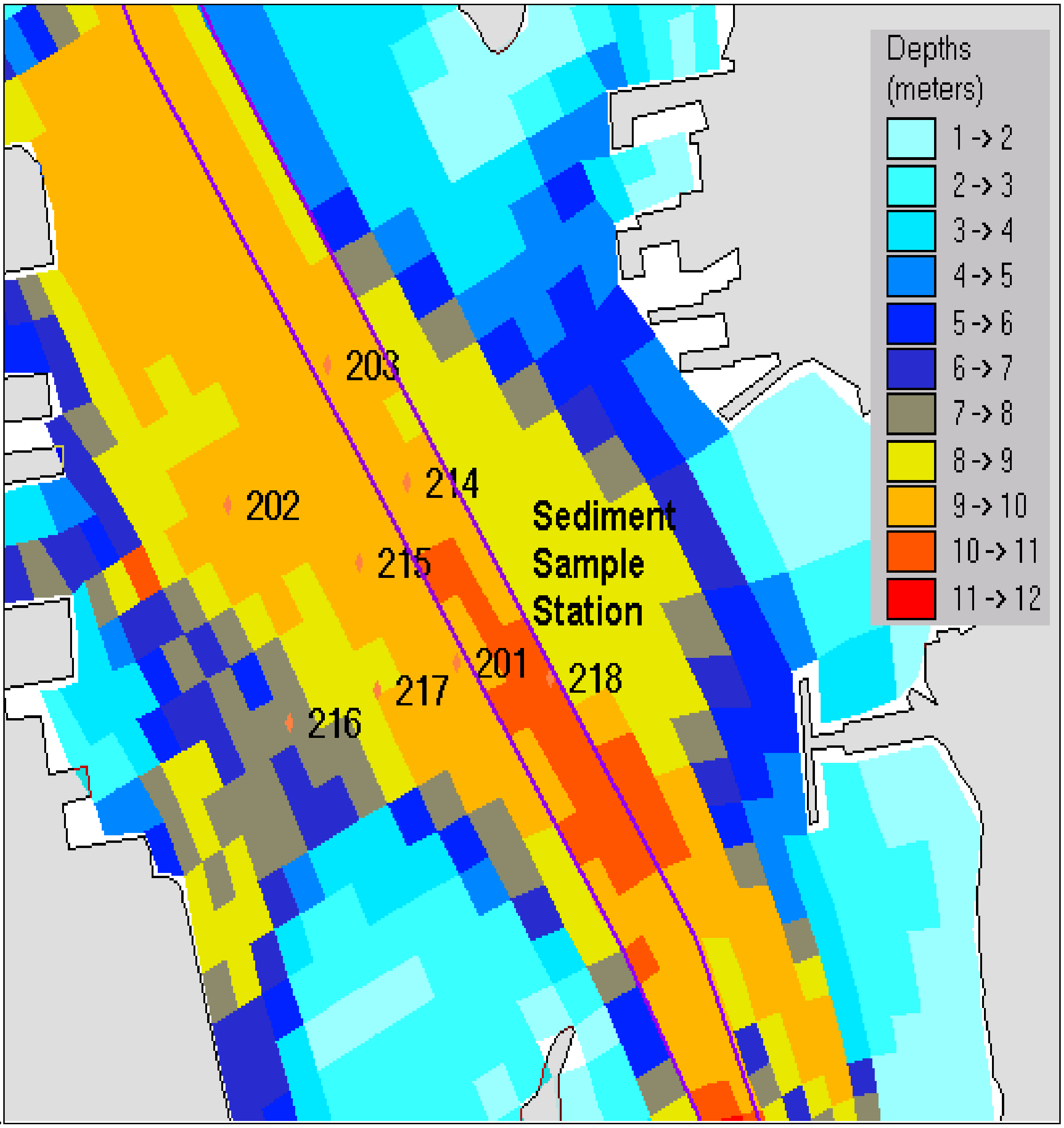


Figure 5-3. Map showing sediment sampling stations near Channel Inner dredge site.

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.

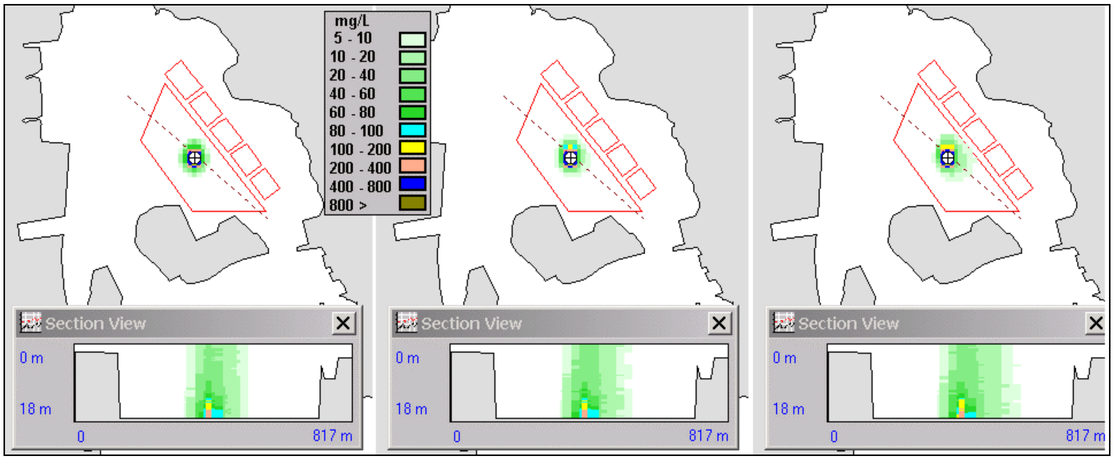
The simulation results presented in this section include:

- Horizontal and vertical view of TSS distribution
- Time series of acreage of exceeding 10 mg/L concentration levels

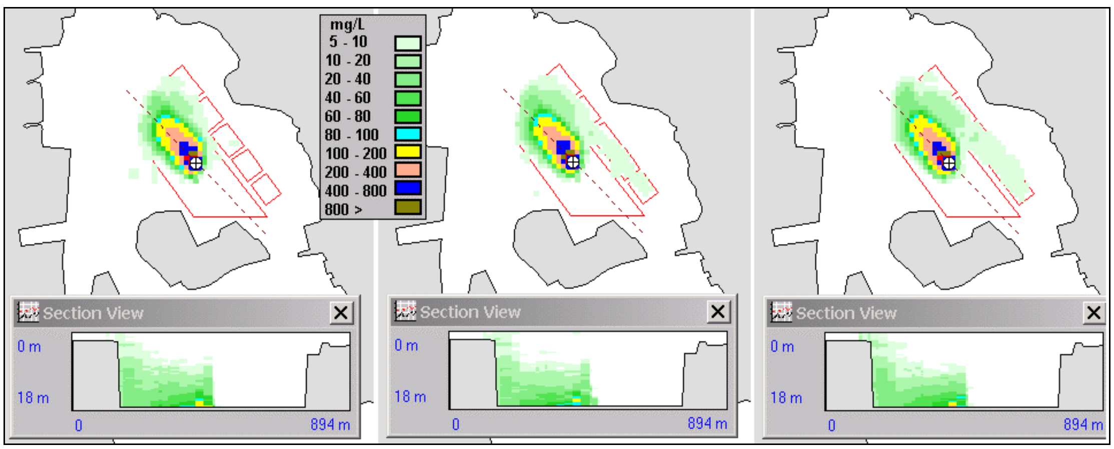
Figure 5-4 shows a plan view of the maximum predicted TSS concentrations throughout the water column during the 12-hour simulation period. Vertical section views of the concentration are inserted in the figure. The frames in the figure are organized by row (wind conditions) and columns (tide conditions). 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.

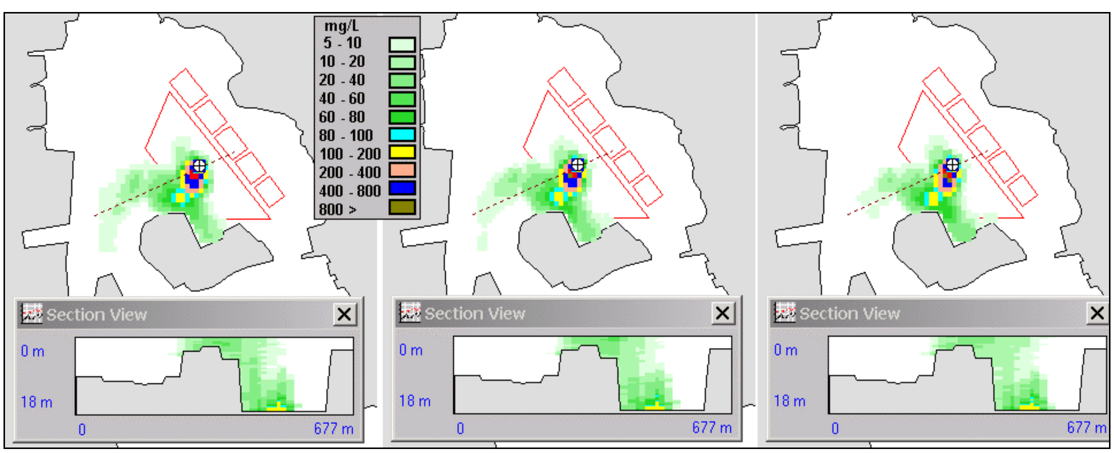
Figure 5-5 shows the area coverage that exceeds a TSS concentration of 10 mg/L (approximately the background threshold) in time. For the case of wind driven circulation, the sediment cloud dissipates within ~ 3 hours. The calm wind tide cases take much longer to settle as most sediment stays in the deep 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.

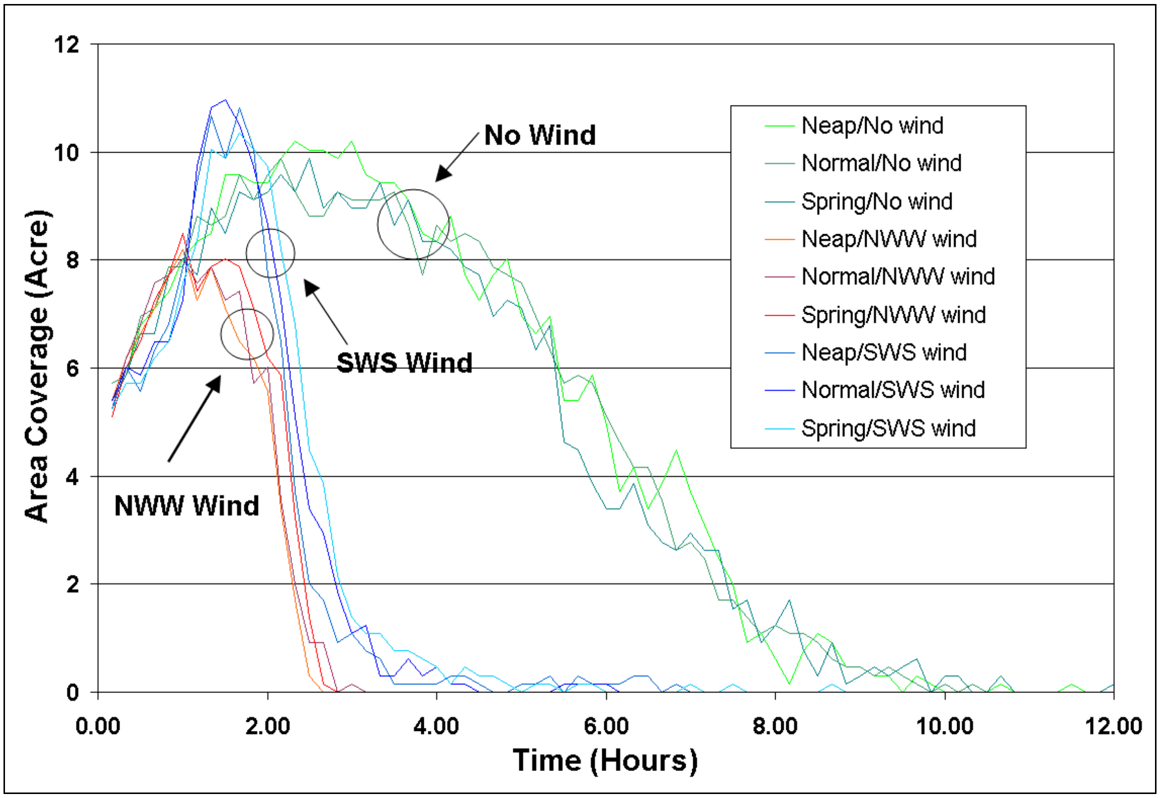


Figure 5-5. Time series of area coverage (acre) (encircled) that exceeds TSS concentration of 10mg/L for the nine hydrodynamic scenarios**.**

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.

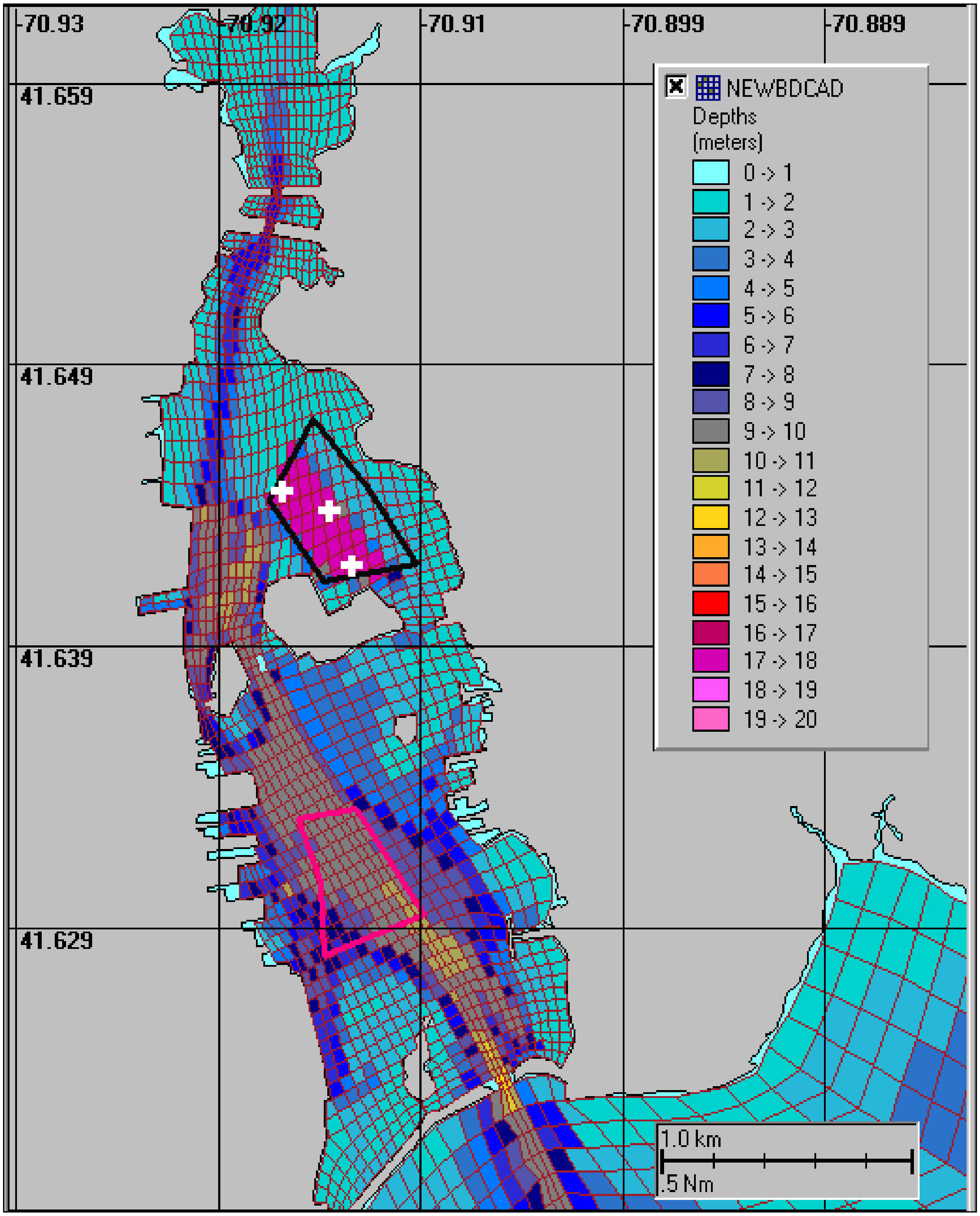


Figure 5-6. Modeled mass load locations (white crosses) used to simulate disposal operations in PIN-CAD site (black polygon), superimposed on bathymetry.

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.

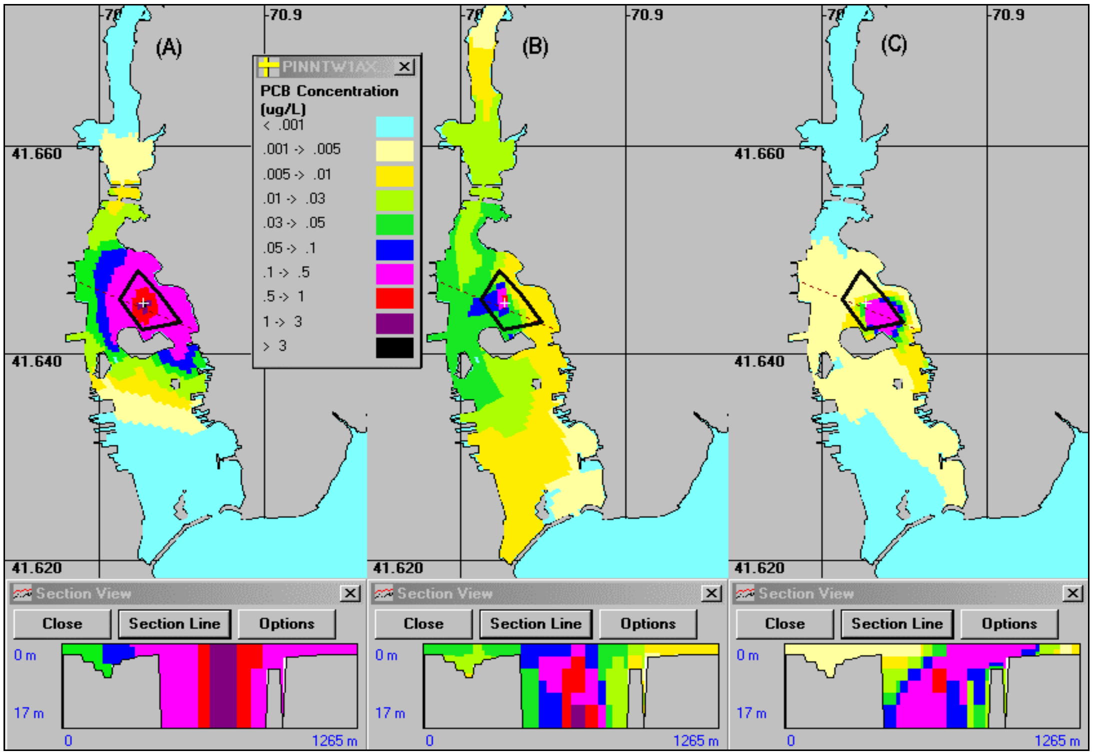


Figure 5-7. Simulated PCB distributions for calm wind (a), southwesterly (b) and northwesterly winds (c). Distributions are shown 1 hour after the final disposal event.

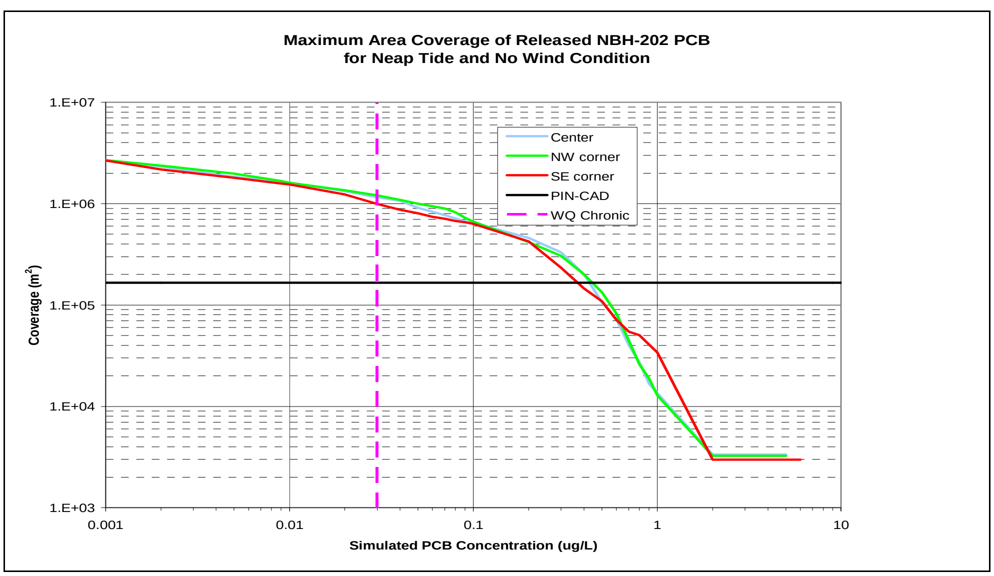


Figure 5-8. Maximum area coverages (y-axis) of PCBs vs. concentrations for neap tides and calm winds for three release sites using the NBH-202 station source strength. The PIN-CAD cell area (1.67×10^5 m^2) is a black horizontal line and the U. S. EPA WQ chronic value for PCB (0.03 μg/L) is a dashed purple 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.

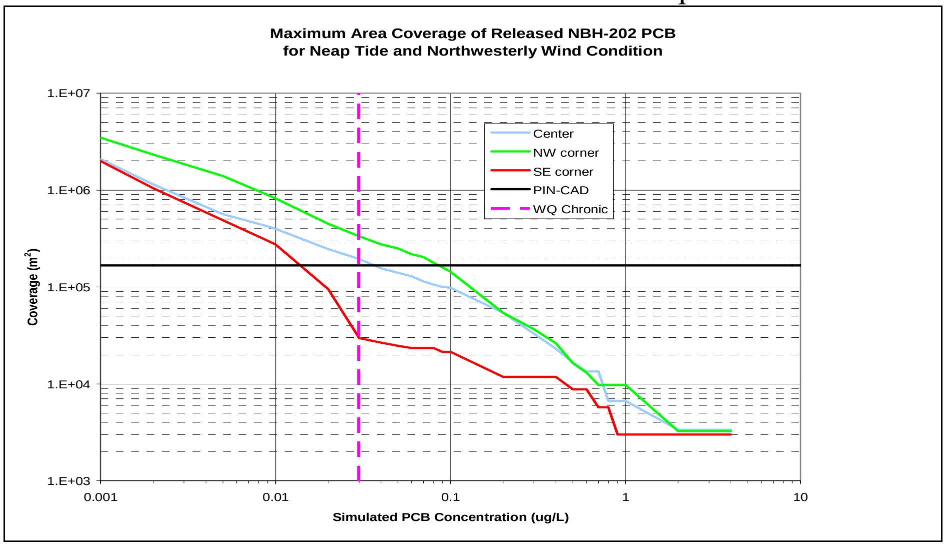


Figure 5-9. Maximum area coverages (y-axis) of PCBs vs. concentrations for neap tides and northwesterly winds for three release sites using the NBH-202 station source strength. The PIN-CAD cell area (1.67×10^5 m^2) a black horizontal line and the U. S. EPA WQ chronic value for PCB (0.03 μg/L) is a dashed purple vertical line.

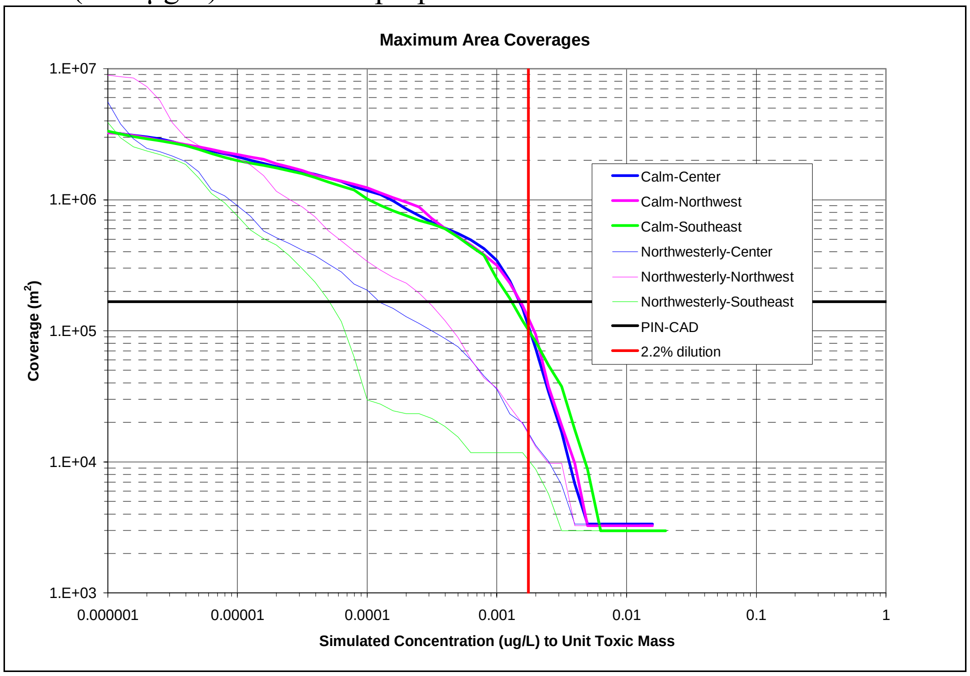


Figure 5-10. Maximum area coverage for released toxic material for calm and northwesterly winds.

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^{o}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

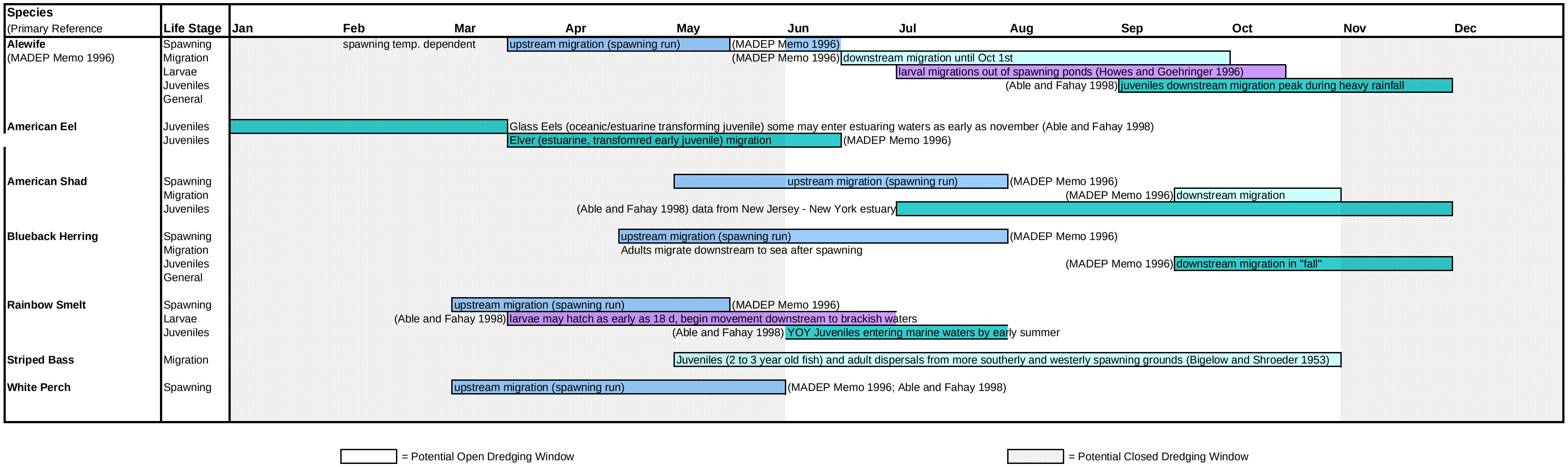
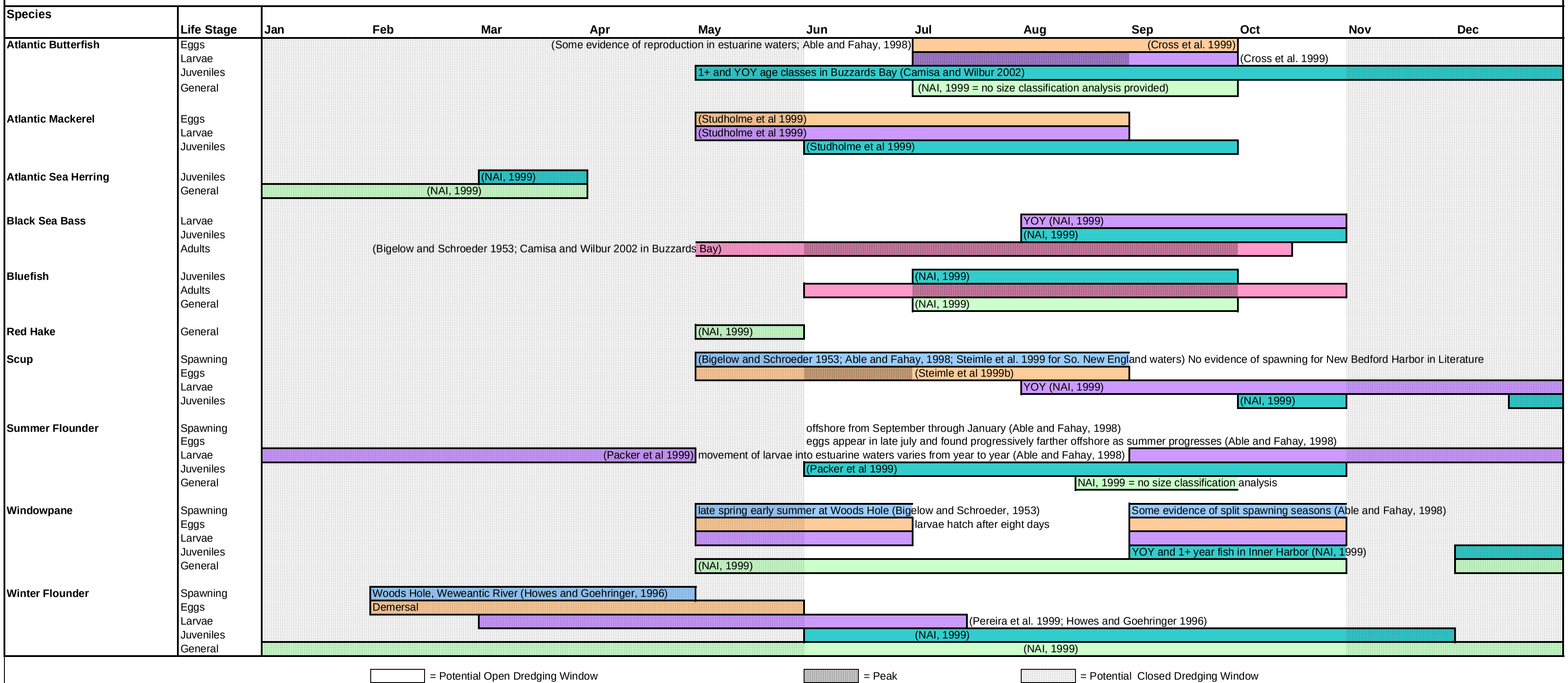


Figure7-2. Seasonal Occurrences of EFH Species Confirmed within the Vicinity of New Bedford Harbor (NAI, 1999) and Vicinity (Other References)



SECTION 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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JANE SWIFT
GOVERNOR

BOB DURAND
SECRETARY

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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.

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 taking any necessary actions.
C. 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
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RECEIVED
JUN 7 2002
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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.

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

A. 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.

B. 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.

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

Abdelrhman, M. A. and E. H. Dettmann, 1995. Modeling of current circulation, residence time, and salinity distribution in New Bedford Harbor, MA. U. S. Environmental Protection Agency, Environmental Research Laboratory, Narragansett, RI.

Able, K.W. and M.P. Fahay, 1998. The first year in the life of estuarine fishes in the Middle Atlantic Bight. Rutgers University Press. New Brunswick, NJ. 342 p.

Apex Environmental, Inc.Underwater Archaeological & Hazards Analysis Remote Sensing Survey: DMMP New Bedford, Massachusetts Site.. For Maguire Group Inc. March 23, 2003.

Apex Environmental, Inc. Addendum To Marine Geophysical Surveys: Seismic Refraction, Subaqueous Disposal Cell Feasibility Studies, Updated Data and Model Revision 1. For Maguire Group Inc. June 23, 2003.

Applied Science Associates, Inc, 2001.Preliminary Dredged Material Transport Modeling Analysis in New Bedford Harbor. ASA Project 01-100. For Maguire Group Inc. 28 pp.

Applied Science Associates, Inc, 2003.Dredged Material Transport Modeling Analysis in New Bedford Harbor. ASA Project 01-100.For Maguire Group Inc. 67 pp.

Ayvazian, S. G., L.A. Deegan,, and J.T. Finn. 1992. Comparison of habitat use by estuarine fish assemblages in the Acadian and Virginian zoogeographic provinces. *Estuaries* 15(3) 368-383.

Bigelow, H.B., and W.C. Schroeder. 1953. *Fishes of the Gulf of Maine*. Fishery Bulletin 74, Fishery Bulletin of the Fish and Wildlife Service, v. 53.

Burnham Associates. personal communication. April 2003.

Carey, Drew A. and Nancy Haley, 2002. Buzzards Bay Disposal Site Report: Massachusetts Division of Marine Fisheries Trawl Data Analysis. Submitted by Coastal Vision, Newport, RI.

Cembrola, Robert
1989 "Draft Report on Marine Archaeology." Report submitted to Camp, Dresser and McKee, Inc. Report on file with the BUAR. Boston.

Commercial Fisheries News.December 2002.*Small Pelagics plant opens in New Bedford.* Lorelei Stevens. Available on the WWW.

Cox, J. Lee, 2001 "New Bedford Harbor Superfund Site, New Bedford, Massachusetts, Underwater Archaeology Remote Sensing Survey." Report submitted by John Milner Associates to Foster Wheeler Environmental Corporation and the USACE (New England Division).

Cox, J. Lee, 2001a "Documentation of Derelict Vessels at Melville Shipyard, New Bedford Harbor Superfund Site, Bristol County, Massachusetts." Report submitted by John Milner Associates to Foster Wheeler Environmental Corporation and the USACE (New England Division).

Day, John W.; Charles A.S. Hall; W. Michael Kemp; Alejandro Yañez-Arancibia. 1989. Estuarine Ecology. John Wiley & Sons. New York. 558 pp.

ENSR. 2003. Draft benthic infaunal analysis for the New Bedford/Fairhaven Harbor Dredged Material Disposal Plan #11669, Confined Aquatic Disposal (CAD). ENSR #04391010.

ENSR, International, 2002. Boston Harbor Navigation Improvement Project Phase 2 Summary Report.

ENSR. 2001. New Bedford Harbor Long Term Monitoring Survey III: Summary Report. Contract number DACW33-96-D-0004. 35 pp. + Appendices.

ENSR, 2001. Boston Harbor Navigational Improvement Project (BHNIP). Prepared for Massachusetts Coastal Zone Management. 56 pp. + Appendices.

Environmental Protection Agency (EPA). 1991. EMAP. Near-Coastal Laboratory Procedures Macrobenthic Community Assessment. Prepared by Versar, Inc.

Foster Wheeler Environmental Corporation, 2001, *Report Of Marine Geophysical Surveys: Phase I Uniboom & Seismic Refraction And Phase II Seismic Refraction, New Bedford Harbor Superfund Site Operable Unit #1*, Foster Wheeler Environmental Corporation, Boston, MA.

Great Lakes Dredge & Dock Company. personal communication. March 2003.

Hoff, J.G. and R. M. Ibara. 1977. Factors affecting the seasonal abundance, composition and diversity of fishes in a southeastern New England Estuary. Estuarine Coastal Marine Science 5: 665-678.

Kalisz, Mayor Frederick M., Jr. June 26, 2002. Largest Cruise Ship To Ever Dock In New Bedford Makes Its Inaugural Port of Call On Monday. Available on the WWW.

Lloyd, H., Zar, J.H., and Karr, J.R. 1968. On the calculation of information-theoretical measures of diversity. American Midland Naturalist. 79: 257-272.

MA DEM. 1992. Cape Cod Disposal Site (Generic EIR).

MA DMF (Massachusetts Division of Marine Fisheries). 1999. Quahog Standing Crop Survey: New Bedford/Fairhaven Inner and Outer Harbors. Produced June 6, 1999.
Science Applications International Corporation (SAIC). 2003. Laboratory Testing In Support of Site Specific Water Quality Criteia Assessment and Hydrographic Data Collection for New Bedford Harbor, Task 2C Water Effects Ratio Study, Data Report. For Maguire Group Inc. 28 January 2003

Maguire Group, Inc. 2002. Draft Environmental Impact Report for the Dredged Material Management Plan (#EOEA 11669). Prepared for Massachusetts Coastal Zone Management, City of New Bedford and Town of Fairhaven. 393 pp. + Appendices.

Magurran, A.E. 1988. Ecological Diversity and Measurement. Princeton University Press, Princeton. 179 pp.

Malcolm Pirnie. Final Operation and management Plan for the Disposal of Dredged Material at the Newark Bay Confined Disposal Facility. For The Port Authority Of New York And New Jersey. August 1998.

Nelson, W.G., B.J. Bergen, S.J. Benyi, G. Morrison, R.A. Voyer, C.J. Strobel, S. Rego, G. Thursby and C.E. Pesch. 1996. New Bedford Harbor Long Term Monitoring Assessment Report: Baseline Sampling. U.S. Environmental Protection Agency, National Health and Environmental Effects Research Laboratory, Atlantic Ecology Division, Narragansett, RI. EPA/600/R-966/097.

Normandeau Associates, Inc. (NAI), 1999. Dredged Material Management Plan. Fisheries Resources Survey for New Bedford. Final Report. Prepared for Massachusetts Office of Coastal Zone Management

Pielou, E.C. (1966). The measurement of diversity in different types of biological collections. Journal of Theoretical Biology. 13: 131-144.

- Charles O'Hara, Robert Oldale, "Geology and Shallow Structure Maps of Eastern Rhode Island Sound and Vineyard Sound, Massachusetts," Department of the Interior, United States Geologic Survey, 1980

- Department of the Navy, Naval Facilities Engineering Command, "NAVFAC Design Manual 7.1," May 1982

- E-an Zen Editor, "Bedrock Geologic Map of Massachusetts," Department of the Interior, United States Geologic Survey, 1983

- Ebasco Services Inc., "Final Draft – Preliminary Geotechnical Investigation of Engineering Properties, New Bedford Harbor," August 1988

- Herbich, John, B., "Handbook of Dredging Engineering," Second Edition, McGraw-Hill Books, 2000

- James Robb, Robert Oldale, "Preliminary Geologic Maps, Buzzards Bay Massachusetts," Department of the Interior, United States Geologic Survey, 1977

- Joseph Bowles, "Foundation Analysis and Design," Fifth Edition, McGraw Hill, 1996
- Schenck, Hilbert, Jr., Editor, "Introduction to Ocean Engineering," McGraw-Hill Books, 1975

Providence Journal. August 24, 2003. *New Bedford ferry to Vineyard gets OK*. P. B-3.

Rhoads, D.C., and J.D. Germano. 1982. "Characterization of benthic processes using sediment profile imaging: an efficient method of remote ecological monitoring of the seafloor (REMOTS System)". *Marine Ecology Progress Series* 8:115-128.

Ricketson, Daniel
1858 *The History of New Bedford, Bristol County Massachusetts: Including a History of the Old Township of Dartmouth and the Present Townships of Westport, Dartmouth, and Fairhaven From Their Settlement to the Present Time*. Published by the Author, New Bedford.

Science Applications International Corporation (SAIC). 1999a. Habitat Characterization of the DMMP Candidate Aquatic Disposal Sites. Submitted to Massachusetts Coastal Zone Management, Boston, MA. Submitted by Science Applications International Corporation, Newport, RI. SAIC Report No. SAIC-99/463.

Santos, S.L. and J.L. Simon, 1980. Marine Soft-Bottom Community Establishment Following Annual Defaunation: Larval or Adult Recruitment? Mar. Ecol. Prog. Ser., Vol 2: 235-241, 1980.

Sayer, William, editor
1889 *New Bedford, Massachusetts, Its History, Industries, Institutions, and Attractions*. Mercury Publishing, New Bedford.

Steimle, Frank W., Christine A Zetlin, Peter L. Berrien, Donna L. Johnson, and Sukwoo Chang. 1999a. Essential Fish Habitat Source Document: Scup, *Stenotomus chrysops*, Life History and Habitat Characteristics. NOAA Technical Memorandum NMFS-NE

United States Army Corps of Engineers. personal communication.Tom Fredette. September 2002.

United States Army Corps of Engineers. Technical Report DOER-1. Guidance for Subaqueous Dredged Material.Dredging Operations and Environmental, Waterways Experiment Station. June 1998.

United States Army Corps of Engineers, New England District. 1998. Providence River and Harbor Maintenance Dredging Project Draft Environmental Impact Statement. U.S. Army Corps of Engineers New England District, Concord, MA.

United States Army Corps of Engineers. 1996. Inventory of Dredging Needs in the Designated Port Areas of Massachusetts: 1996-2016. Conducted by the U.S. Army Corps of Engineers, New England Division for the Massachusetts Executive Office of Environmental Affairs, Office of Coastal Zone Management. December, 1996.

United States Army Corps of Engineers, New England Division and Massport (Massachusetts Port Authority). 1995. "Boston Harbor, Massachusetts Navigation Improvement Project and Berth Dredging Project." Final Environmental Impact Report and Final Environmental Impact Statement. Massachusetts Executive Office of Environmental Affairs, File Number 8695.

U.S. Environmental Protection Agency (USEPA). 2002. Explanation of Significant Differences for the Upper and Lower Harbor Operable Unit - New Bedford Superfund Site, New Bedford, Massachusetts. Region I - New England. August 2002.

Witting, D.A., K.W. Able, and M.P. Fahay. 1999. Larval and Juvenile Fishes of a Middle Atlantic Bight Estuary: Assemblage Structure and Stability. Can J. Fish. Aquat. Sci. 56:222-230.

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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

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:

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251 Causeway Street, Suite 900
Boston, MA 02202

Submitted by:

Maguire Group Inc.

July 2003

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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, <u>Boring Program General Information Summary</u> and Table 2, <u>Boring Program Bedrock Information Summary</u> for more detailed and summarized Boring Program information. Refer to Appendix I, <u>Popes Island North Project Boring Logs</u> and Appendix III, <u>Channel Inner Project Boring Logs</u> 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, <u>Popes Island North and Channel Inner CAD Cell Site Location Plan</u>:
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  - Proposed CAD Cell configurations.
- Figure 2, <u>Popes Island North CAD Cell Configuration, Subsurface Profile and Exploration Location Plan</u>:
  - 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, <u>Popes Island North Ebasco Boring Logs,</u>
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- Figure 3, <u>Popes Island North Subsurface Profile A-A'</u>:
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  - 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':
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  - Projected Project boring information,
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  - 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.

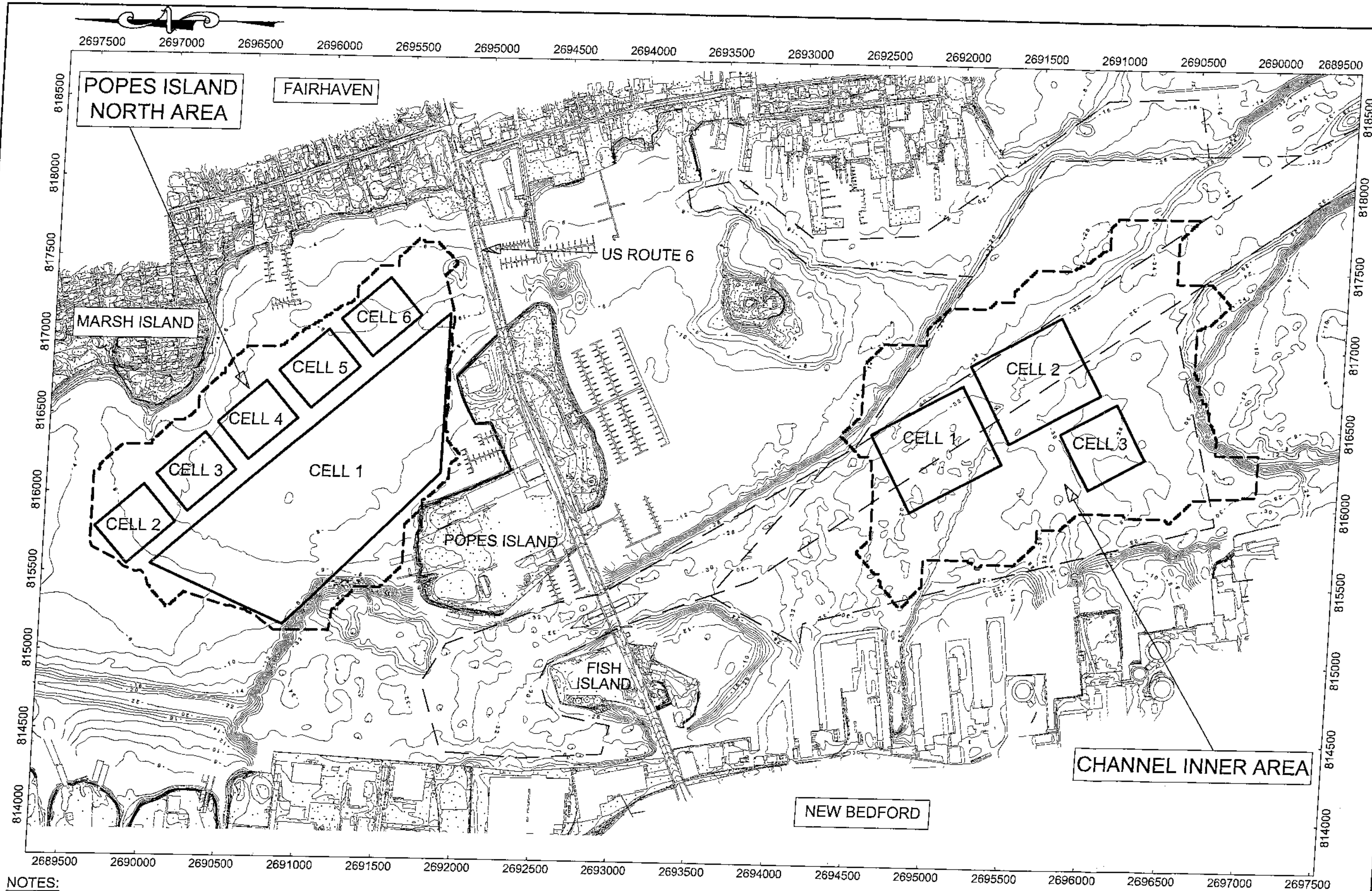
In the Popes Island North site, accommodation for several small volume dredge projects, ±50,000 yd^3 each, as well as a large volume dredge project, ±1,800,000 yd^3, fits well with revealed subsurface conditions. The relatively shallow sediment depths along the area's eastern, Fairhaven, limits favors 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



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

CZM

Maguire Group Inc.
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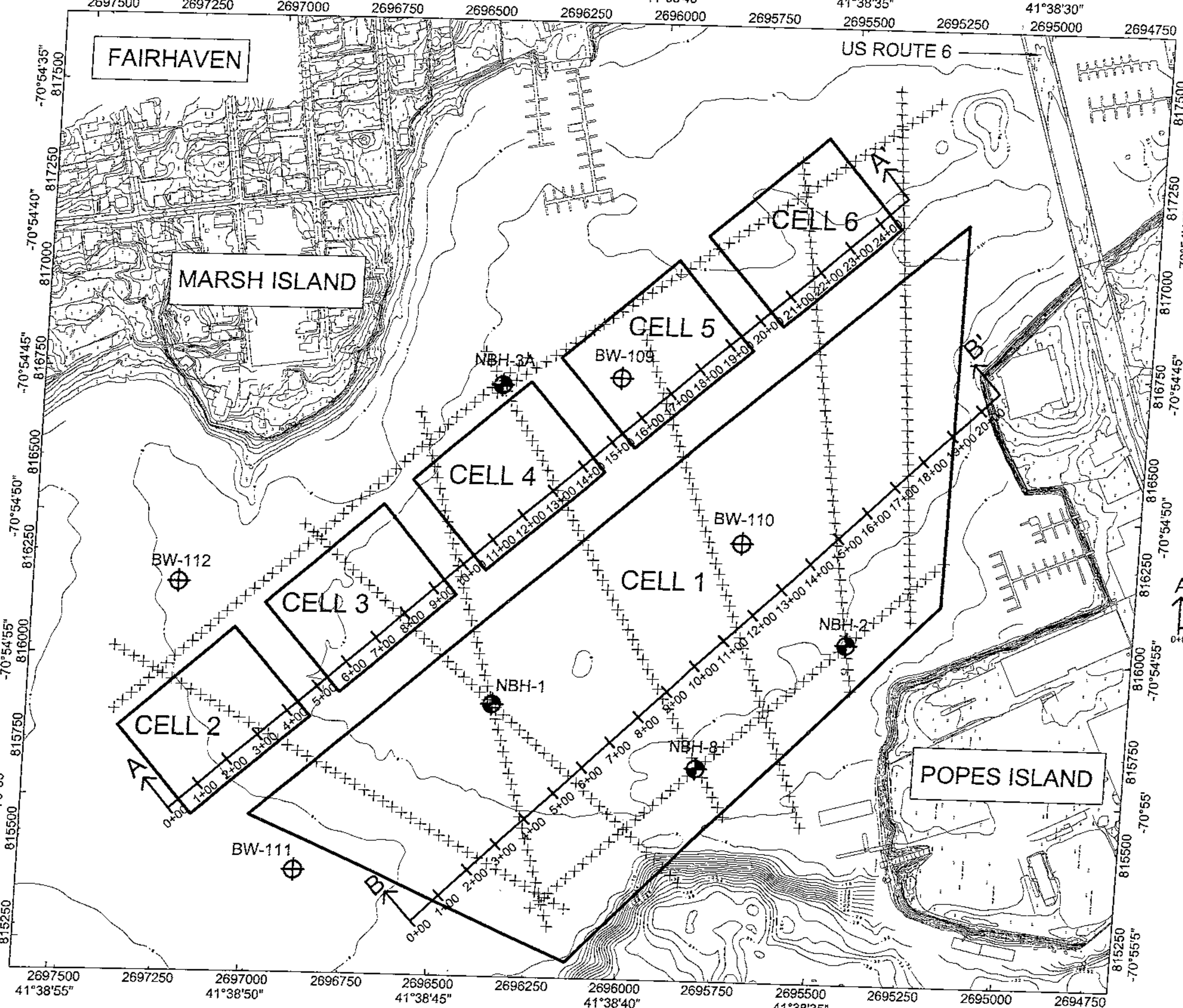
NEW BEDFORD HARBOR
NEW BEDFORD, MASSACHUSETTS
POPES ISLAND NORTH AND CHANNEL INNER
CAD CELL SITE LOCATIONS

PROJECT NO.: 16454
DESIGNED BY: ---
DRAWN BY: ---
CHK'D BY:
DATE: 06/02/03
SCALE: AS NOTED
SHEET NO.
1
SHEET 1 OF 7



POPES ISLAND NORTH
CAD CELL CONFIGURATION
SUBSURFACE PROFILE AND EXPLORATION LOCATION PLAN

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' (0+00 1+00 2+00 3+00 4+00) PROFILE LOCATION WITH STATIONING

3. SCALE:

0 300 600 900

SCALE: 1"=300' FEET

CZM

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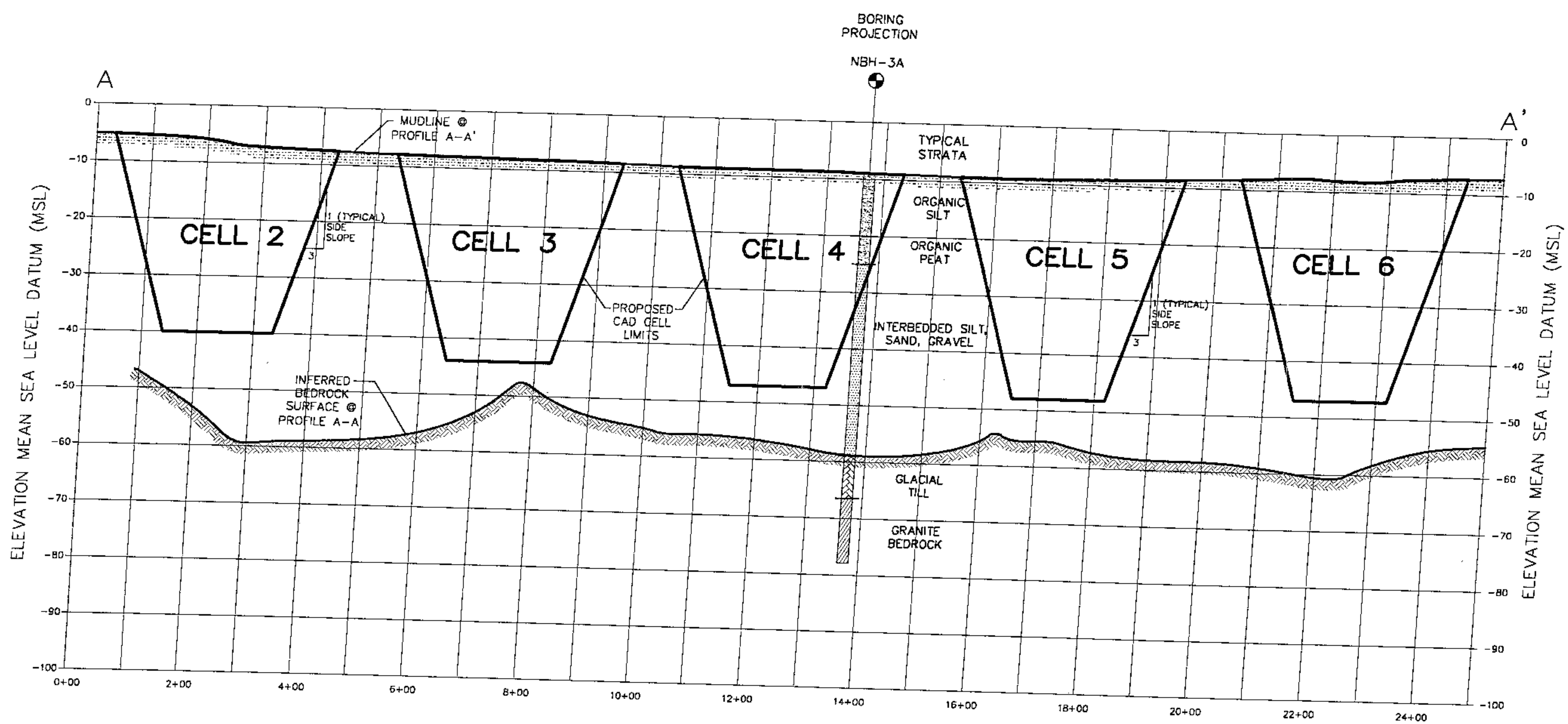
NEW BEDFORD HARBOR
NEW BEDFORD, MASSACHUSETTS

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	
SHEET NO. 2	



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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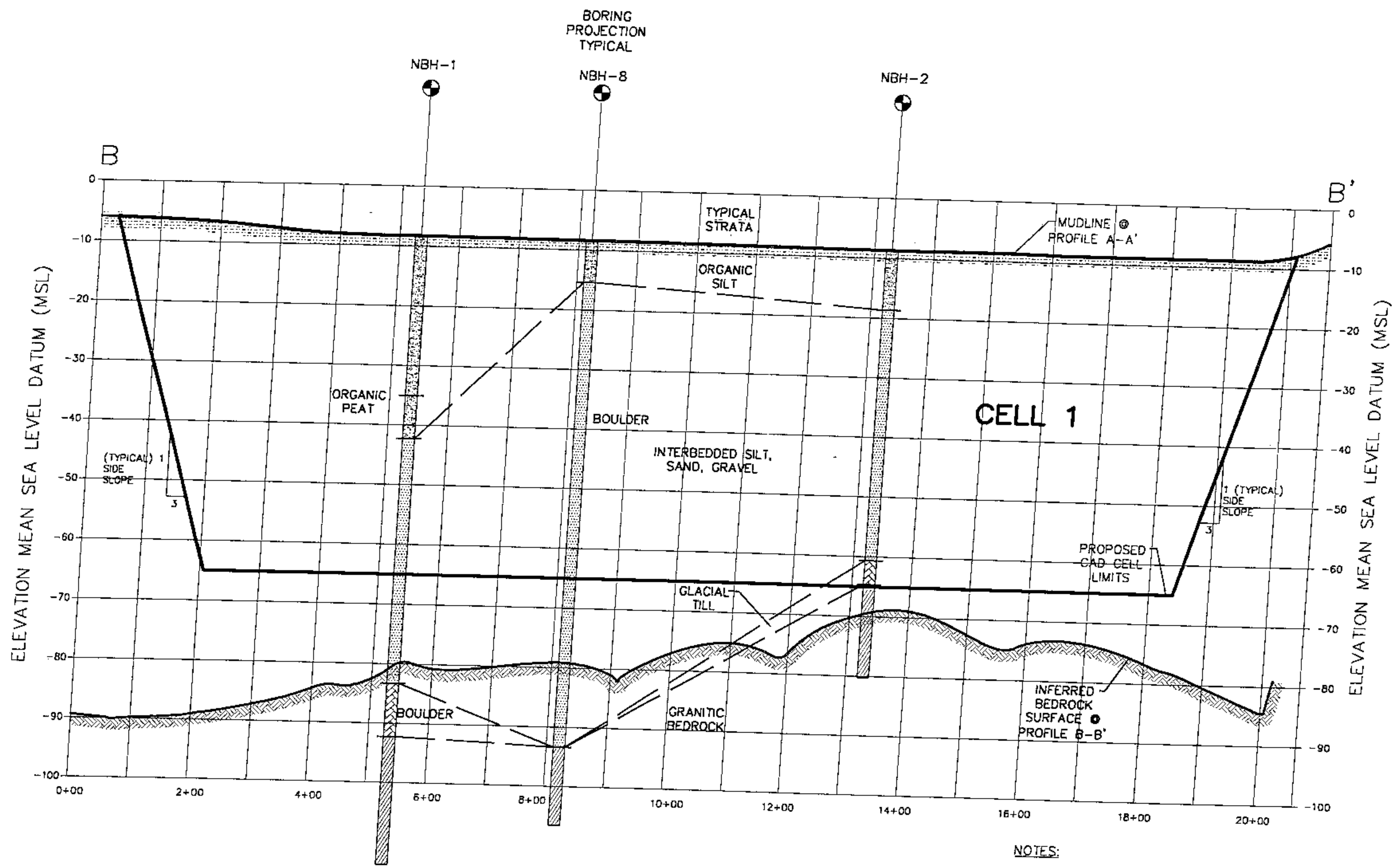
MAGUIRE GROUP

NEW BEDFORD HARBOR
NEW BEDFORD, MASSACHUSETTS

POPES ISLAND NORTH
SUBSURFACE PROFILE A-A'

PROJECT NO.: 16454
DESIGNED BY: ---
DRAWN BY: ---
CHK'D BY:
DATE: 06/02/03
SCALE: AS NOTED
SHEET NO.
3



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

CZM

Maguire Group Inc.
Architects/Engineers/Planners
225 Foxborough Boulevard
Foxborough, Massachusetts 02035

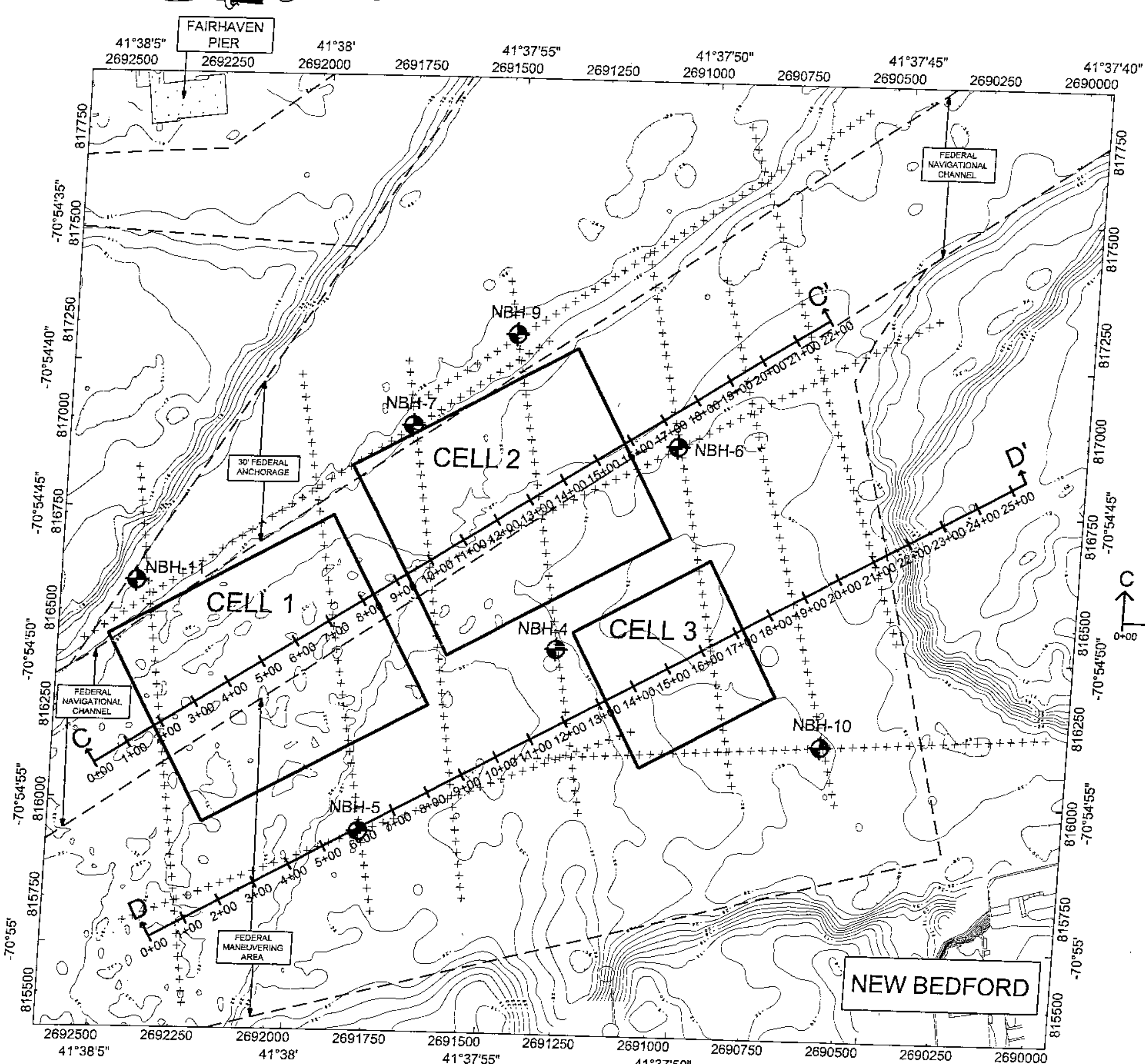
NEW BEDFORD HARBOR
NEW BEDFORD, MASSACHUSETTS

POPES ISLAND NORTH
SUBSURFACE PROFILE B-B'

PROJECT NO.: 16454	
DESIGNED BY: ---	
DRAWN BY: ---	
CHK'D BY:	
DATE:	06/02/03
SCALE: AS NOTED	

SHEET NO.

4



CHANNEL INNER
CAD CELL CONFIGURATION
SUBSURFACE PROFILE AND EXPLORATION LOCATION PLAN

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

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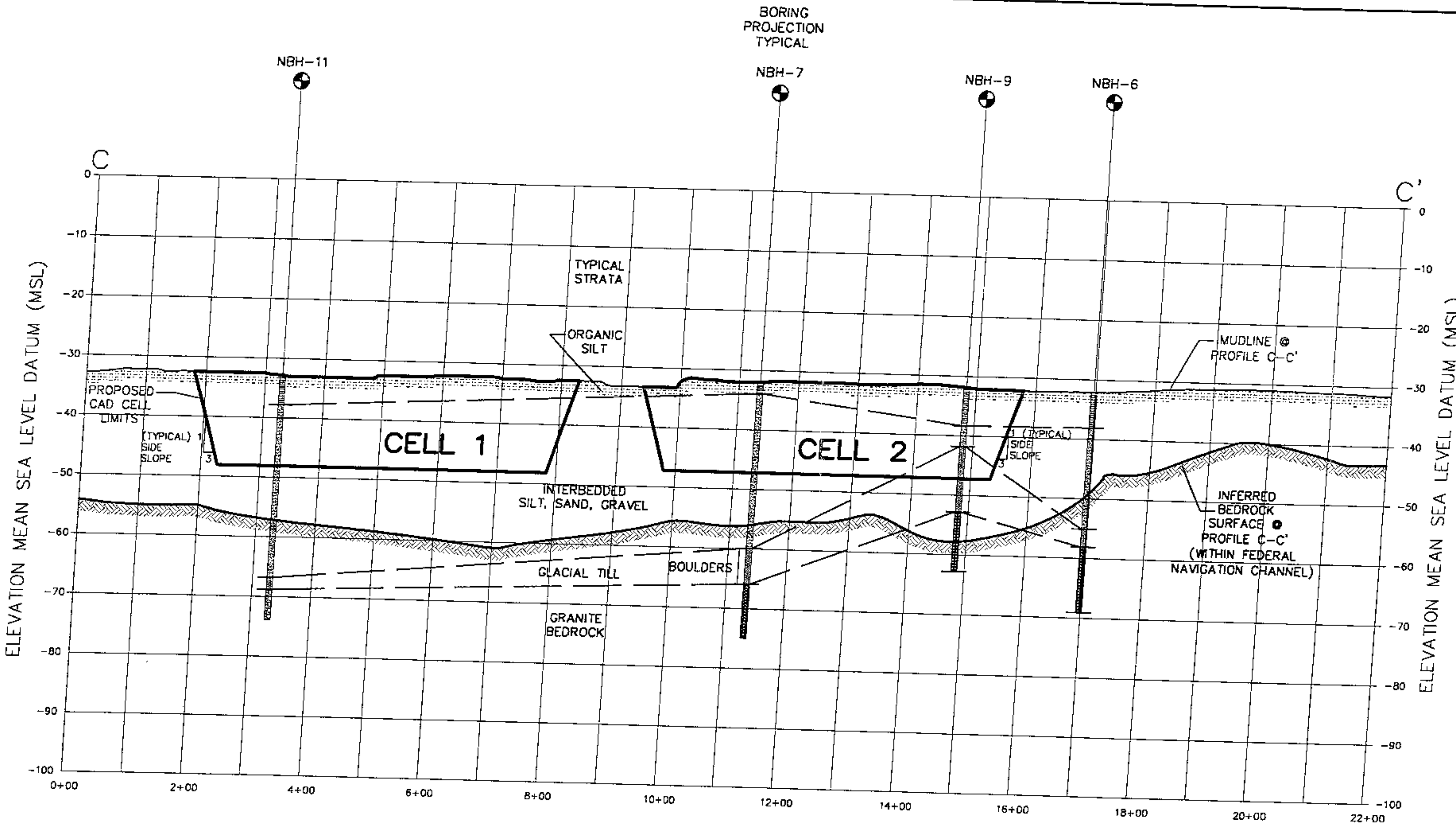
Foxborough, Massachusetts 02035

NEW BEDFORD HARBOR
NEW BEDFORD, MASSACHUSETTS
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	
SHEET NO.	5



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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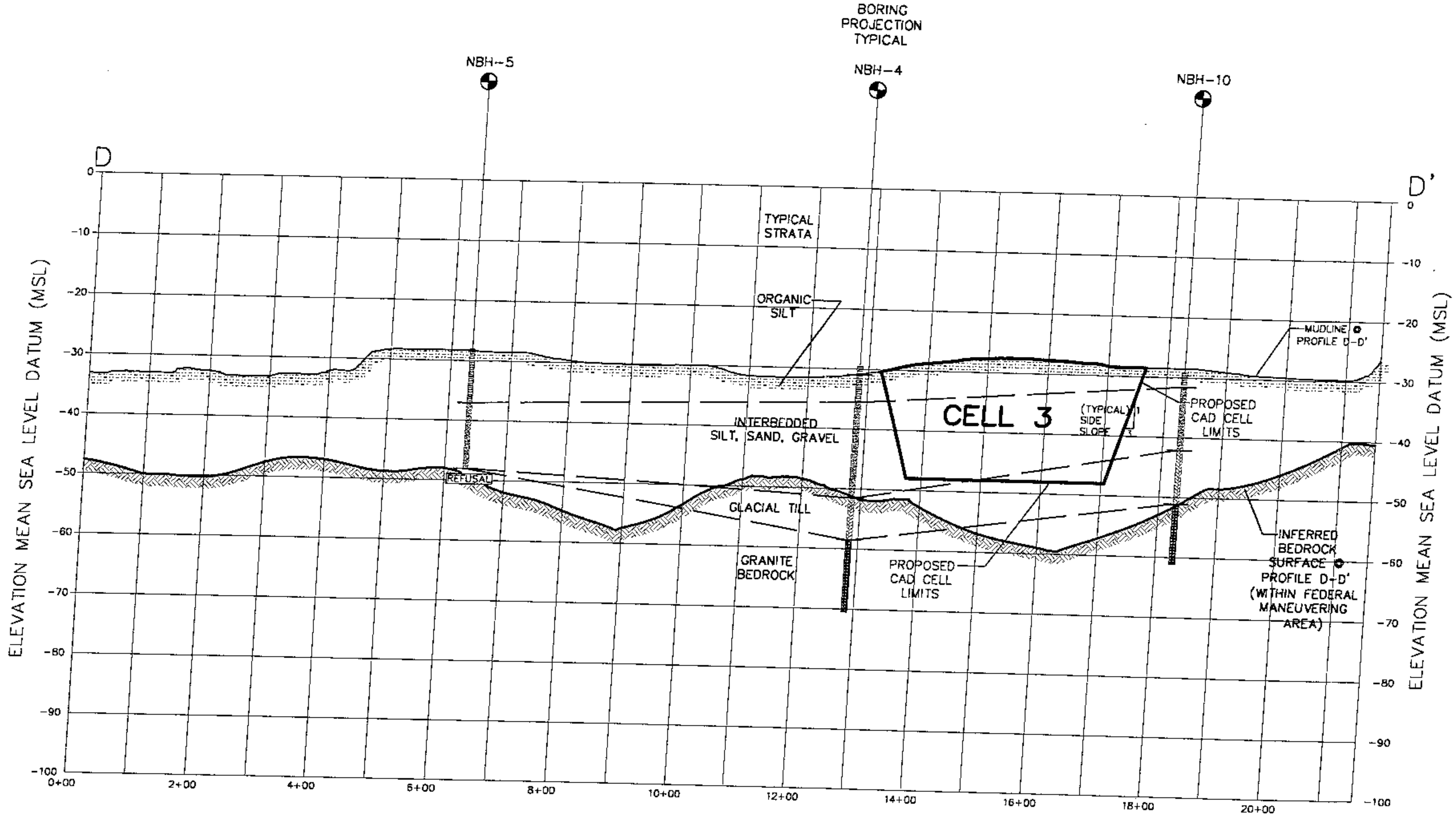
Foxborough, Massachusetts 02035

NEW BEDFORD HARBOR
NEW BEDFORD, MASSACHUSETTS

CHANNEL INNER
SUBSURFACE PROFILE C-C'

PROJECT NO.: 16454	
DESIGNED BY: ---	
DRAWN BY: ---	
CHK'D BY:	
DATE:	06/02/03
SCALE: AS NOTED	
SHEET NO.	6



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

CZM

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Architects/Engineers/Planners
225 Foxborough Boulevard
Foxborough, Massachusetts 02035

MAGUIRE GROUP

NEW BEDFORD HARBOR
NEW BEDFORD, MASSACHUSETTS

CHANNEL INNER
SUBSURFACE PROFILE D-D'

PROJECT NO.: 16454
DESIGNED BY: ---
DRAWN BY: ---
CHK'D BY:
DATE: 06/02/03
SCALE: AS NOTED
SHEET NO.
7

SHEET 7 OF 7

Tables

New Bedford Harbor Confined Aquatic Disposal Cell Feasibility Study

Popes Island Summary Geotechnical Laboratory Index Testing

Table 3A

Boring, Sample	Sample Location (Avg.)[2] Depth (Ft.)	Sample Location (Avg.)[2] Elevation (MSL)	Stratum ID.[3]	Test Type[4]	% Fines[5] Clay	% Fines[5] Silt	% Fines[5] Tot. Fines	% Sand[5] Fine	% Sand[5] Medium	% Sand[5] Coarse	% Gravel[5] Fine	% Gravel[5] Coarse	Wn[6]	Atterberg Limits[7] LL	Atterberg Limits[7] PL	Atterberg Limits[7] PI	Organic Content %[8]	Tot. Wt. (Lb/Ft^3)	Unified 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	Boring Length (Ft.)		
	Northing	Easting	Distance from Intended (Ft.)		Mudline	Bedrock	Dia. Used[3]	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		Bedrock Core Runs[2]							Rock Mass Quality[10]
	Type	Surface Elev.[1]	Dia. (in)[3]	Length (Ft.)[4]	ID.[5]	Depth (Ft.)[6]	Elevation (MSL)[7]	% Recovery[8]	% RQD[9]	
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

Boring, Sample	Sample Location (Avg.)[2] Depth (Ft.)	Elevation (MSL)	Stratum ID.[3]	Test Type[4]	% Fines[5] Clay	Silt	Tot. Fines	% Sand[5] Fine	Medium	Coarse	% Gravel[5] Fine	Coarse	Wn[6]	Atterberg Limits[7] LL	PL	PI	Organic Content %[8]	Tot. Wt. (Lb/Ft^3)	Unified 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

Boring, Sample	Sample Location (Avg.)[2] Depth (Ft.)	Elevation (MSL)	Stratum ID.[3]	Test Type[4]	% Fines[5] Clay	Silt	Tot. Fines	% Sand[5] Fine	Medium	Coarse	% Gravel[5] Fine	Coarse	Wn[6]	Atterberg Limits[7] LL	PL	PI	Organic Content %[8]	Tot. Wt.[9] (Lb/Ft^3)	Unified 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/ft^3)[5] γ_{total}	Unit Weight (lb/ft^3)[5] $\gamma_{bouyant}$	Unit Weight (lb/ft^3)[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. | 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

GROUND WATER OBSERVATIONS		CASING	SAMPLER	CORE BAR.		DATE
At ____ after ____ Hours	Type	HW-NW	S/S	NV-II	Start	6/20/01
	Size I.D.	4" 3"	1-3/8"		Complete	6/27/01
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 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."
		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 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."
						9			Gray fine SAND and Silt			
		43.5-45.5	D	5	4	5		44.0	Gray fine to medium SAND, some silt, trace fine gravel & coarse sand	10	24	12
45						9						
		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.

SHEET 3 OF 3

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."
		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	Proportions Used		140 lb. Wt x 30" fall on 2" O.D. Sampler					SUMMARY:
D=Drive C=Cored W=Washed	trace	0 to 10%	Cohesionless	Density	Cohesive	Consistency		Earth Boring 87.5'
UP=Fixed Piston UT=Shelby Tube	little	10 to 20%	0-10	Loose	0-4	Soft	30 + Hard	Rock Coring 15'
TP=Test Pit A=Auger	some	20 to 35%	10-30	Med. Dense	4-8	M./Stiff		Samples 17
OE = Open End Rod	and	35 to 50%	30-50	Dense	8-15	Stiff		
* 300# hammer			50+	Very Dense	15-30	V-Stiff		HOLE NO. NBH-1

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-2
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. -7.8' MSL

GROUND WATER OBSERVATIONS		CASING	SAMPLER	CORE BAR.		DATE
At ____ after ____ Hours	Type	HW-NW	S/S	NV-II	Start	6/29/01
	Size I.D.	4" 3"	1-3/8"		Complete	7/2/01
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	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												
								36.0				
		38.0-40.0	D	11	7	7			Gray fine to coarse SAND, some fine to medium gravel, little silt	8	24	6
						10						

GROUND SURFACE TO ____ USED ____ CASING: THEN ____

Sample Type	Proportions Used		140 lb. Wt x 30" fall on 2" O.D. Sampler					SUMMARY:
D=Drive C=Cored W=Washed	trace	0 to 10%	Cohesionless	Density	Cohesive	Consistency		Earth Boring 59'
UP=Fixed Piston UT=Shelby Tube	little	10 to 20%	0-10	Loose	0-4	Soft	30 + Hard	Rock Coring 10'
TP=Test Pit A=Auger	some	20 to 35%	10-30	Med. Dense	4-8	M./Stiff		Samples 11
OE = Open End Rod	and	35 to 50%	30-50	Dense	8-15	Stiff		
* 300# hammer			50+	Very Dense	15-30	V-Stiff		HOLE NO. NBH-2

GUILD DRILLING CO., INC.
100 WATER STREET • EAST PROVIDENCE, R.I.

TO Maguire Group, Inc. | ADDRESS Foxborough, MA | HOLE NO. NBH-2

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. -7.8' MSL

Depth	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler 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."
		43.0-45.0	D	6	9	15			Gray Brown silty fine SAND (compact), trace fine	9	24	10
						14			gravel			
45												
								46.0				
		48.0-50.0	D	8	5	9			Gray silty very fine SAND	10	24	12
						7						
50												
								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	Proportions Used		140 lb. Wt x 30" fall on 2" O.D. Sampler					SUMMARY:
D=Drive C=Cored W=Washed	trace	0 to 10%	Cohesionless	Density	Cohesive	Consistency		Earth Boring 59'
UP=Fixed Piston UT=Shelby Tube	little	10 to 20%	0-10	Loose	0-4	Soft	30 + Hard	Rock Coring 10'
TP=Test Pit A=Auger	some	20 to 35%	10-30	Med. Dense	4-8	M./Stiff		Samples 11
OE = Open End Rod	and	35 to 50%	30-50	Dense	8-15	Stiff		
* 300# hammer			50+	Very Dense	15-30	V-Stiff		HOLE NO. NBH-2

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-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

GROUND WATER OBSERVATIONS		CASING	SAMPLER	CORE BAR.		DATE
At ____ after ____ Hours	Type	HW-NW	S/S	NV-II	Start	7/12/01
	Size I.D.	4" 3"	1-3/8"		Complete	7/13/01
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 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."
		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.

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		C1	60	52
		RQD = 90%					5		GRANITE			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	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 1 OF 3

TO	Maguire Group, Inc.	ADDRESS	Foxborough, MA
PROJECT NAME	Aquatic Disposal Project	LOCATION	New Bedford, MA
REPORT SENT TO	above	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 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."
		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	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

GUILD DRILLING CO., INC.
100 WATER STREET • EAST PROVIDENCE, R.I.

SHEET 2 OF 3

TO Maguire Group, Inc. | ADDRESS Foxborough, MA | HOLE NO. NBH-8
PROJECT NAME Aquatic Disposal Project | LOCATION New Bedford, MA | PROJ. NO. 16421
REPORT SENT TO above | OUR JOB NO. 03-100 | SURF. ELEV. -7.5

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."
		41.5-43.5	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
								84.0	Gray fine to coarse SAND and Gravel, some silt & weathered rock			
85		85.0-85.3	D	120/3"						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	Proportions Used		140 lb. Wt x 30" fall on 2" O.D. Sampler					SUMMARY:
D=Drive C=Cored W=Washed	trace	0 to 10%	Cohesionless	Density	Cohesive	Consistency		Earth Boring 86'
UP=Fixed Piston UT=Shelby Tube	little	10 to 20%	0-10	Loose	0-4	Soft	30 + Hard	Rock Coring 11'
TP=Test Pit A=Auger	some	20 to 35%	10-30	Med. Dense	4-8	M./Stiff		Samples 16
OE = Open End Rod	and	35 to 50%	30-50	Dense	8-15	Stiff		HOLE NO. NBH-8
* 300# hammer			50+	Very Dense	15-30	V-Stiff		

DEPTH (FT.)	CASING BLOWS/FT	SAMPLE NO. PENETRATION/RECOVERY	LAB TEST	WATER CONTENT (%)	SHEAR STRENGTH, Su PEAK/RESIDUAL (psf) ROD PROBE (BLOWS/FT)	SOIL CLASS	SOIL DESCRIPTION	STANDARD PENETRATION RESISTANCE BLOWS/FT
1	WOC					SANDY ORGANIC SILT	Dark gray sandy organic silt, little shell fragments, H_2S odor.	
2	WOC	S-1 2.0 poor			49/15		Very soft, wet.	WOR
3					122/37	4.0		
4		S-2 2.0 poor	G	214.9		SILTY SAND	Dark gray silty sand, little shell fragments, very loose, H_2S odor, wet.	WOR
5					184/52			
6		S-3 2.0			203/21		No recovery.	WOR
8		S-4 2.0			209/25			WOR
10	WOC	S-5 2.0			295/31		Medium dark gray silty sand, little gravel, little shell fragments, medium dense, wet. Layer, 0.05', brown fine fibrous peat.	10
11	7							
12	26					12.0 SAND	Gray fine to coarse sand, little to some gravel, trace silt, dense, wet.	
13	13	S-6						31
14	19					14.0 GRAVELLY SAND	Gray gravelly fine to coarse sand, trace silt, medium dense, gap graded, wet.	
15	21	S-7	G	12.5				26
16	22							
17	34							
18	61							
19	46							
20	35	S-8 2.0 poor						9
21	17							
22	19							
23	16							
24	23							
25	15	S-9						8
26	21							
27	23							
28	30							
29	38							
30	28	S-10						8
31	19							
32	24						Gray gravelly fine to coarse sand, trace silt, medium dense, gap graded, wet.	
33	43					33.0 SAND	Light brown fine to coarse sand, trace gravel, very loose, well graded, wet.	
34	60	S-11						4
35	40							
36	36				2		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".	
37	53				7			
38	73				8			
39	90				13			
40	73				51			

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 1/2
Project No. 4959-19	Date Drilled 2/4 - 2/9/88	Sheet A-12

DEPTH (FT.)	CASING BLOWS/FT.	SAMPLE NO. PENETRATION/RECOVERY	SAMPLE	LAB TEST	WATER CONTENT (%)	SHEAR STRENGTH, Su PEAK/RESIDUAL (psi) 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	90					72	Grayish brown fine to medium sand, dense to very dense.				
41											
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				
							* Rock core obtained with a double barrel N core and NWX core bit.				
55											
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.				
2		U-1 H 2.0 / 1.3									
8		U-2 H 2.0 / 0.0				10.0	No recovery.				
10							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

DEPTH (FT.)	CASING BLOWS/FT	SAMPLE NO. PENETRATION/RECOVERY	SAMPLE	LAB TEST	WATER CONTENT (%)	SHEAR STRENGTH, Su PEAK/RESIDUAL (psi) 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							ORGANIC SILT — Dark gray silt, some shell fragments.				
1	WOC										
2	WOC	C-1 2.0		G	88.5	52/12	Trace to little fine sand, H_2S odor, wet.				
3	WOC				76.7						
4	WOC				87.3	52/12	Some fine sand, very soft.		WOR		
5	WOM	S-1 2.0									
	WOM	C-2 2.0		G	85.6	92/18					
					59.7						
					52.0	221/43	Two layers, ≈0.1' to 0.3', fine sandy silt.		WOR		
		S-2 2.0				166/13	10.0				
10		C-3 2.0					SANDY ORGANIC SILT — Dark gray fine sandy silt, trace gravel, very soft, H_2S odor, moist.				
						215/61	Layer, 0.2', silty fine sand.		WOR		
		S-3 2.0 2.0									
		C-4 2.0			14.0	353					
15	WOM						15.3				
	3					-	SAND — Dark gray fine to medium sand, little shell fragments, trace to little silt, very loose, well graded, H_2S odor, moist.		2		
	3	S-4 2.0									
	4						Layers of brown peat, moist.		2		
	4	S-5 2.0					Fine sand, trace medium sand, very loose, faint H_2S odor.				
20	5						Some brown peat lenses.				
	8										
	12										
	16						23.0				
	21	S-6					PEAT — 1.2'-1.4' Dark brown peat, some shell fragments, trace sand, very soft, H_2S odor moist.		3		
25	21						0.0'-1.1' Blackish dark brown silty peat, very soft, H_2S odor, moist.				
	25										
	18										
	18										
	20	C-5 2.0					Layer, 0.2', gray silt, little fine sand.				
	28						Gray "super" watered silty peat, saturated.				
30	30	S-7					Layer, 0.3', gray silt, little fine sand.		11		
	29						31.5				
	39	S-8					SAND — Gray fine to med. sand, trace silt. 1.0'-1.5' Gray fine to coarse sand, some silt, trace shell fragments, trace gravel, peat lenses, wet.		12		
	34						34.0				
35		S-9 2.0 0.6		G	10.9		0.0'-1.0' Gray fine to medium sand, little coarse sand, trace gravel, medium dense, wet.		33		
						24	Gray gravelly fine to coarse sand, trace silt, dense, gap graded.				
						28	Probed from 36.0' to 62.0' with				
						28	BW drill rods and hollow stem tip.				
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-110		Page 1/2
Project No. 4959-19	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: BM-110		Page 2/2
Project No. 4959-19	Date Drilled 2/9 - 2/10/88	Sheet A-16

Depth (ft.)	Casing Blows/Ft
0–1	3
1–2	5
2–3	5
3–4	7
4–5	3
5–6	3
6–7	3
7–8	3
8–9	3
9–10	3
10–11	3
11–12	11
12–13	4
13–14	13
14–15	18
15–16	25
16–17	21
17–18	26
18–19	23
19–20	18
20–21	22
21–22	38
22–23	43
23–24	47
24–25	39
25–26	52
26–27	57
27–28	54
28–29	50
29–30	51
30–31	64
31–32	54
32–33	68
33–34	53
34–35	64
35–36	80
36–37	96
37–38	107
38–39	71
39–40	56

Sample No. / Penetration / Recovery	Lab Test	Water Content (%)	Soil Description	Soil Class	Standard Penetration Resistance Blows/Ft
			Brown fine sand, little silt.	SAND	
S-1 2.0/1.0	S	18.0	Wet. No silt, medium dense, well graded.		11
S-2 2.0/0.8	G		Trace coarse sand, trace shell fragments, loose.		10
S-3 2.0/0.9	G D	33.7			4
S-4 2.0/1.15			Trace silt, no shell fragments.		10
S-5 2.0/0.9			0.5'–0.9' Some coarse sand, trace medium sand, trace shell fragments, wet. Layer, 0.075', brown silt.		14
S-6 2.0/1.1			0.0'–0.4' Brown fine sand, well graded, wet. Trace coarse sand, medium dense.		17
S-7 2.0/1.1			Grayish brown fine sand, trace coarse sand, trace medium sand, medium dense, well graded, wet, brown mottling throughout, layer, 0.15', gray fine sandy silt.		11
S-8			Grayish brown fine to coarse sand, little silt, very loose, gap graded, wet. Fine sand, no silt, well graded.		3
S-9			Brownish gray fine sand, trace medium sand, trace silt, loose, well graded, wet.		6
S-10			0.85'–1.1' Fine to coarse sand, trace gravel. Layer, 0.5', brownish gray silty fine sand. 0.0'–0.4' Brownish gray fine sand, trace silt, loose, well graded, wet.		3
S-11 2.0/1.0		18.6	No silt, very loose.		2
S-12 2.0/1.2			Gray fine sand, trace silt, loose, well graded, wet.		5

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-111 Page 1/2

Project No. 4959-19 Date Drilled 1/28 – 2/3/88 Sheet A-17

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	78										
41	102										
42	110						Layer, 1.0', gray silty fine sand. Gray fine sand, loose, well graded, wet.				
43	83	S-13 2.0/1.8							6		
44	97										
45	110										
46	122										
47	136	S-14 2.0/1.2		G	29.6		Layer, >1.2', gray silty fine sand.		5		
48	95										
49	116										
50	73										
51	62										
52	83	S-15 2.0/1.5					Little to some silt, medium dense, well graded.		11		
53	127										
54	98										
55	114										
56	117										
57	125	S-16 2.0/[illegible]					Layer, 0.25', gray fine to coarse sand, trace gravel, trace silt, medium dense, well graded.		16		
58	x										
59	x										
60	x										
61	x						Casing refusal, cored through large cobble. Telescoped casing from 4.0" nominal steel casing to 3.0" nominal to continue advancement of the borehole.				
62	x	R-1									
63	33										
64	18										
65	27										
66	43										
67	50										
68	63	S-17 [illegible]					Brown fine to medium sand, some gravel, trace coarse sand, trace silt, very dense, wet.				
69	49										
70	54										
71	58										
72	48						73.0'				
73		*R-2 1.75/[illegible]					BEDROCK AT 73.0 FEET Gray fine grained muscovite gneiss, few garnet inclusions, thin foliations (¼" to 1"), trace chloritization. RQD = 0.0%				
74							74.75'				
75							BOTTOM OF EXPLORATION AT DEPTH OF 74.75 FEET				
80							* Rock core obtained with a single barrel B core and BWX core bit.				

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-111 Page 2/2

Project No. 4959-19 | Date Drilled 1/28 - 2/3/88 | Sheet 4-18

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							ORGANIC SILT — Dark gray organic silt, some shell fragments, H_2S odor.				
1	WOC					110/15	Trace shell fragments, very soft, wet.				
2	WOC	S-1 2.0/1.3		G K D	38.0		2.5		WOH		
3	WOC						SILTY SAND — Dark gray silty fine sand, trace medium sand, very loose, H_2S odor, wet.				
4	WOC	S-2 2.0/0.0					No recovery		WOH		
5	WOH						6.0				
	WOH	S-3 2.0/0.4		G	22.6		SAND — Dark brown fine to coarse sand, trace silt, very loose, wet. Layer, <0.1', peat.		4		
	1										
	4	S-4 2.0/1.0					Brown fine sand, little medium sand, trace coarse sand, medium dense, wet.		29		
	12										
10	19	S-5 2.0/1.0					Trace medium sand, trace gravel, trace silt, very dense, little mottling.		55		
	22										
	22	S-6 2.0/1.35					Brownish gray fine sand, little gravel, trace coarse sand, trace medium sand, dense, wet.		46		
	12										
	21	S-7					Little to some gravel, gap graded.		33		
15	18										
	30										
	34										
	53										
	35	S-8		G	17.6		Some gravel, little coarse sand, loose.		8		
20	9										
	12										
	26										
	38	S-9					Grayish brown fine to medium sand, some gravel, trace coarse sand, loose, wet.		5		
	13	1.35									
25	14										
	32										
	56										
	64	S-10		G	17.6		Little coarse sand.				
	23										
30	28										
	53										
	53						0.4'-0.7' Grayish brown coarse sand, little gravel, trace med. sand, trace fine sand, medium dense.				
	55	S-11 2.0					34.0				
	x						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.				
35	x						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, 47, 29, 51					
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-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							110					
41							183	NO PENETRATION				
42							100+					
43							42.8	*REFUSAL SURFACE ENCOUNTERED AT DEPTH OF 42.8 FEET				
44												
45								* Refusal of drilling tools and sampling equipment with methods used. Refusal surface is assumed to represent bedrock.				
50												
55												
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-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 Maquire 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' MLLW

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 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."
		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				
10		9.0-11.0	D	1	2	2			Tan fine SAND, little medium sand, trace silt	3	24	8
						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.

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' 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."
							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	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 1 OF 1

TO Maguire Group, Inc. | ADDRESS Foxborough, MA | HOLE NO. NBH-5
PROJECT NAME Harbor Aquatic Disposal Cell | LOCATION New Bedford, MA | PROJ. NO. 164-21
REPORT SENT TO above / Feasibility Study | OUR JOB NO. 02-011 | SURF. ELEV. -27.8' MLLW

GROUND WATER OBSERVATIONS		CASING	SAMPLER	CORE BAR.		DATE
At ______ after ____ Hours	Type	HW	S/S		Start	7/5/01
	Size I.D.	4"	1-3/8"		Complete	7/5/01
At ______ after ____ Hours	Hammer Wt.	300#	140#	BIT	Boring Foreman	J. Medeiros
	Hammer Fall	24"	30"		Inspector/Engr.	R. Sharpnack

LOCATION OF BORING

Depth	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler 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."
		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 / 4		9.0	Brown fine to coarse SAND, some fine to coarse gravel, little silt	3	24	8
								12.0				
15		14.0-16.0	D	14	9	5 / 6			Brown silty fine SAND, little fine gravel	4	24	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. | ADDRESS Foxborough, MA | HOLE NO. NBH-6
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. -28.6' MLLW

GROUND WATER OBSERVATIONS		CASING	SAMPLER	CORE BAR.		DATE
At ___ after ___ Hours	Type	HW-NW	S/S	NV-II	Start	7/9/01
	Size I.D.	4" 3"	1-3/8"		Complete	7/9/01
At ___ after ___ Hours	Hammer Wt.	300#	140#	BIT	Boring Foreman	J. Medeiros
	Hammer Fall	24"	30"	Dia.	Inspector/Engr.	R. Sharpneck

LOCATION OF BORING

Depth	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler 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."
		0.0-2.0	D	Wt.	of	Rods			Black Organic SILT	1	24	11
		4.0-6.0	D	Wt.	Rods	3			" trace shells	2	24	20
5						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												
		14.0-16.0	D	5	4	4			" color change to Brown	4	24	6
15						6						
		18.5-20.5	D	3	2	3			" & fine Gravel	5	24	2
20						5						
		23.5-25.5	D	36	30	42		23.5	Brown fine to coarse SAND and Gravel, little silt	6	24	7
25						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. | ADDRESS Foxborough, MA | HOLE NO. NBH-7
PROJECT NAME Harbor Aquatic Disposal Cell | LOCATION New Bedford, MA | PROJ. NO. 10421
REPORT SENT TO above / Feasibility Study | OUR JOB NO. 02-011 | SURF. ELEV. -28.7' MLLW

GROUND WATER OBSERVATIONS		CASING	SAMPLER	CORE BAR.		DATE
At ______ after ____ Hours	Type	HW-NW	S/S	NV-II	Start	7/10/01
	Size I.D.	4" 3"	1-3/8"		Complete	7/11/01
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 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."
		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	2	24	20
5						8			Gravel, little silt, trace shells (organic)			
		9.0-11.0	D	5	6	7		9.0	Light Brown silty fine SAND, little fine to medium	3	24	12
10						10			gravel			
		13.0-15.0	D	4	6	10		13.0	Brown fine to medium SAND, little silt & coarse sand,	4	24	9
						11			trace fine gravel			
15												
		18.0-20.0	D	3	4	6		18.0	Brown fine SAND, little silt	5	24	8
						6						
20												
		23.0-25.0	D	2	4	3				6	24	12
						5						
25												
								28.0				
									BOULDERS			
30												
							Min/Ft	34.0				
35		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	Proportions Used		140 lb. Wt x 30" fall on 2" O.D. Sampler					SUMMARY:
D=Drive C=Cored W=Washed	trace	0 to 10%	Cohesionless	Density	Cohesive	Consistency		Earth Boring 35'
UP=Fixed Piston UT=Shelby Tube	little	10 to 20%	0-10	Loose	0-4	Soft	30 + Hard	Rock Coring 8'
TP=Test Pit A=Auger	some	20 to 35%	10-30	Med. Dense	4-8	M./Stiff		Samples 6
OE = Open End Rod	and	35 to 50%	30-50	Dense	8-15	Stiff		
* 300# hammer			50+	Very Dense	15-30	V-Stiff		HOLE NO. NBH-7

GUILD DRILLING CO., INC.
100 WATER STREET • EAST PROVIDENCE, R.I.

TO **Maguire Group, Inc.** ADDRESS **Foxborough, MA** HOLE NO. **NBH-7**
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. -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. | ADDRESS Foxborough, MA | HOLE NO. NBH-9
PROJECT NAME Aquatic Disposal Project | LOCATION New Bedford, MA | PROJ. NO. 16421
REPORT SENT TO above | OUR JOB NO. 03-100 | 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 49			Brown Gray fine to coarse SAND and Gravel, little silt	2	24	10
15												
		18.0-20.0	D	50	29	43 88				3	24	10
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	Proportions Used		140 lb. Wt x 30" fall on 2" O.D. Sampler					SUMMARY:
D=Drive C=Cored W=Washed	trace	0 to 10%	Cohesionless	Density	Cohesive	Consistency		Earth Boring 21'
UP=Fixed Piston UT=Shelby Tube	little	10 to 20%	0-10	Loose	0-4	Soft	30 + Hard	Rock Coring 10'
TP=Test Pit A=Auger	some	20 to 35%	10-30	Med. Dense	4-8	M./Stiff		Samples 3
OE = Open End Rod	and	35 to 50%	30-50	Dense	8-15	Stiff		
* 300# hammer			50+	Very Dense	15-30	V-Stiff		HOLE NO. NBH-9

GUILD DRILLING CO., INC.
100 WATER STREET • EAST PROVIDENCE, R.I.

SHEET 1 OF 1

TO Maguire Group, Inc. ADDRESS Foxborough, MA HOLE NO. NBH-10
PROJECT NAME Aquatic Disposal Project LOCATION New Bedford, MA PROJ. NO. 16421
REPORT SENT TO above OUR JOB NO. 03-100 SURF. ELEV. -29.1'

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	10/22/02
Complete	10/23/02
Boring Foreman	G. Brouillette
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. | ADDRESS Foxborough, MA | HOLE NO. NBH-11
PROJECT NAME Aquatic Disposal Project | LOCATION New Bedford, MA | PROJ. NO. 16421
REPORT SENT TO above | OUR JOB NO. 03-100 | 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 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."
		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~~	~~8~~	~~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	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 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

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

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%
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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	

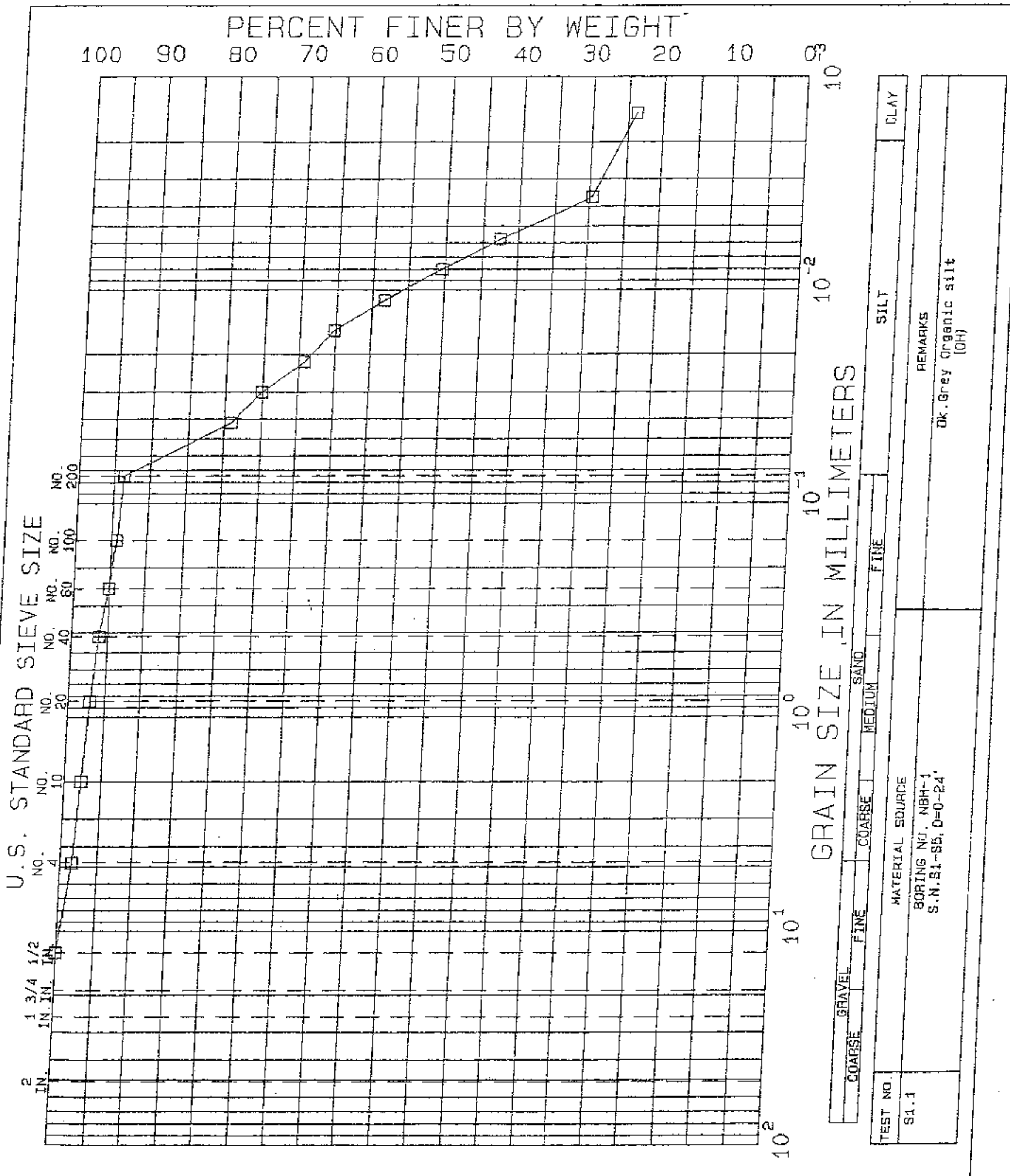
SUMMARY:
Earth Boring 36'
Rock Coring 5'
Samples 8

HOLE NO. NBH-11

Appendix IV

Popes Island North Laboratory Testing Data

Phase I, NBH – 1, 2, and 3A
Phase II, NBH – 8



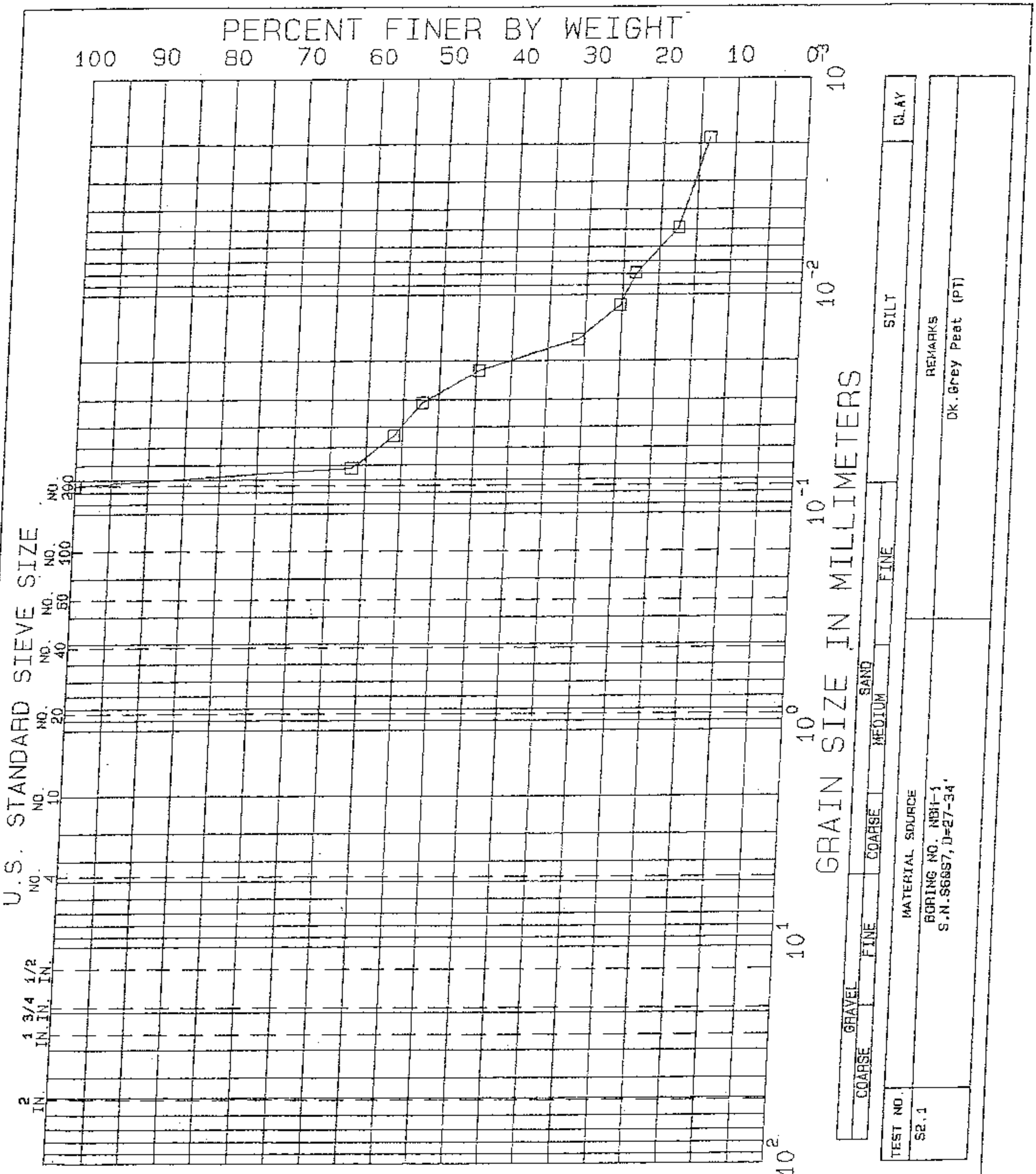
NEW BEDFORD HARBOR FEASIBILITY
STUDY, NEW BEDFORD, MA.

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 L16928



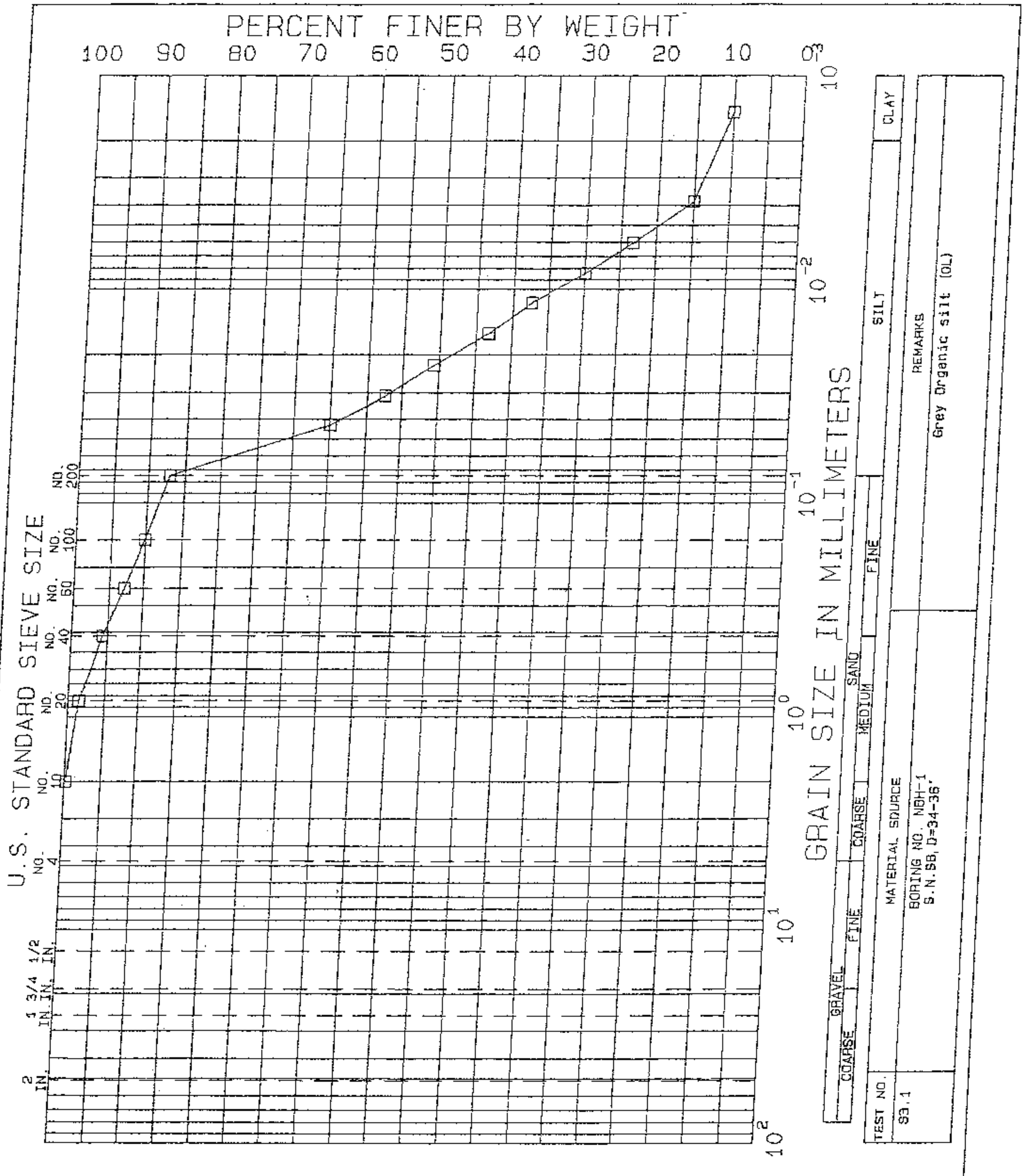
NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-1
SAMPLE S6&S7
DEPTH 27-34'
TECH. mst
REVIEWER NCM

TEST SERIES
NO. 2
DATE SEPT. 01

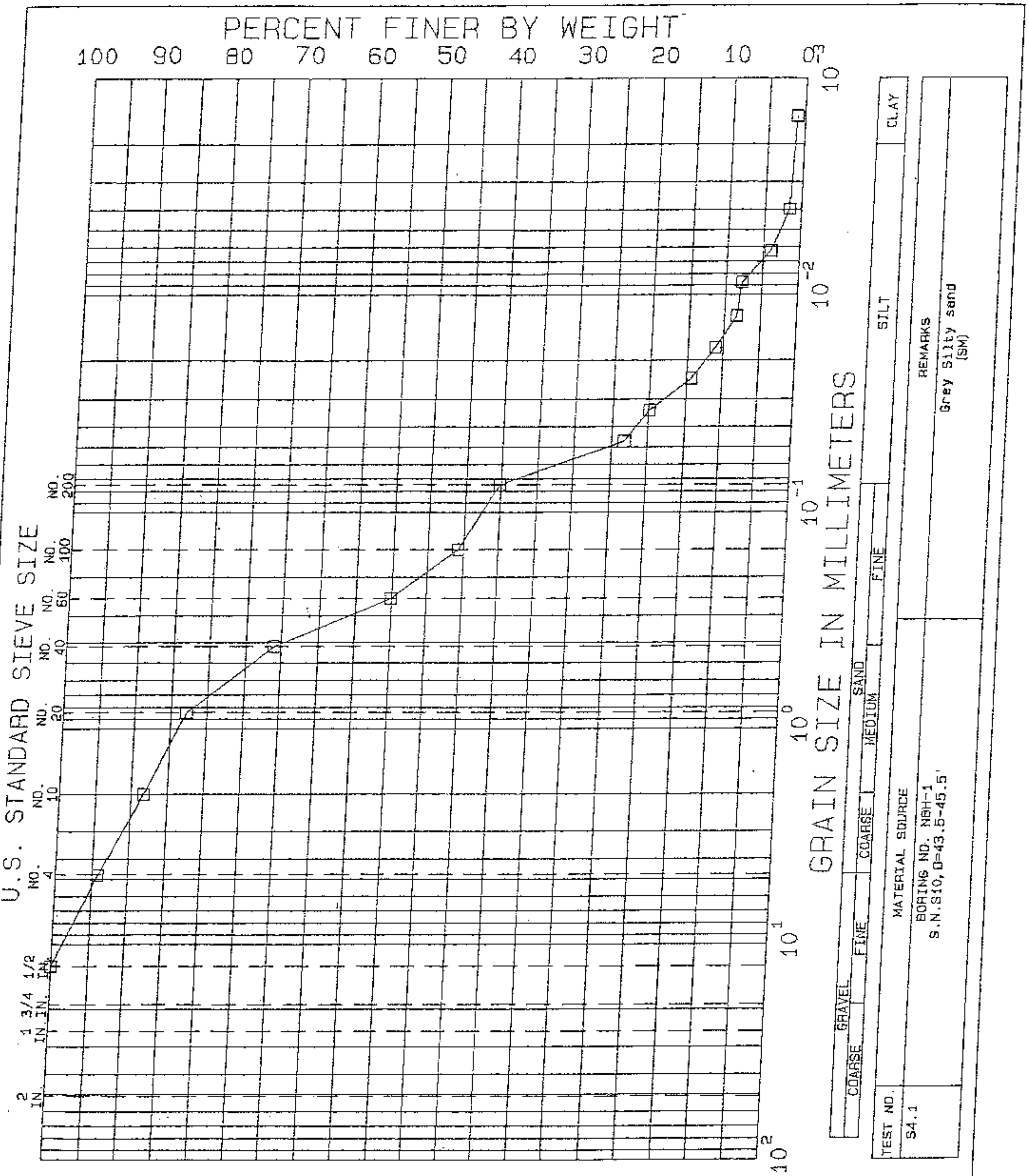
FILE L16528



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



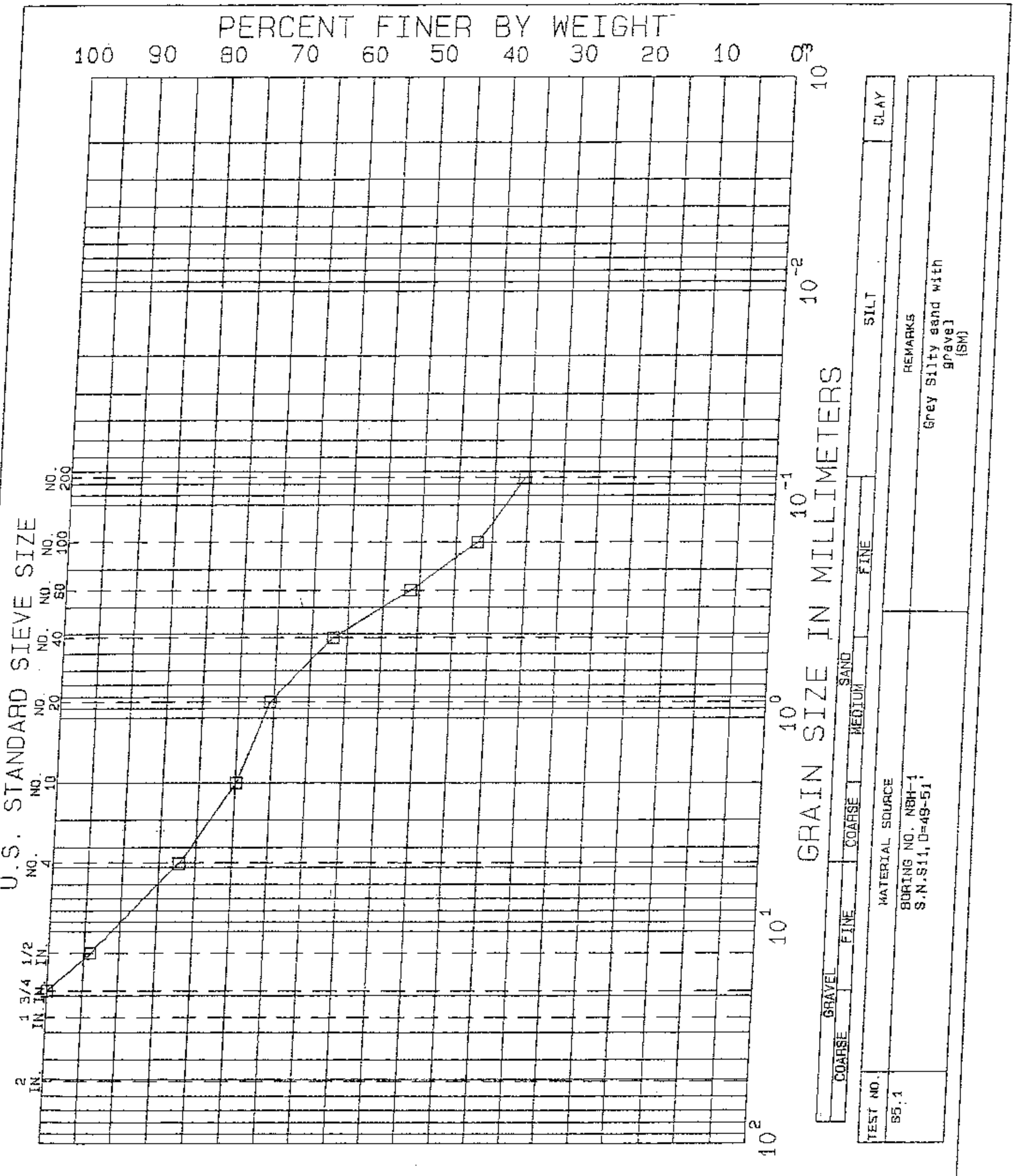
NEW BEDFORD HARBOR FEASIBILITY
STUDY, NEW BEDFORD, MA.

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



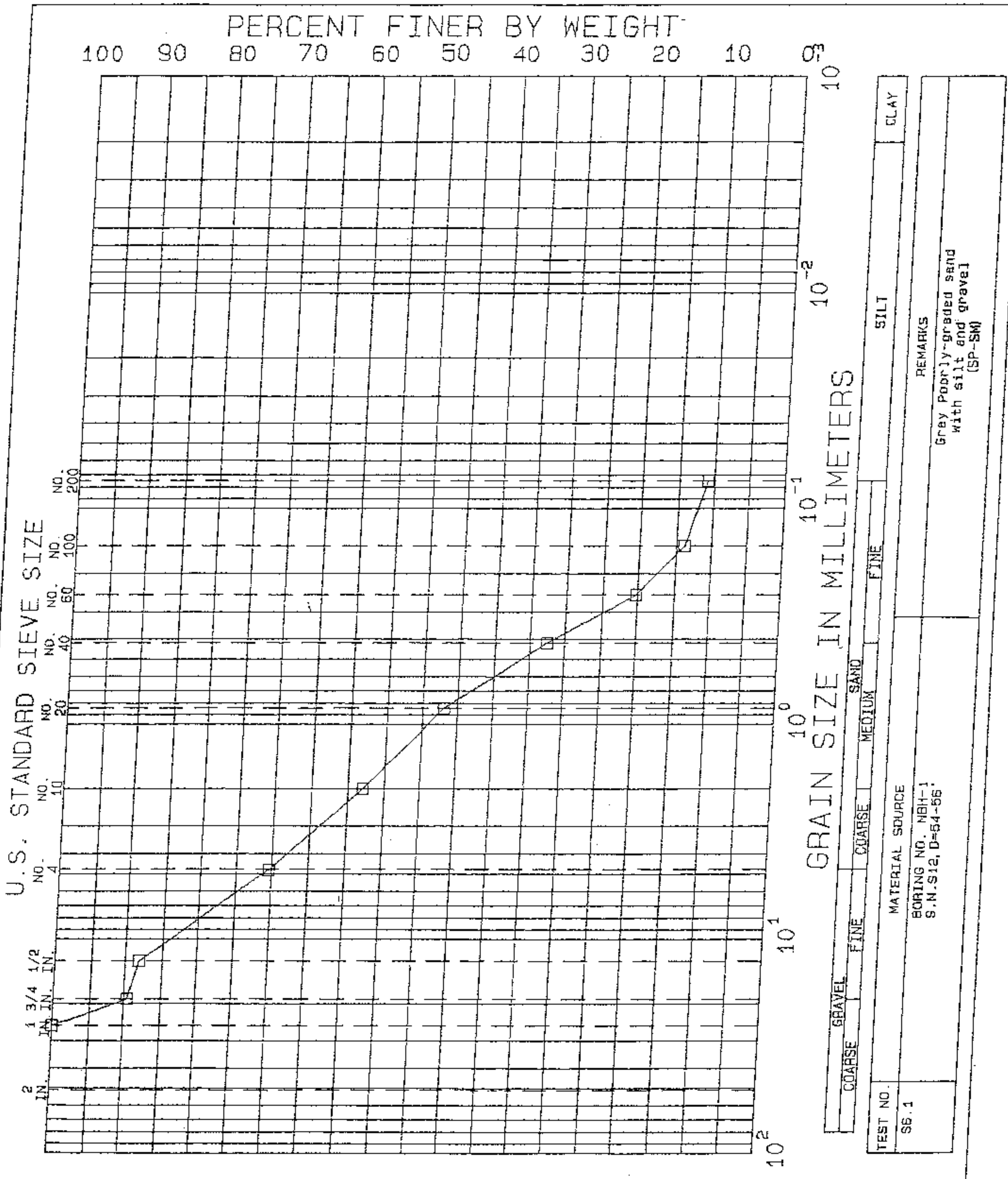
NEW BEDFORD HARBOR FEASIBILITY
STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-1
SAMPLE S11
DEPTH 49-51'
TECH. mst
REVIEWER MCM

TEST SERIES
NO. 5
DATE SEPT. 01

FILE L16928



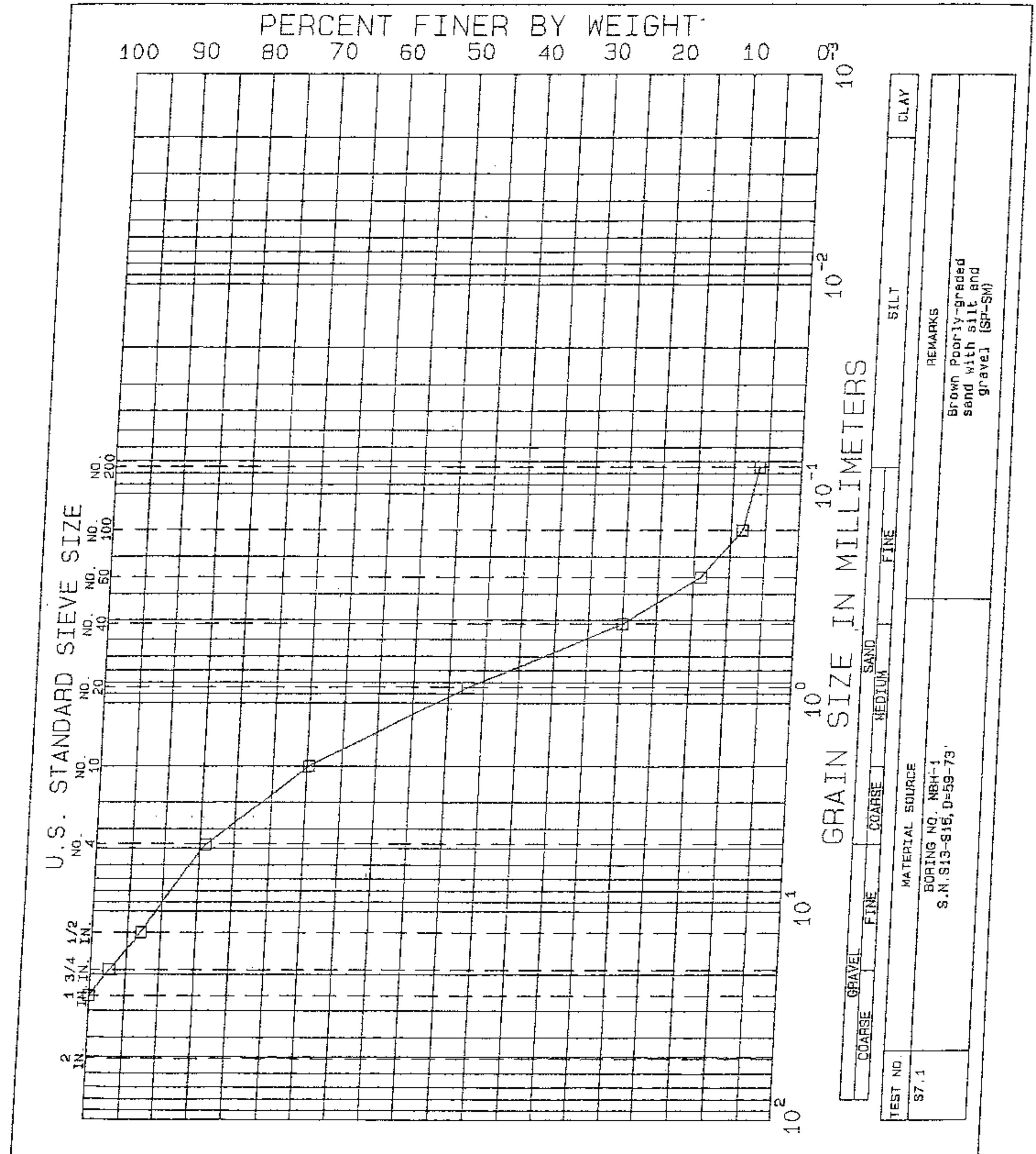
NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-1
SAMPLE S12
DEPTH 54-56'
TECH. mst
REVIEWER MCM

TEST SERIES
NO. 6
DATE SEPT. 01

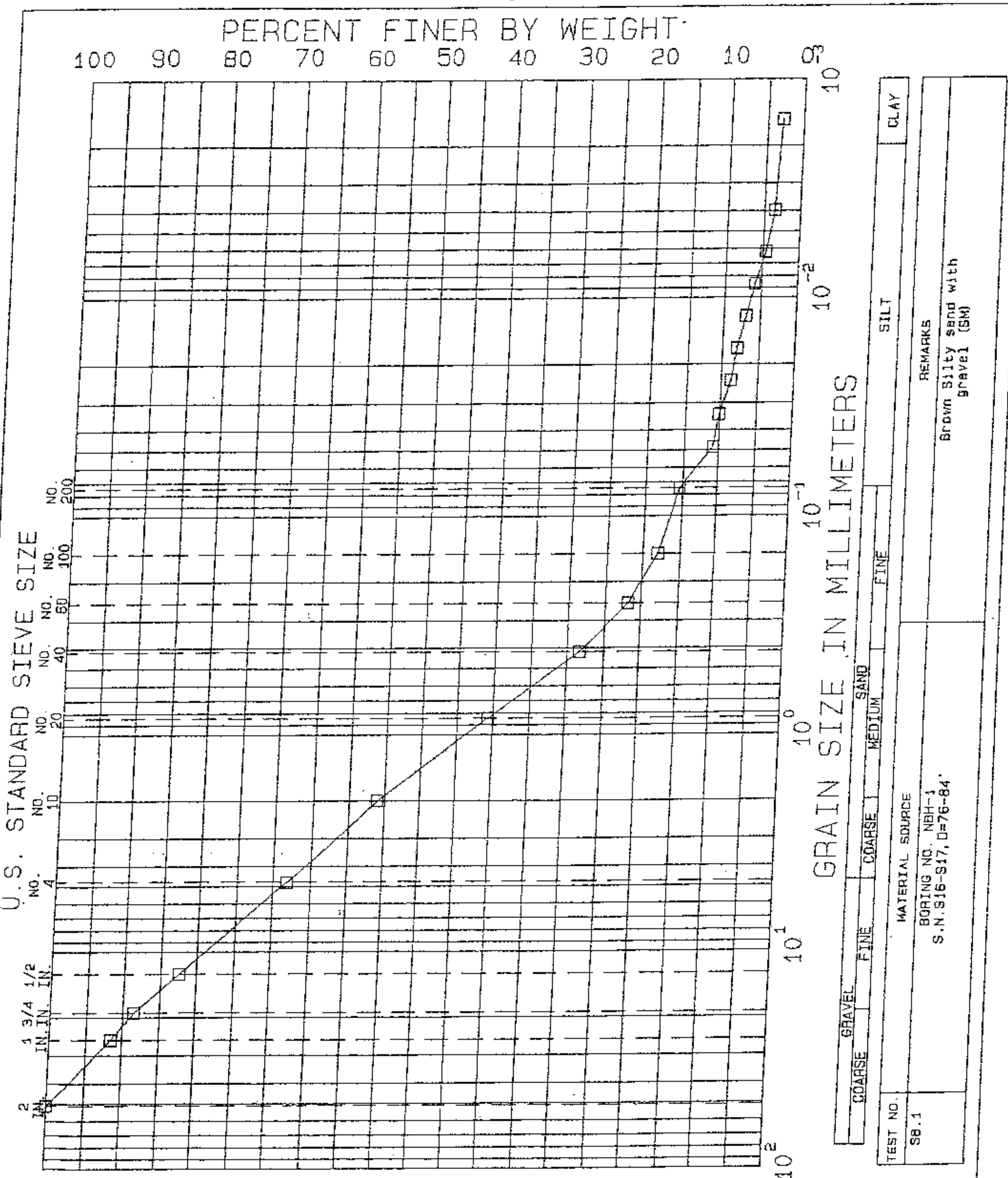
FILE L16928



NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-1	TEST SERIES
SAMPLE S13-15	NO. 7
DEPTH 59-73'	DATE SEPT. 01
TECH. mst	
REVIEWER MCM	FILE L16928



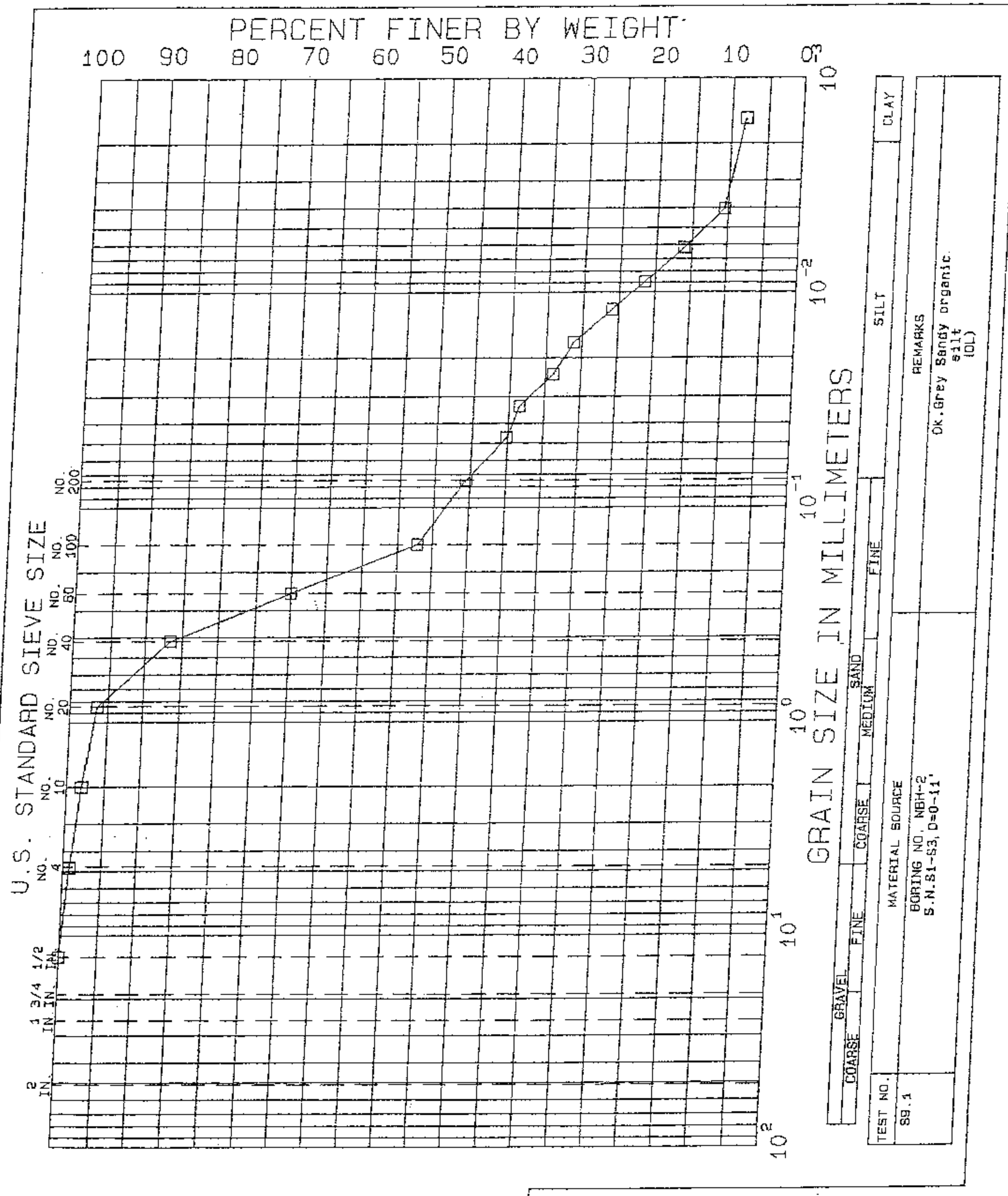
NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-1
SAMPLE S16&17
DEPTH 76-84'
TECH. mst
REVIEWER MCM

TEST SERIES NO. 8
DATE SEPT. 01

FILE L16928



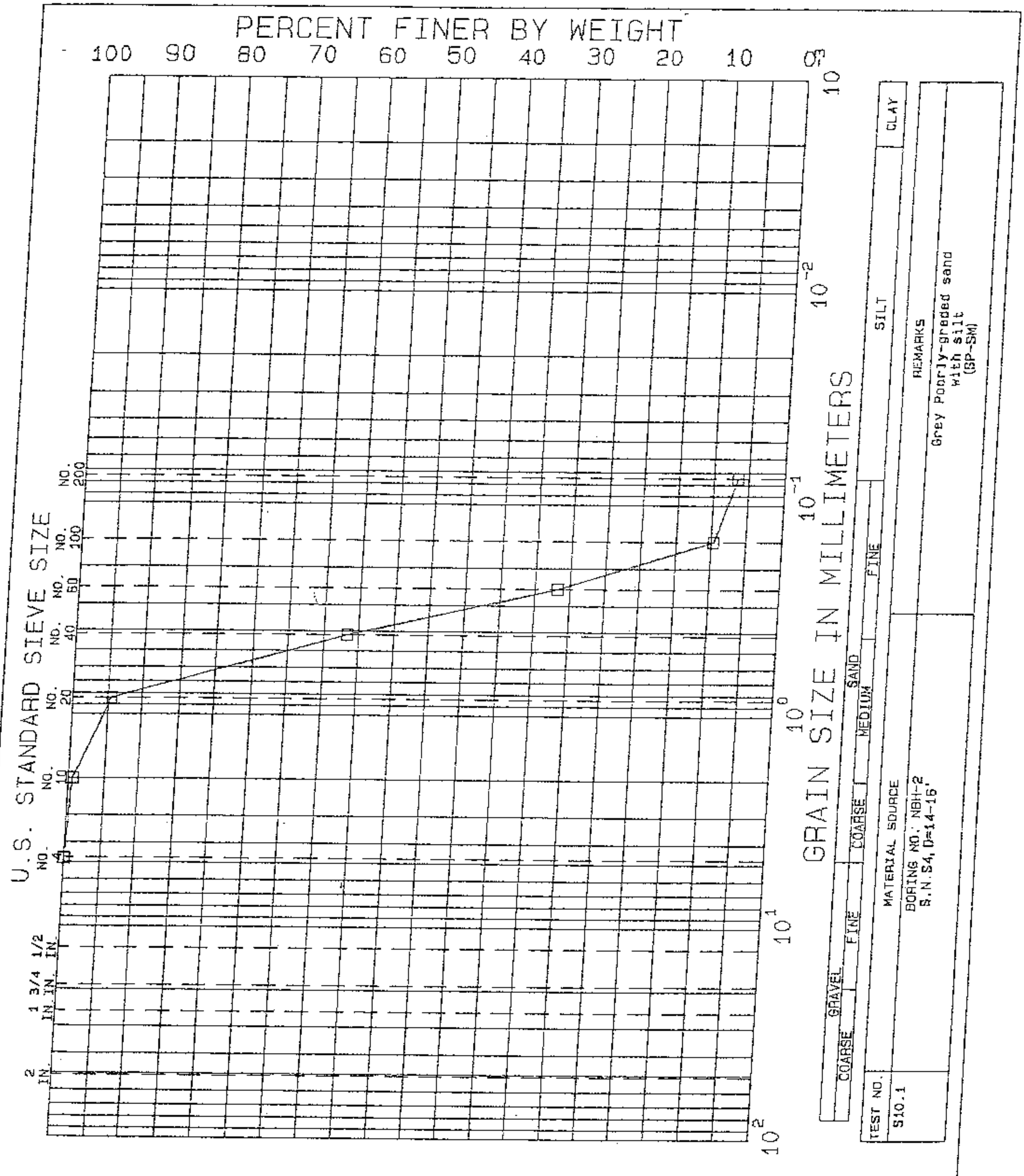
NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-2
SAMPLE S1-S3
DEPTH 0-11'
TECH. mst
REVIEWER MCM

TEST SERIES NO. 9
DATE SEPT. 01

FILE L16828



NEW BEDFORD HARBOR FEASIBILITY
STUDY, NEW BEDFORD, MA.

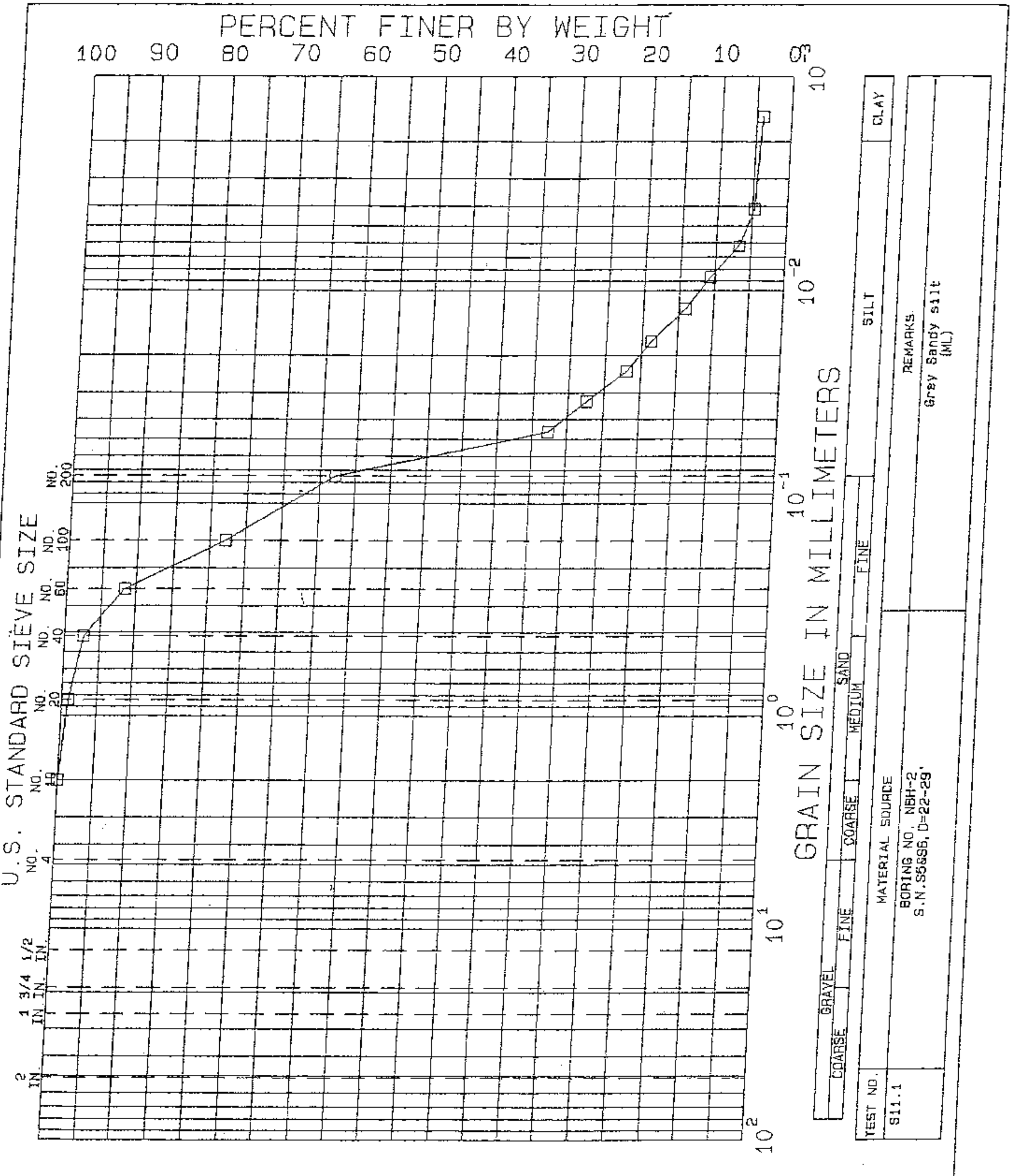
GRADATION TESTS

BORING NO. NBH-2
SAMPLE S4
DEPTH 14-16'
TECH. mst
REVIEWER MCM

TEST SERIES
NO. 10
DATE SEPT. 01

FILE L16928

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS



NEW BEDFORD HARBOR FEASIBILITY
STUDY, NEW BEDFORD, MA.

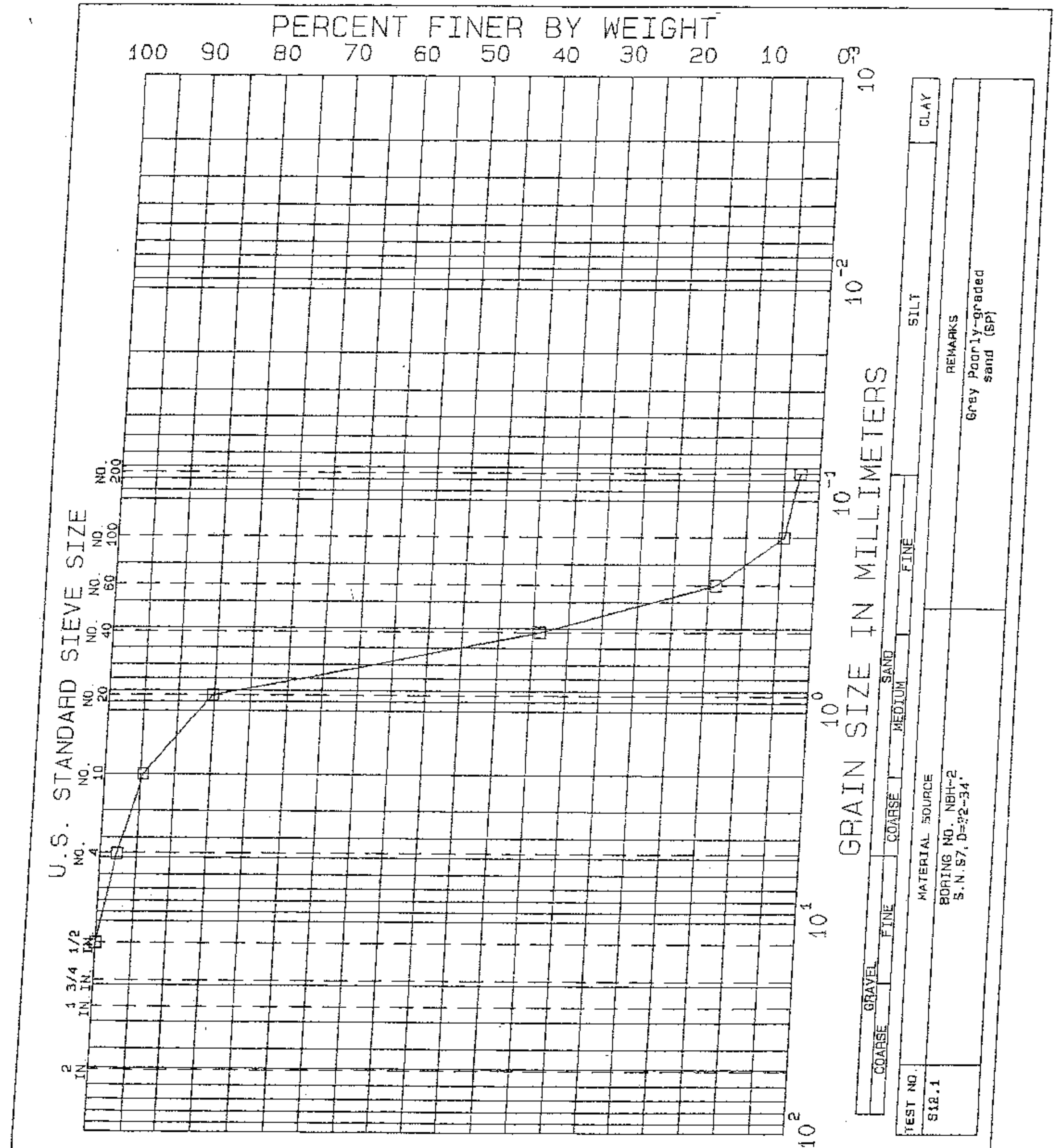
GRADATION TESTS

BORING NO. NBH-2
SAMPLE S5&S6
DEPTH 22-29'
TECH. mst
REVIEWER MCM

TEST SERIES
NO. 11
DATE SEPT. 01

FILE L16928

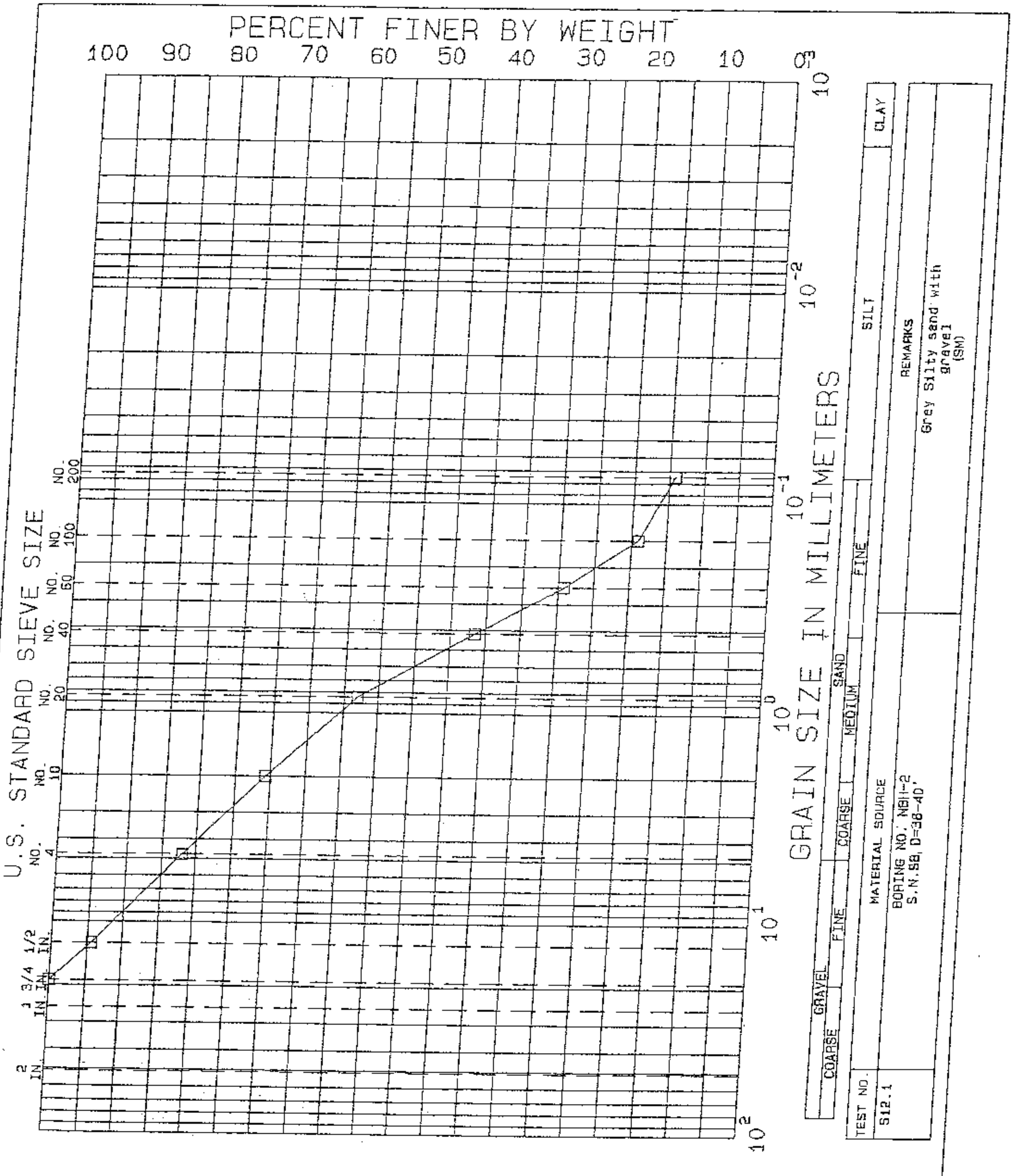
GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS



NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-2	TEST SERIES
SAMPLE S7	NO. 12
DEPTH 32-34'	DATE SEPT. 01
TECH. mst	
REVIEWER MCM	FILE L16928



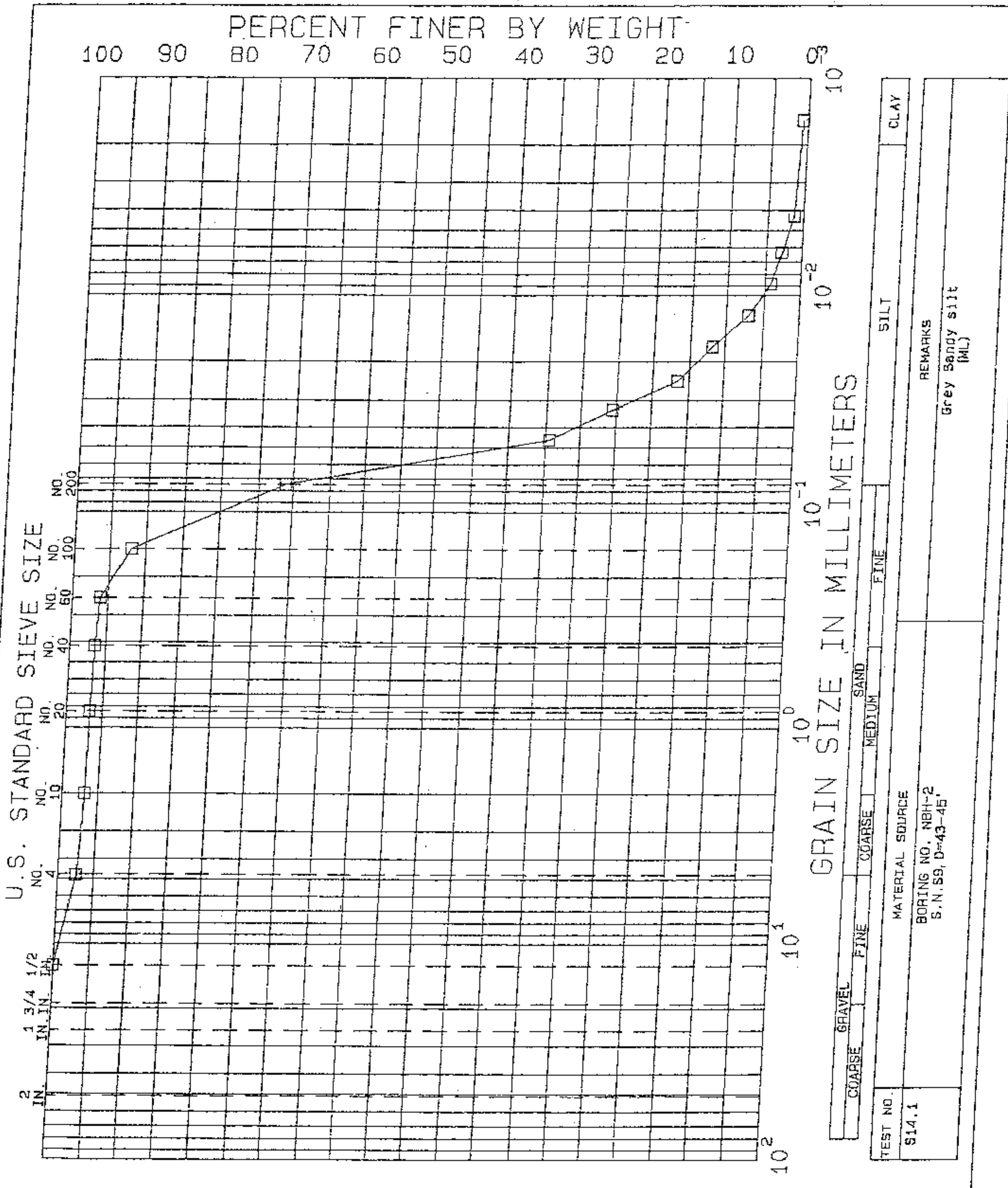
NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-2
SAMPLE S8
DEPTH 38-40'
TECH. mst
REVIEWER MCM

TEST SERIES
NO. 13
DATE SEPT. 01

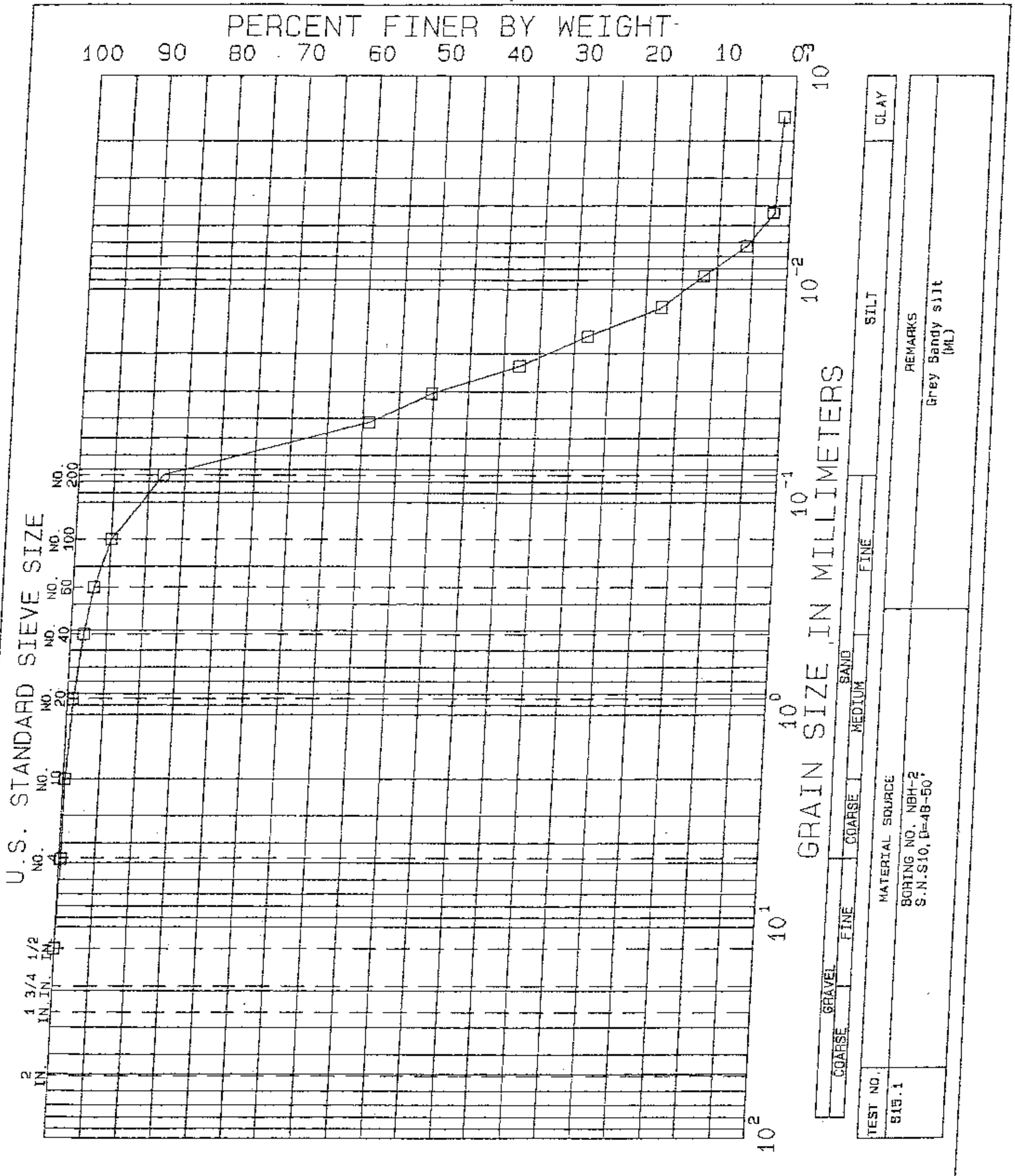
FILE L16928



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



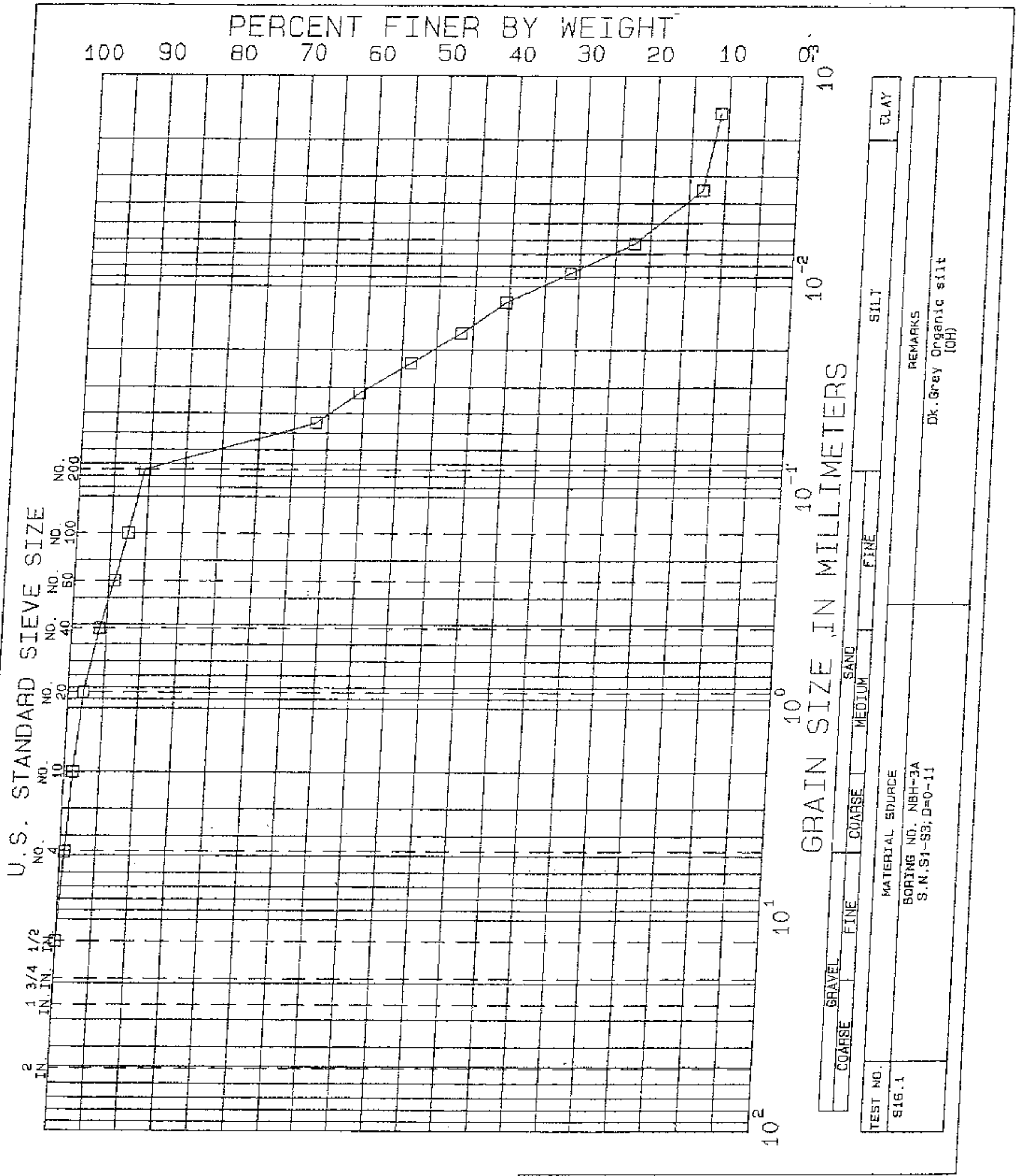
NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-2
SAMPLE S10
DEPTH 48-50'
TECH. mst
REVIEWER MCM

TEST SERIES
NO. 15
DATE SEPT. 01

FILE L16928



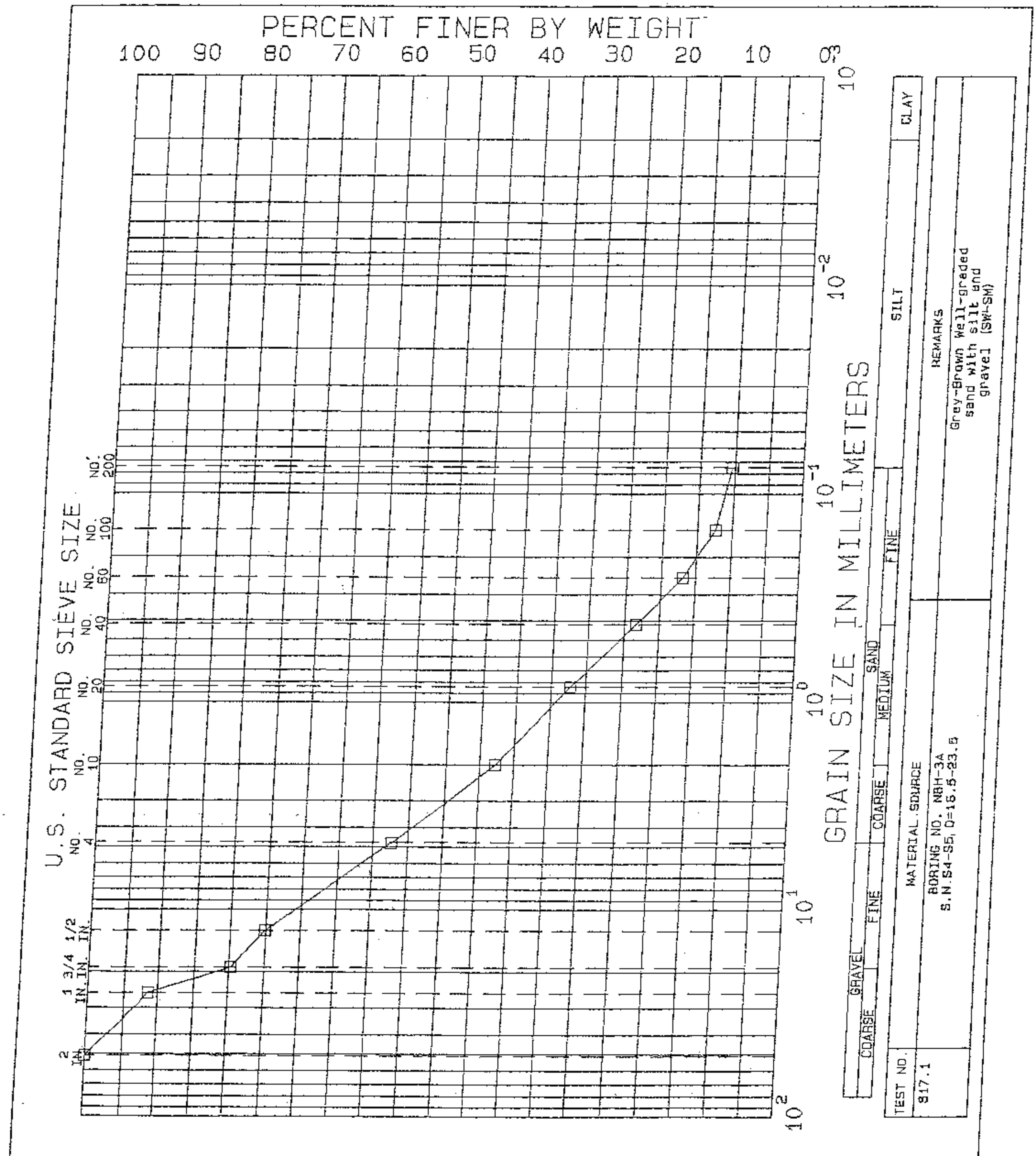
NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-3A
SAMPLE S1-S3
DEPTH 0-11'
TECH. mst
REVIEWER MCM

TEST SERIES NO. 16
DATE SEPT. 01

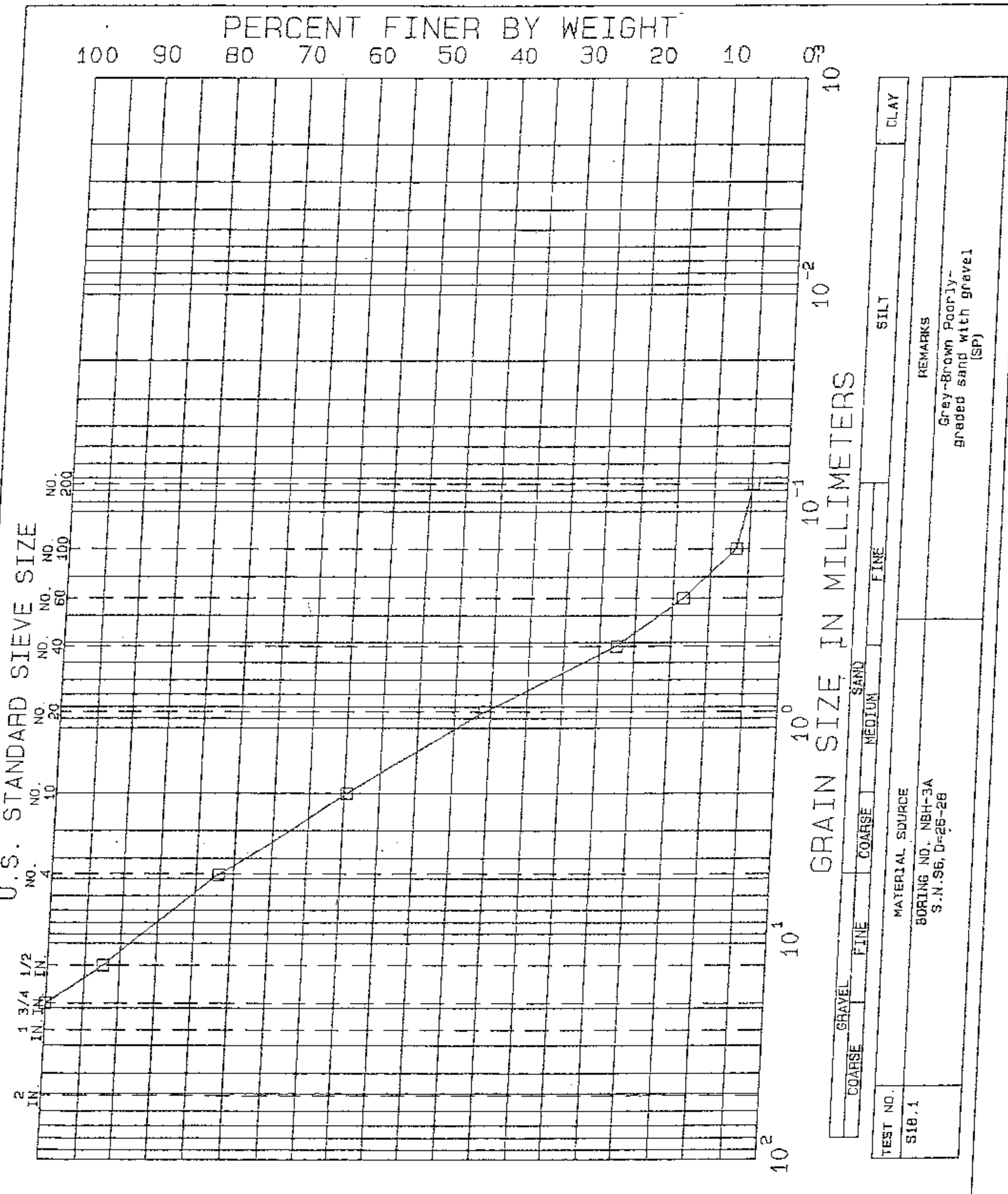
FILE L16928



NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-3A	TEST SERIES
SAMPLE S4-S5	NO. 17
DEPTH 16.5-23.5'	DATE SEPT. 01
TECH. mst	
REVIEWER MCM	FILE L16928

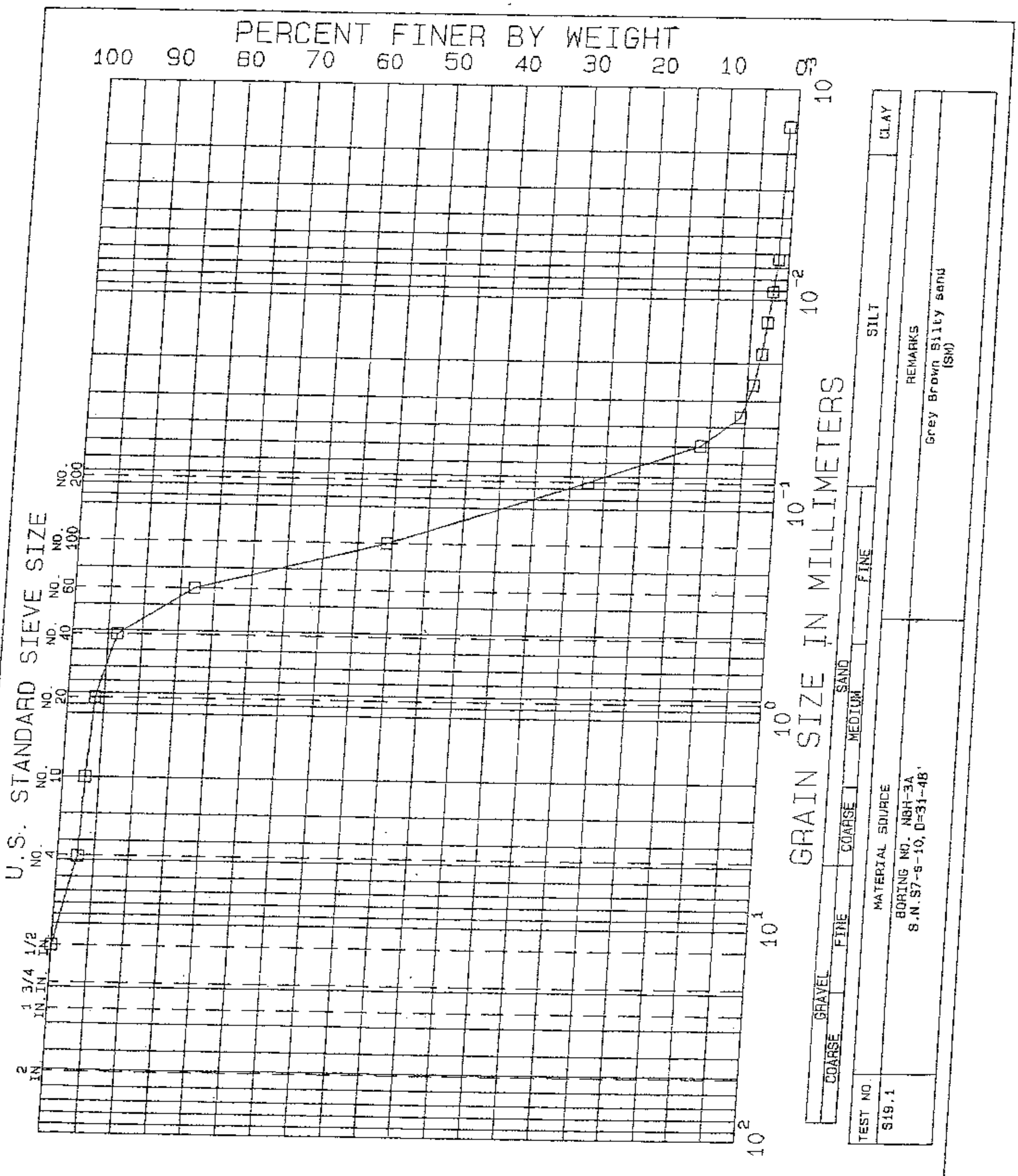


NEW BEDFORD HARBOR FEASIBILITY

STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-3A	TEST SERIES
SAMPLE S6	NO. 18
DEPTH 26-28'	DATE SEPT. 01
TECH. mst	
REVIEWER MCM	FILE L16928



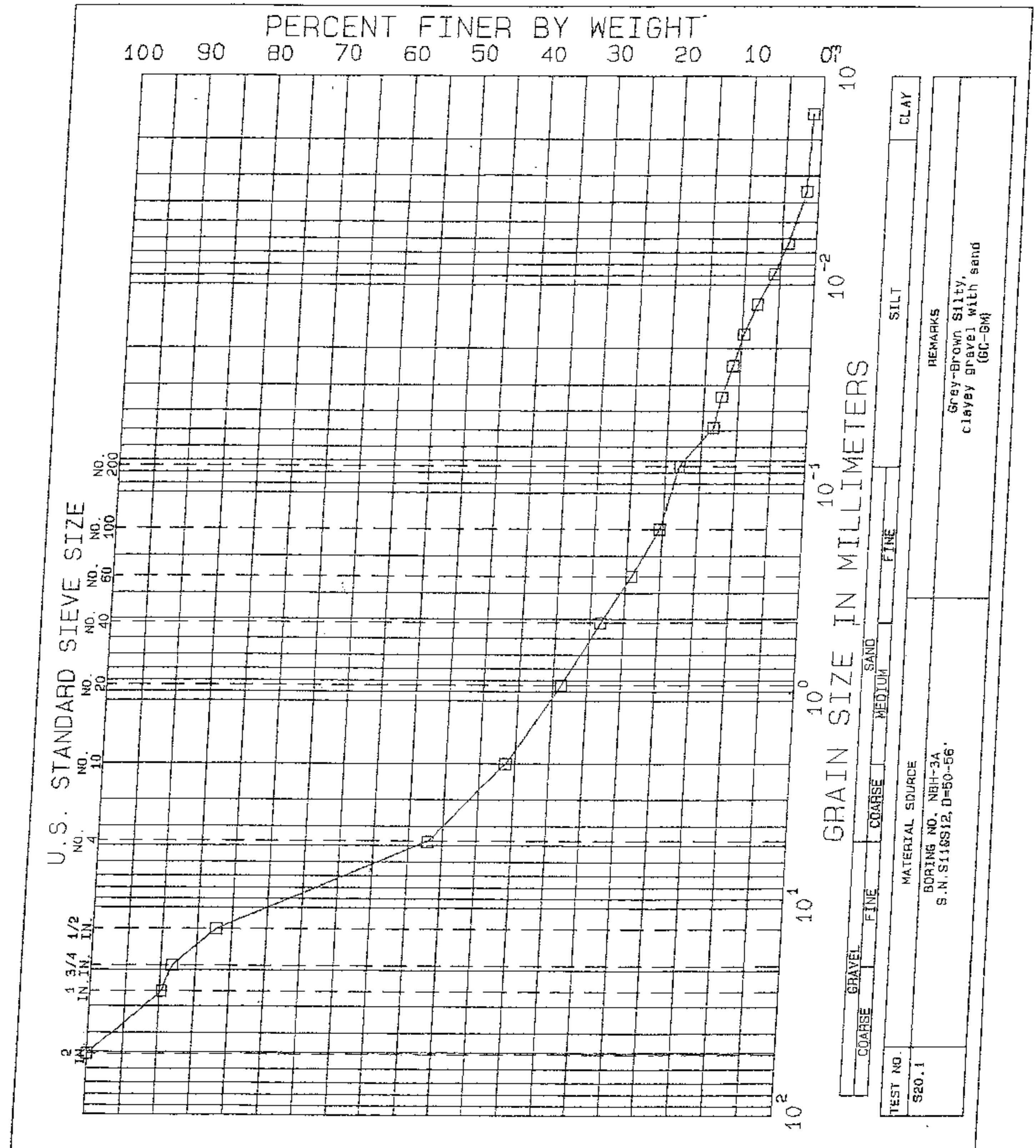
NEW BEDFORD HARBOR FEASIBILITY
STUDY, NEW BEDFORD, MA.
GRADATION TESTS

BORING NO. NBH-3A
SAMPLE S7-S10
DEPTH 31-48'
TECH. mst
REVIEWER MCM

TEST SERIES
NO. 19
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
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
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.: $\frac{C_c}{1+e_0}$	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																
		5.1-5.6		21.5																
											105.3									Brown fine SAND, little (-) Silt
		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																

Project Name NEW BEDFORD HARBOR
NEW BEDFORD, MA.

Project No. L17571

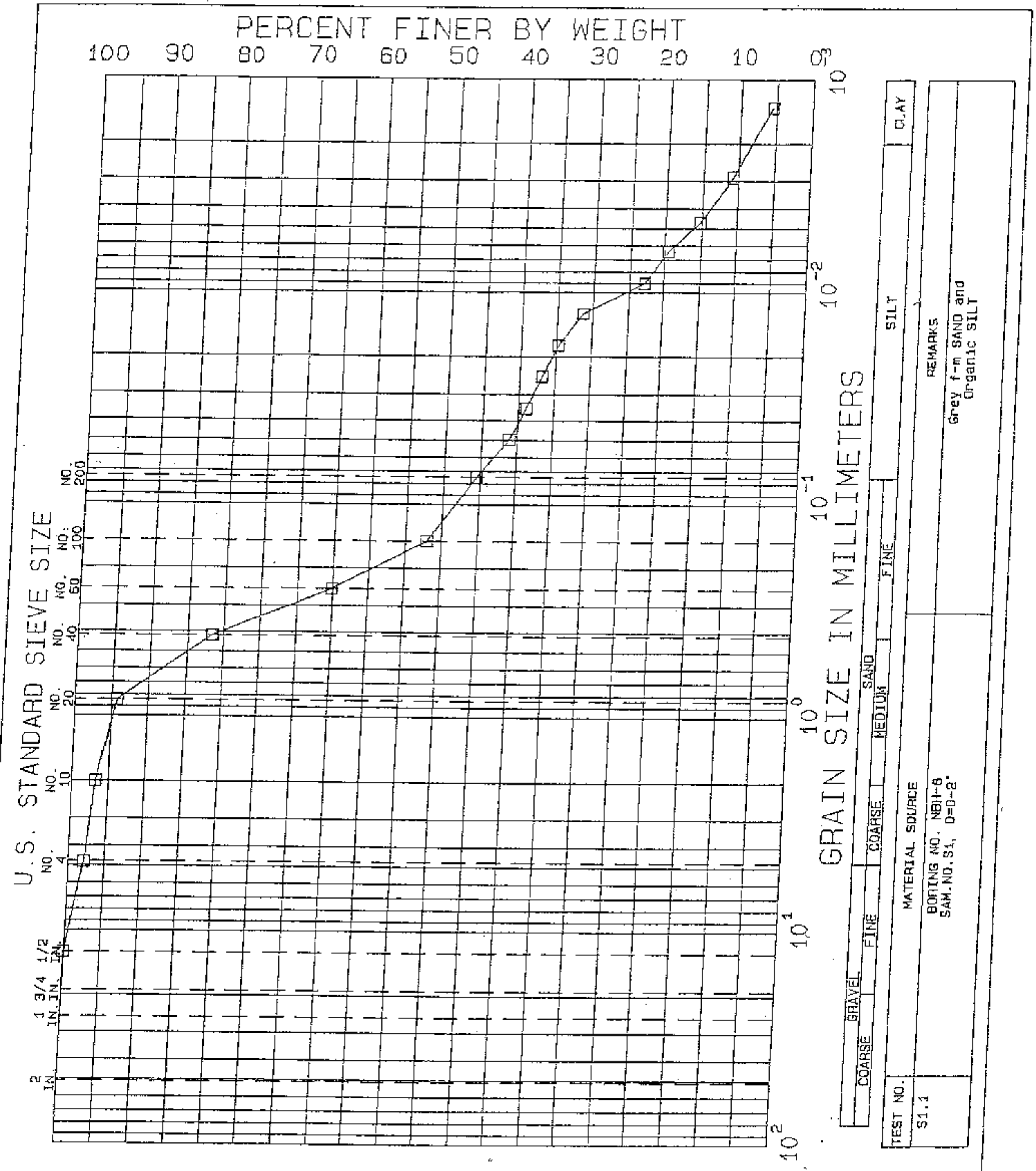
Project Engineer D. SCHULZE

LABORATORY TESTING DATA SHEET

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} (%)	Perme-ability 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-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

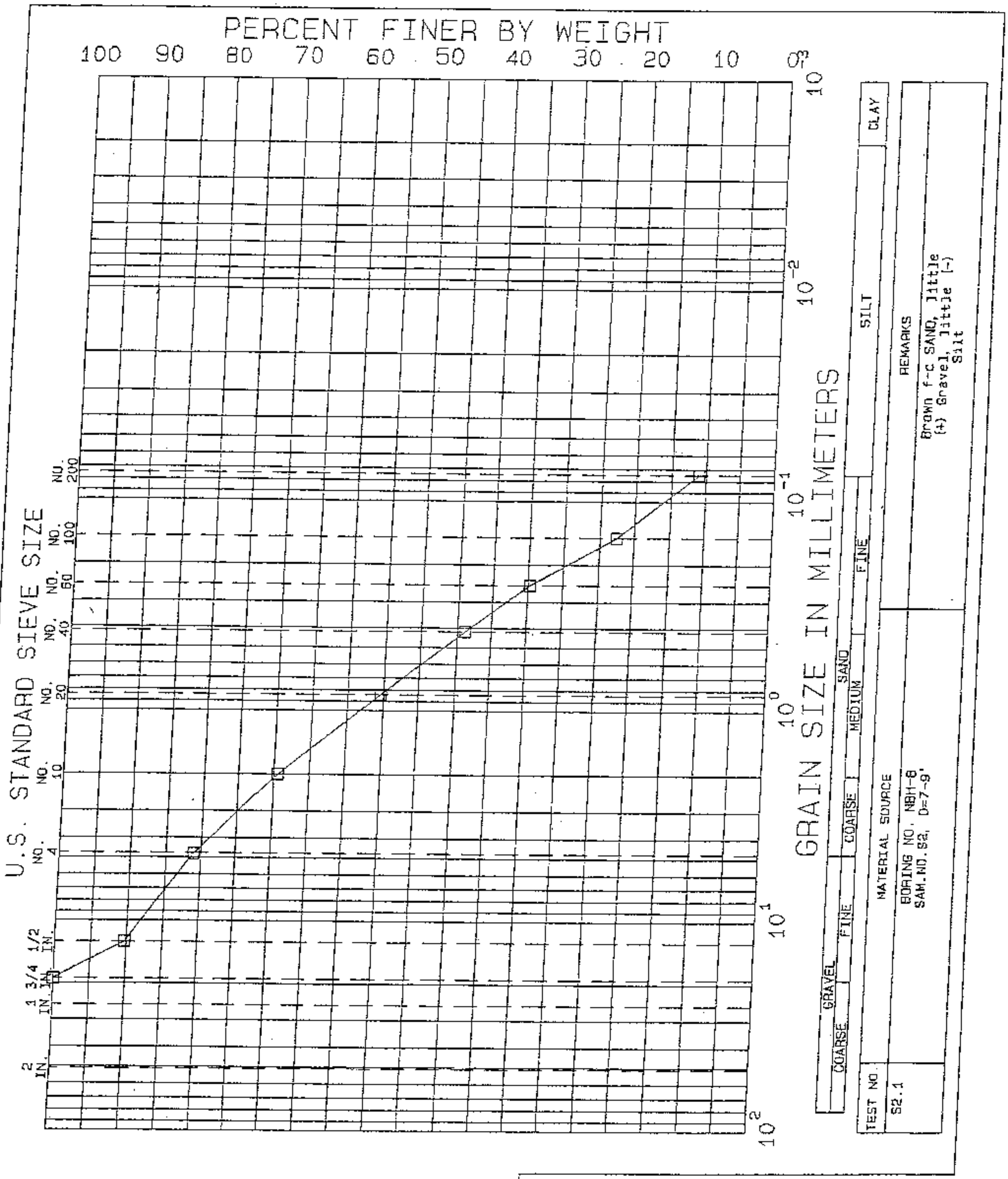


NEW BEDFORD HARBOR

NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-8		TEST SERIES
SAMPLE	S-1	NO. 1
DEPTH	0-2'	DATE Jan.03
TECH.	MST	
REVIEWER	MCM	FILE L17571



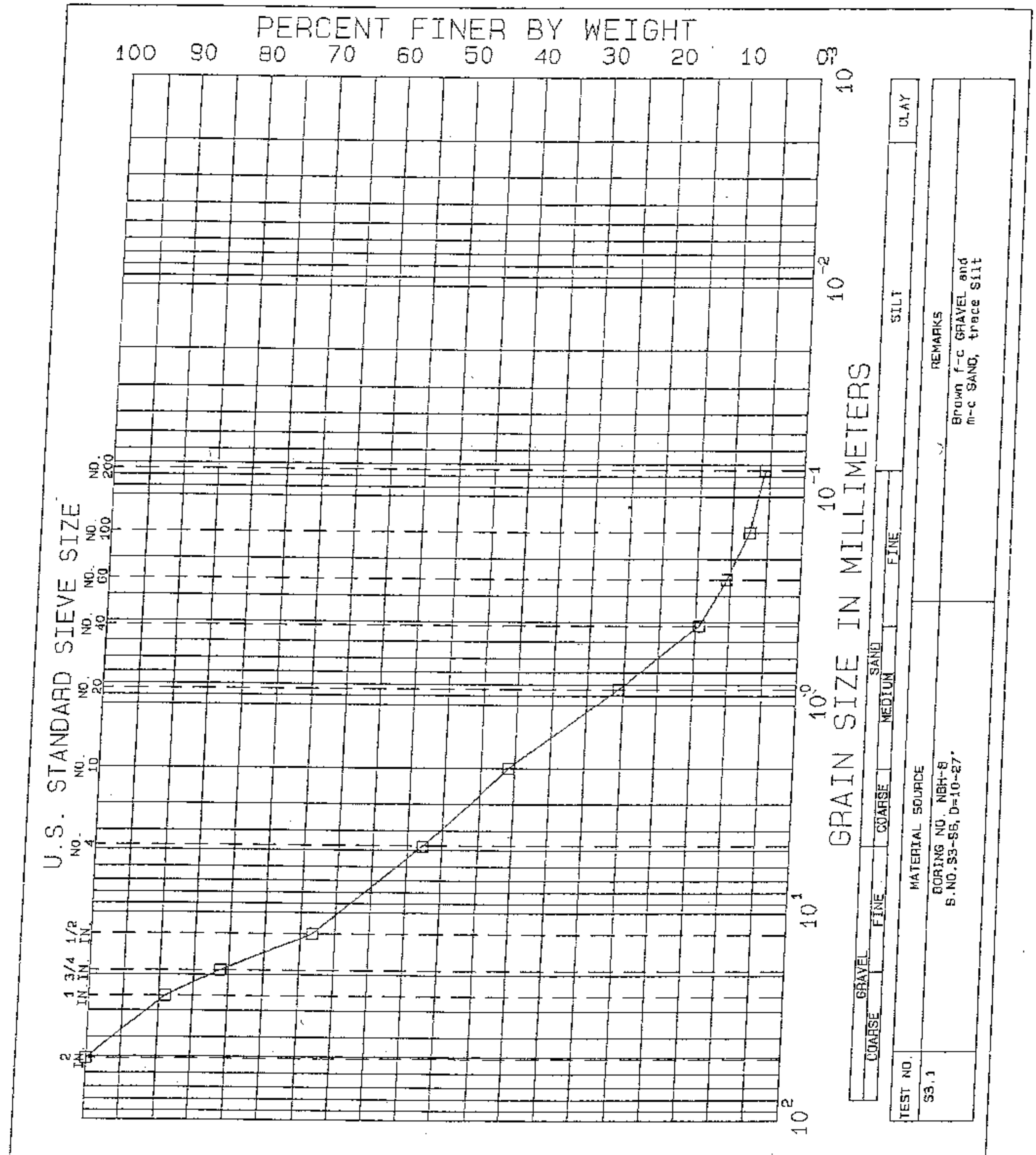
NEW BEDFORD HARBOR

NEW BEDFORD, MA.

GRADATION TESTS

BORING NO.	NBH-8	TEST SERIES	
SAMPLE	S-2	NO.	2
DEPTH	7-9'	DATE	Jan.03
TECH.	MST		
REVIEWER	MCM	FILE	L17571

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS

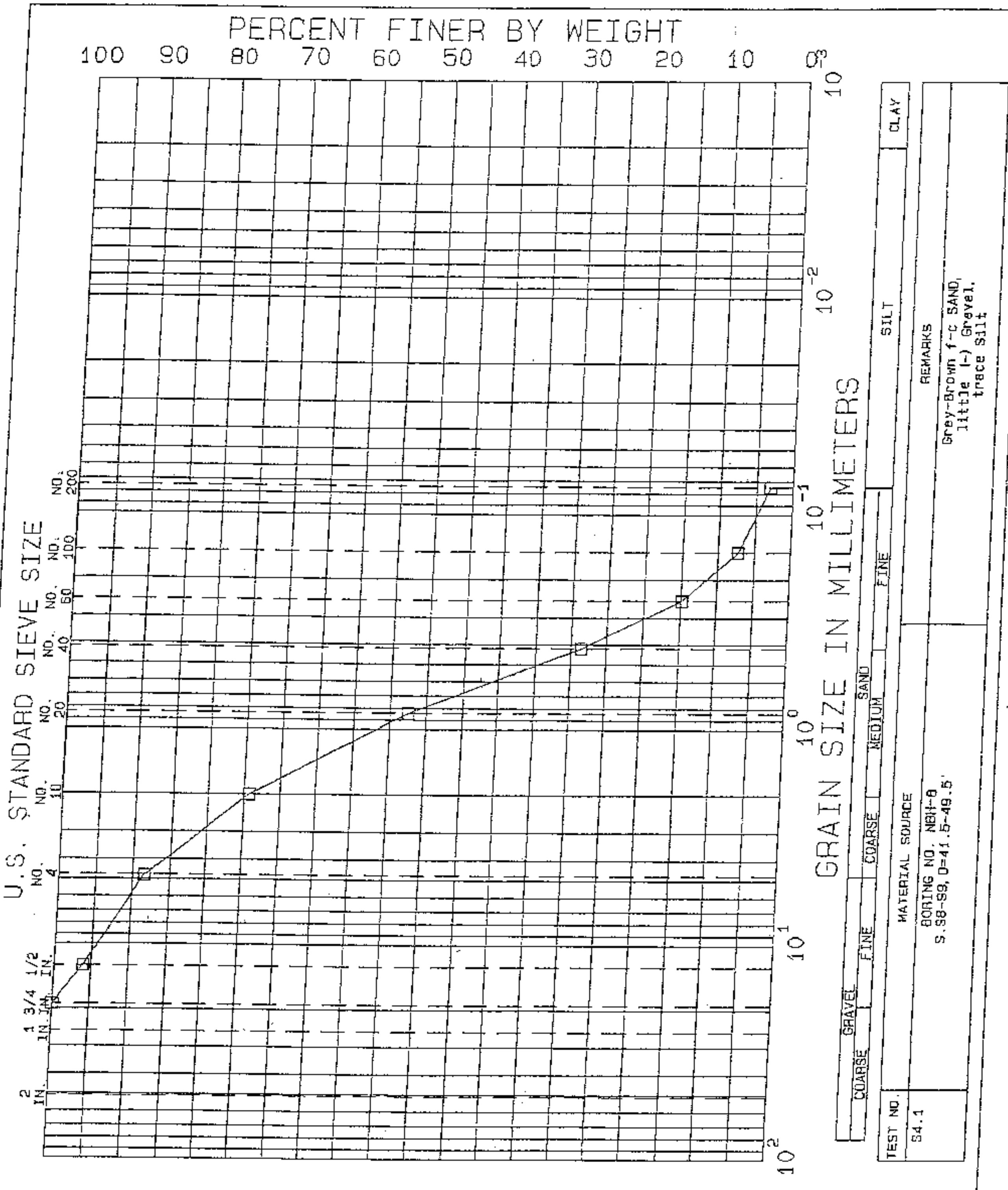


NEW BEDFORD HARBOR

NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-8	TEST SERIES
SAMPLE S3-S6	NO. 3
DEPTH 10-27'	DATE Jan.03
TECH. MST	
REVIEWER MCM	FILE L17571



NEW BEDFORD HARBOR

NEW BEDFORD, MA.

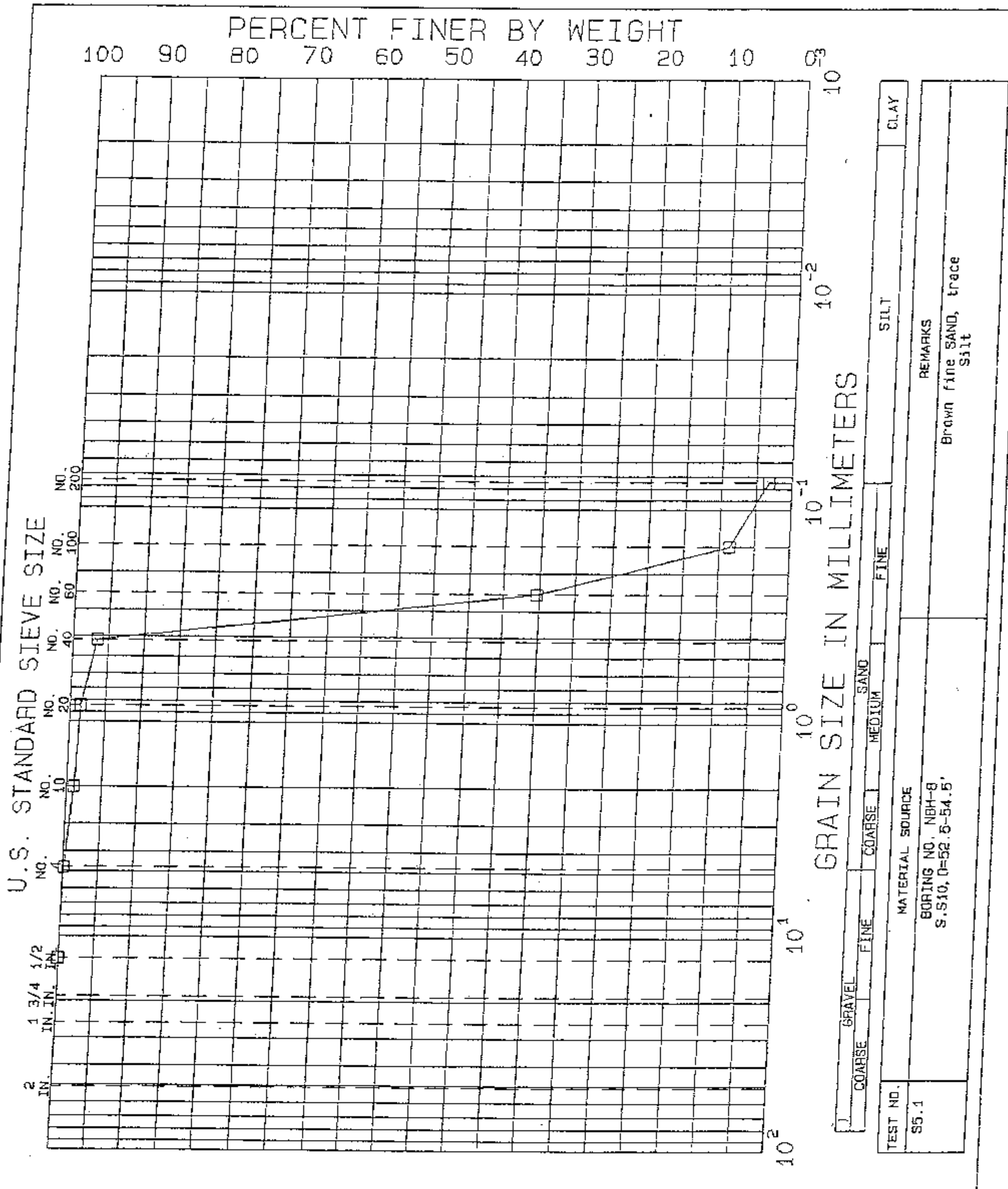
GRADATION TESTS

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



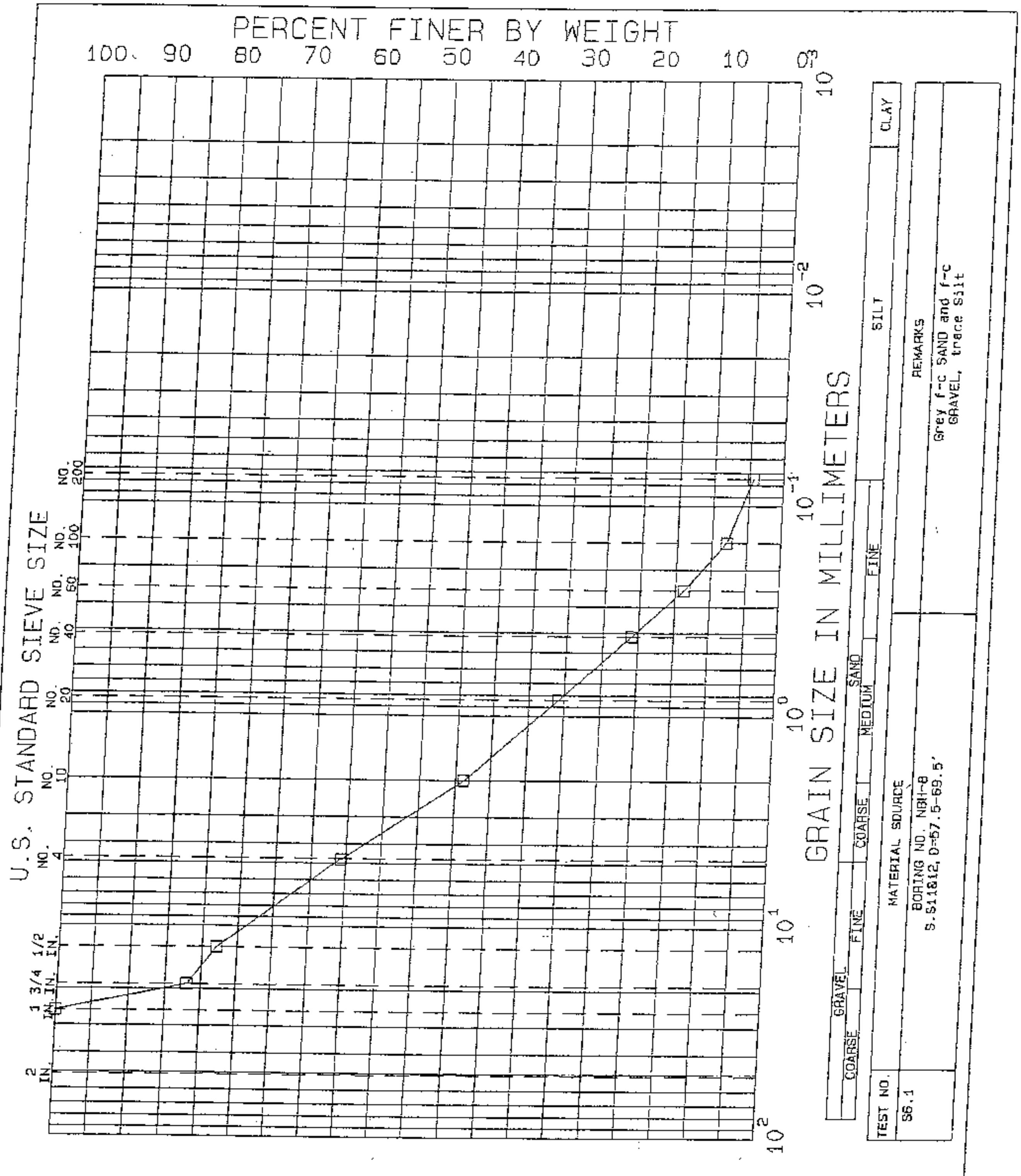
NEW BEDFORD HARBOR

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 L:7571

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS



NEW BEDFORD HARBOR

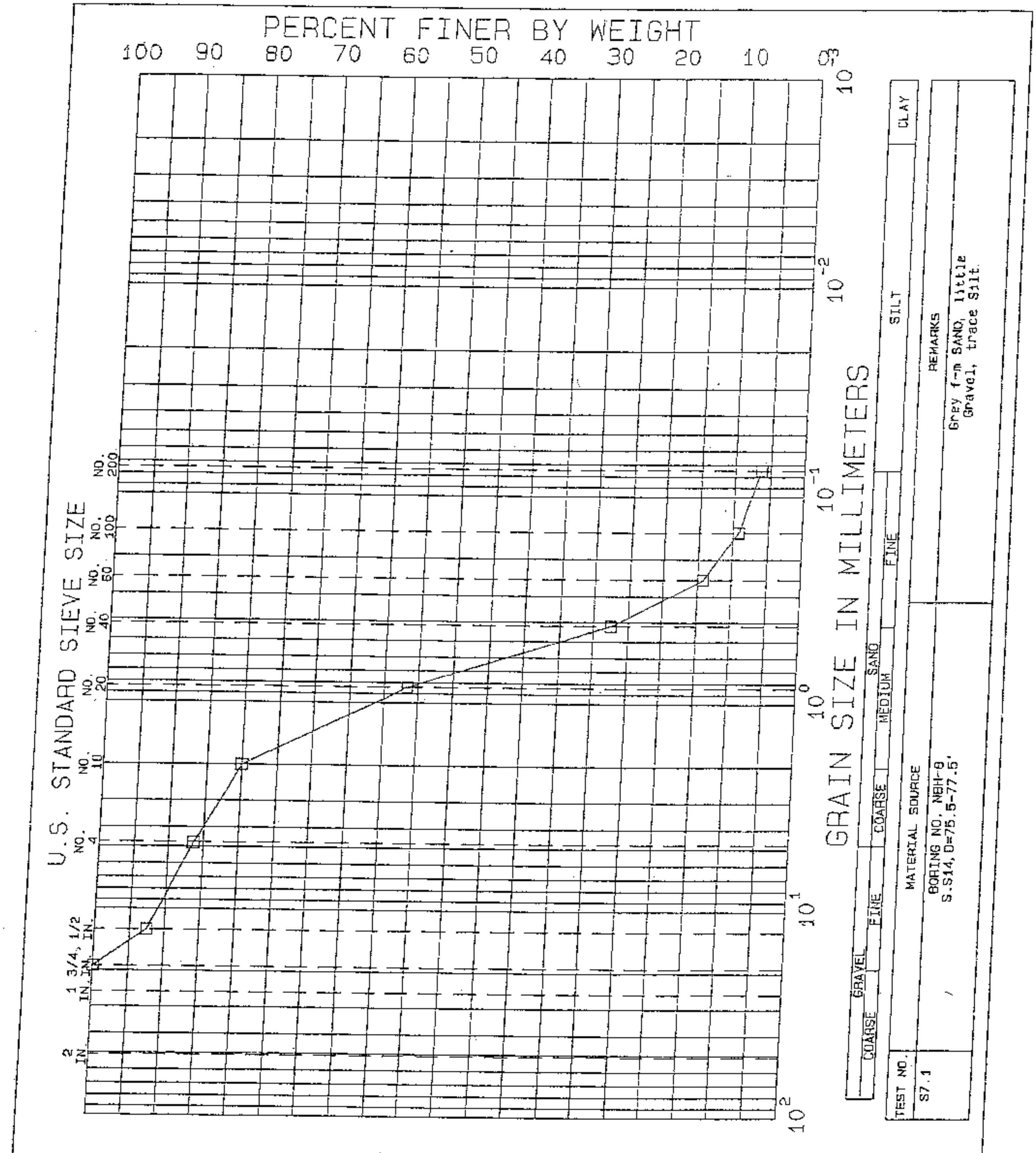
NEW BEDFORD, MA.

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

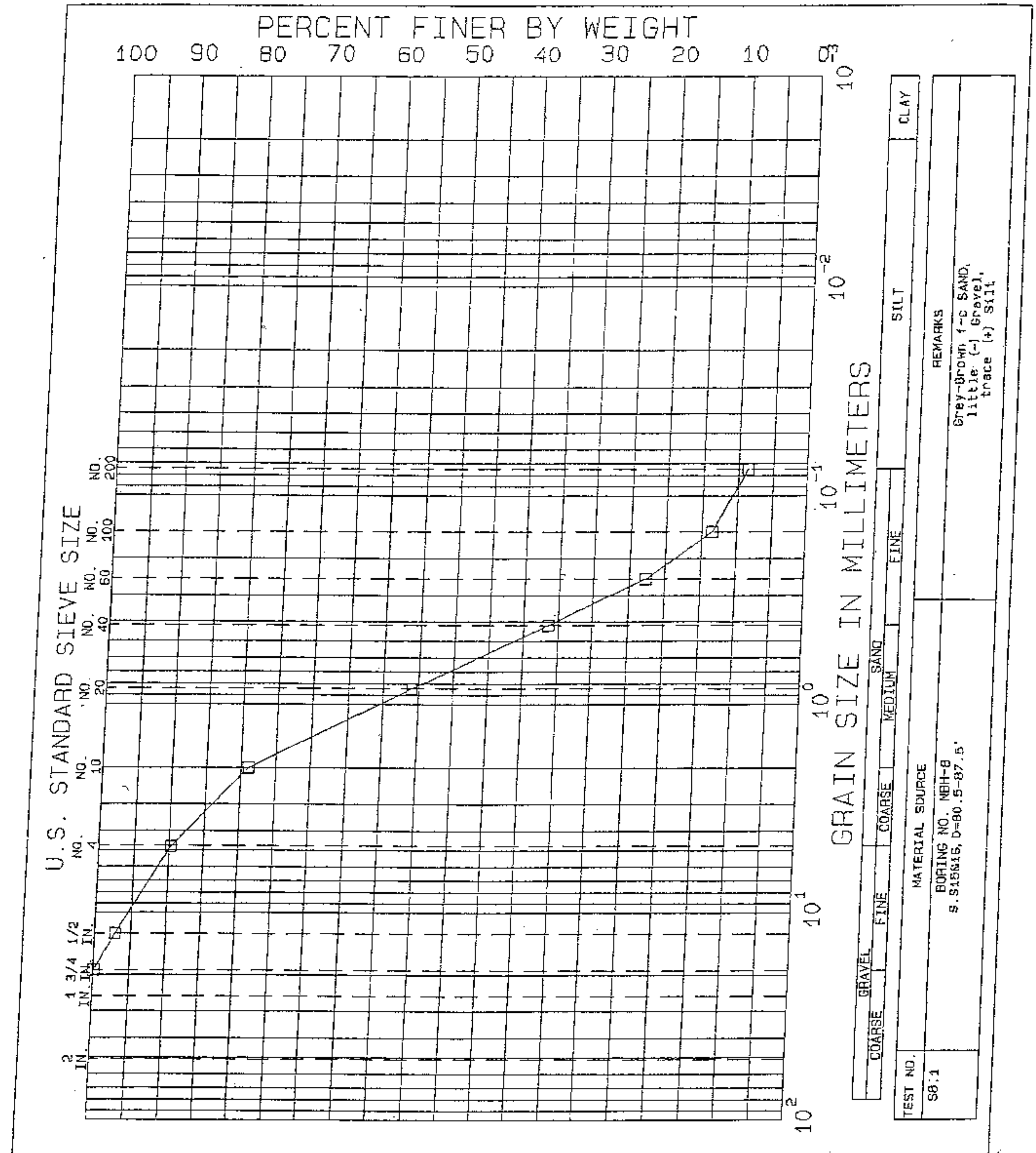


NEW BEDFORD HARBOR

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



NEW BEDFORD HARBOR

NEW BEDFORD, MA.

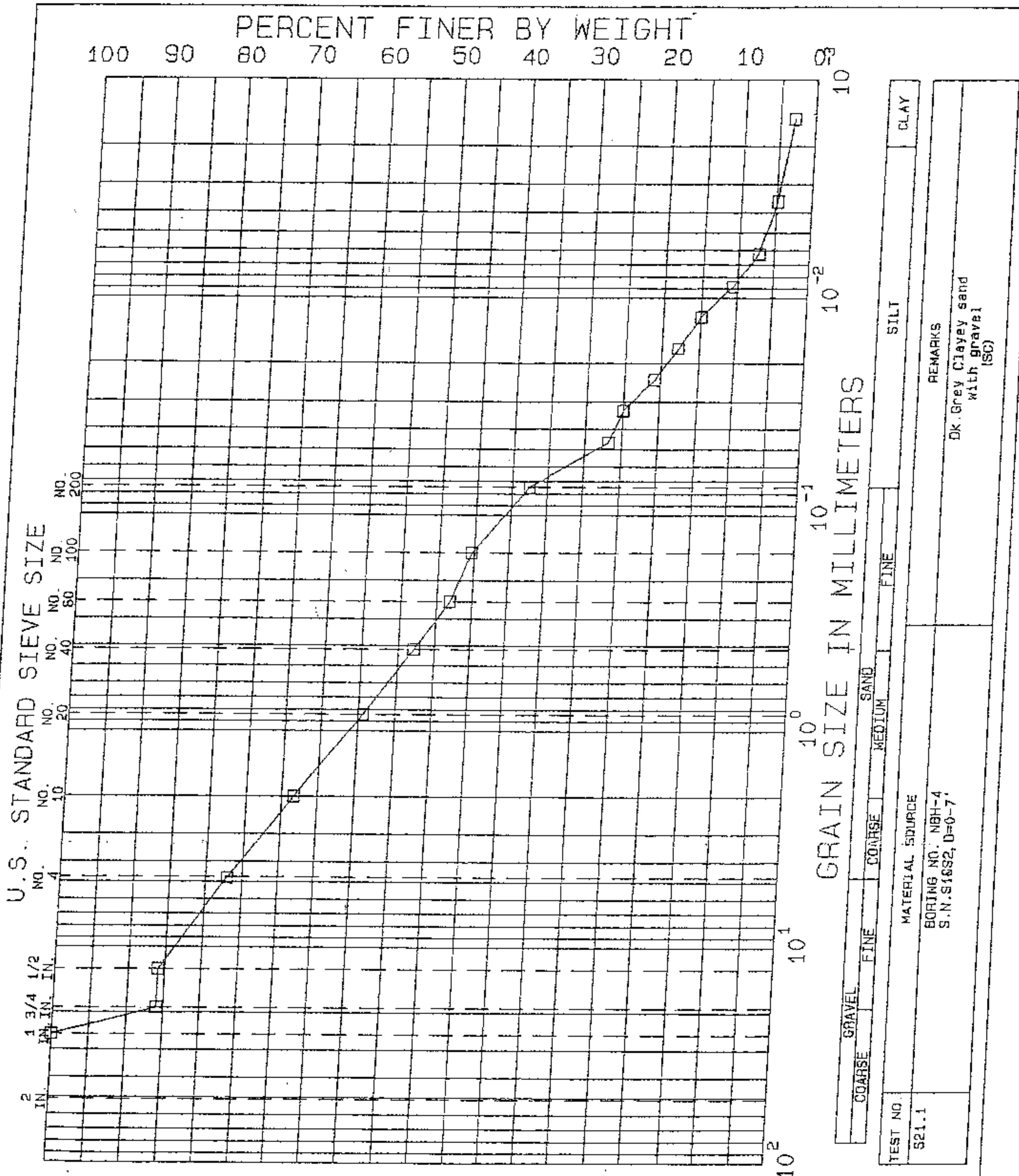
GRADATION TESTS

BORING NO. NBH-8	TEST SERIES
SAMPLE S15&16	NO. B
DEPTH 80.5-87.5'	DATE Jan.03
TECH. MST	
REVIEWER MCM	FILE L17571

Appendix V

Channel Inner Laboratory Testing Data

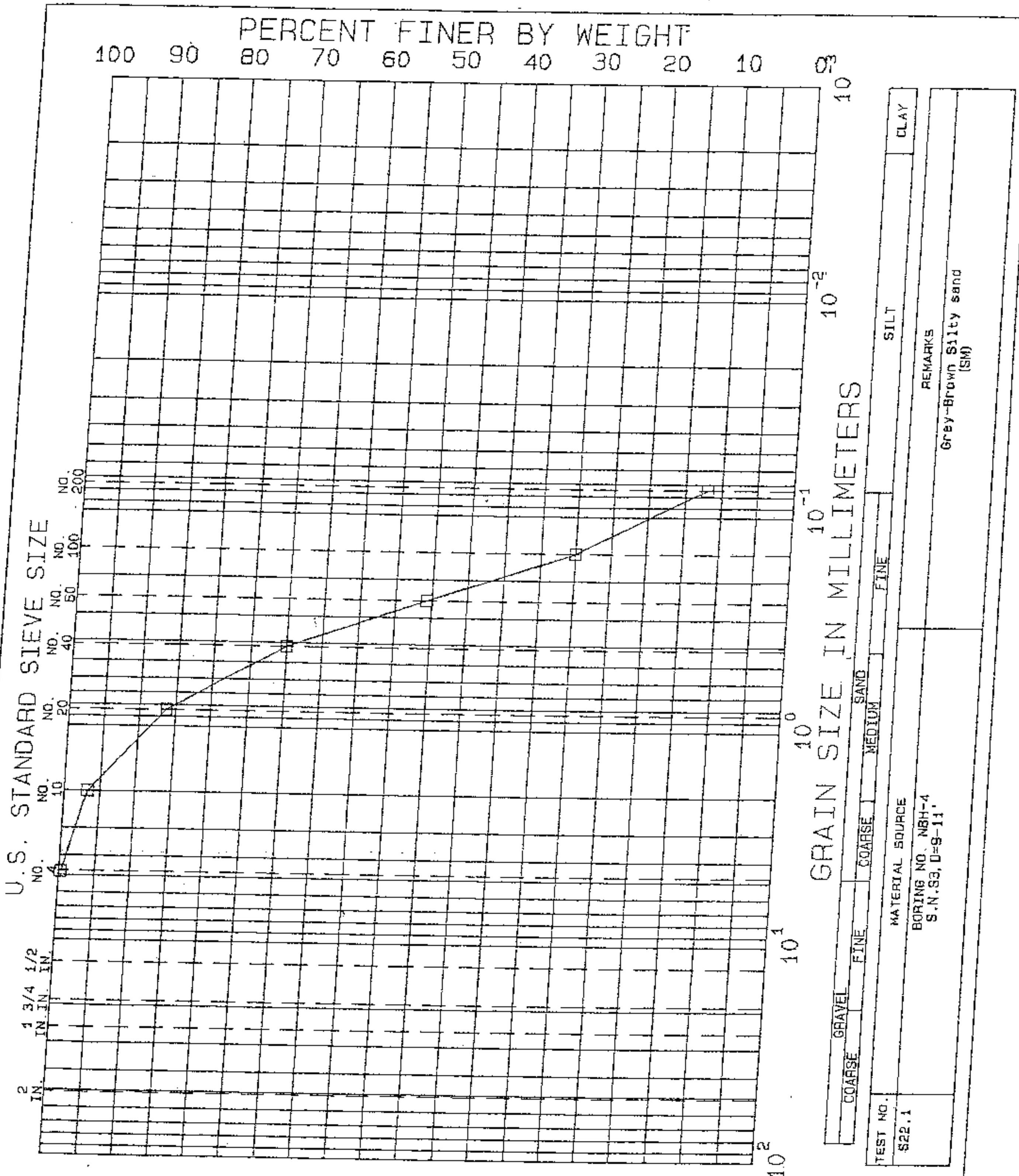
Phase I, NBH – 4, 5, 6 and 7
Phase II, NBH – 9, 10 and 11



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 L16928

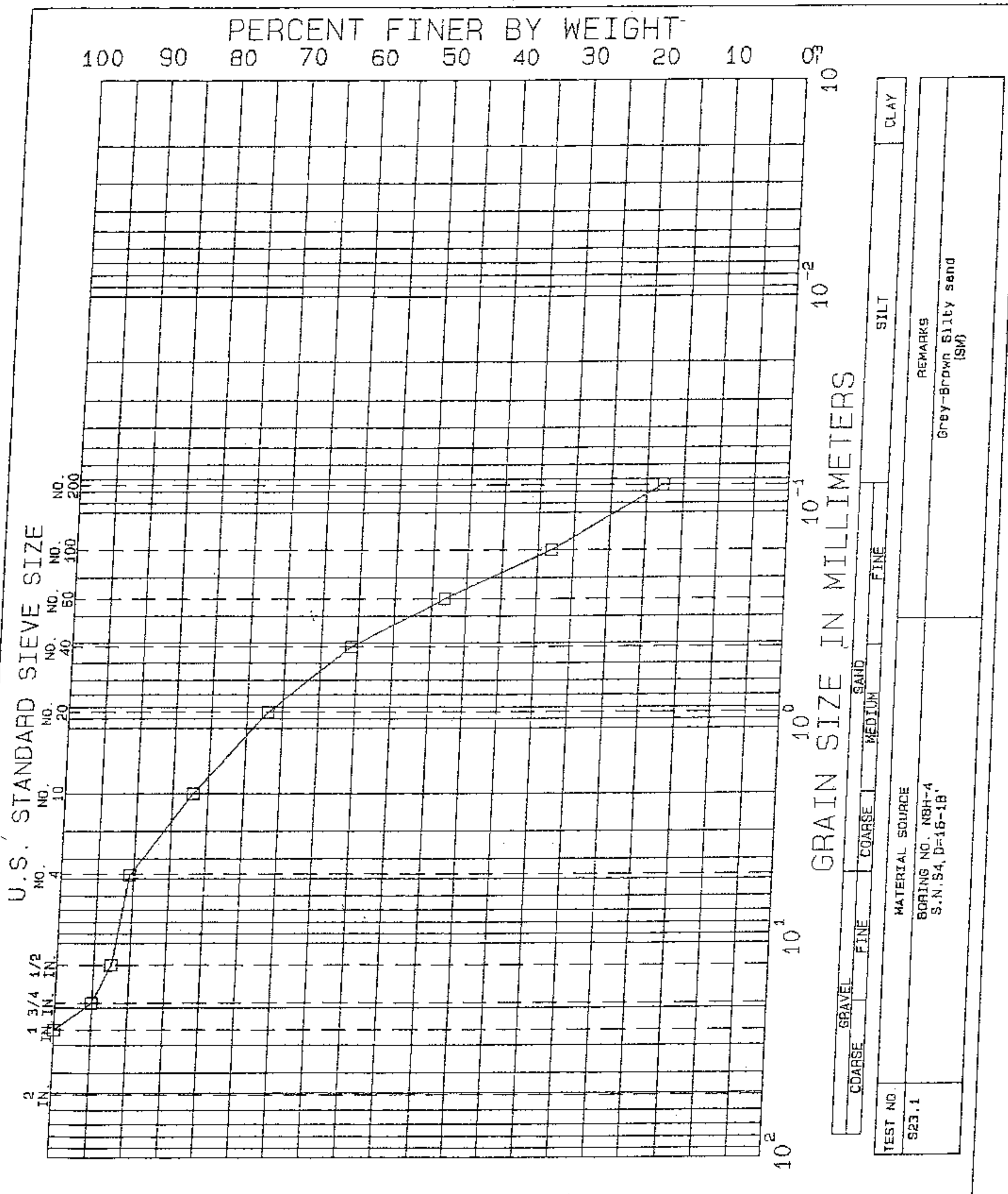


NEW BEDFORD HARBOR FEASIBILITY
STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO.	NBH-4	TEST SERIES NO.	22
SAMPLE	S3	DATE	SEPT. 01
DEPTH	9-11'		
TECH.	mst		
REVIEWER	MCM	FILE	L16928

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS



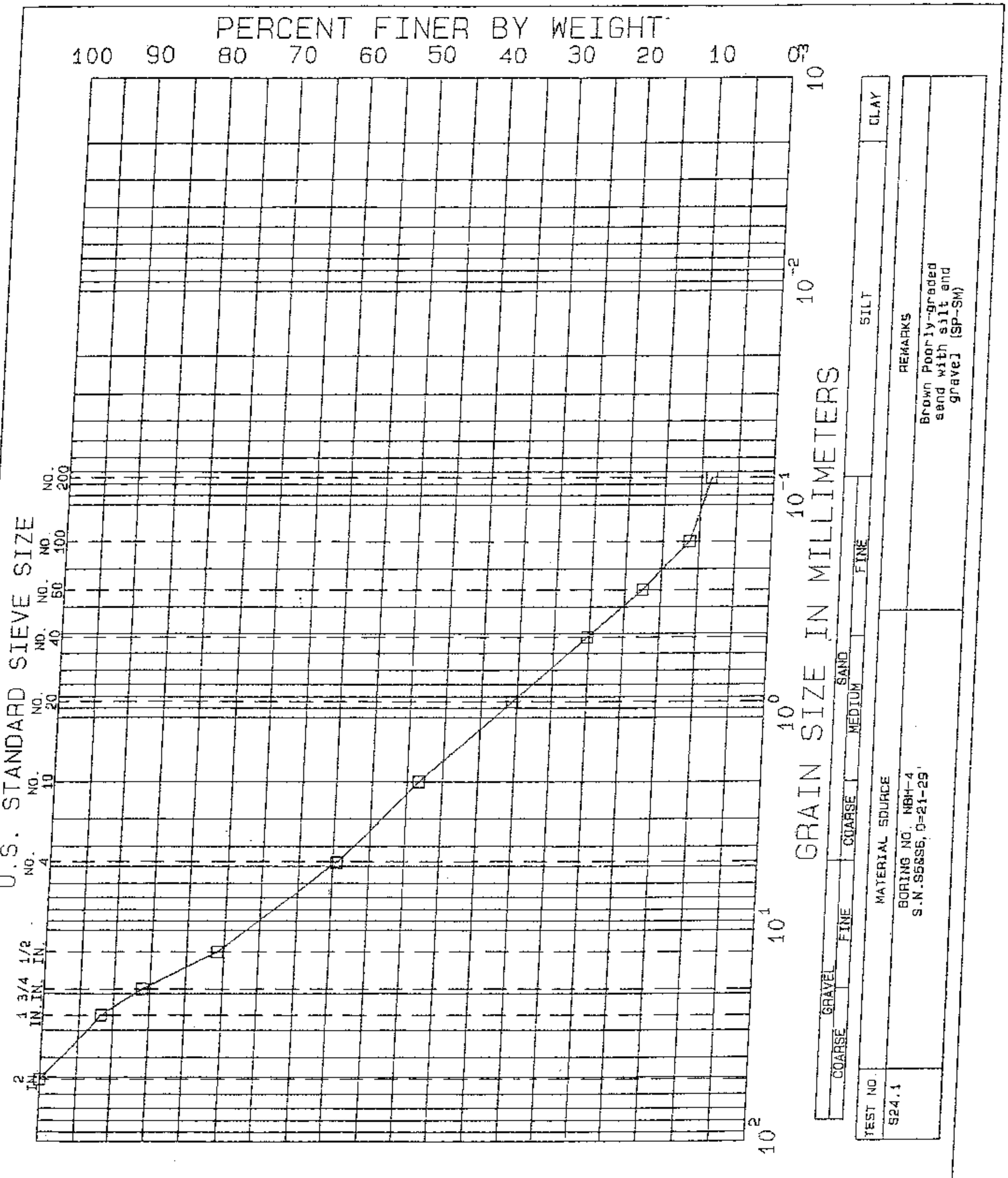
NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-4
SAMPLE S4
DEPTH 16-18'
TECH. mst
REVIEWER MCM

TEST SERIES NO. 23
DATE SEPT. 01

FILE L16928



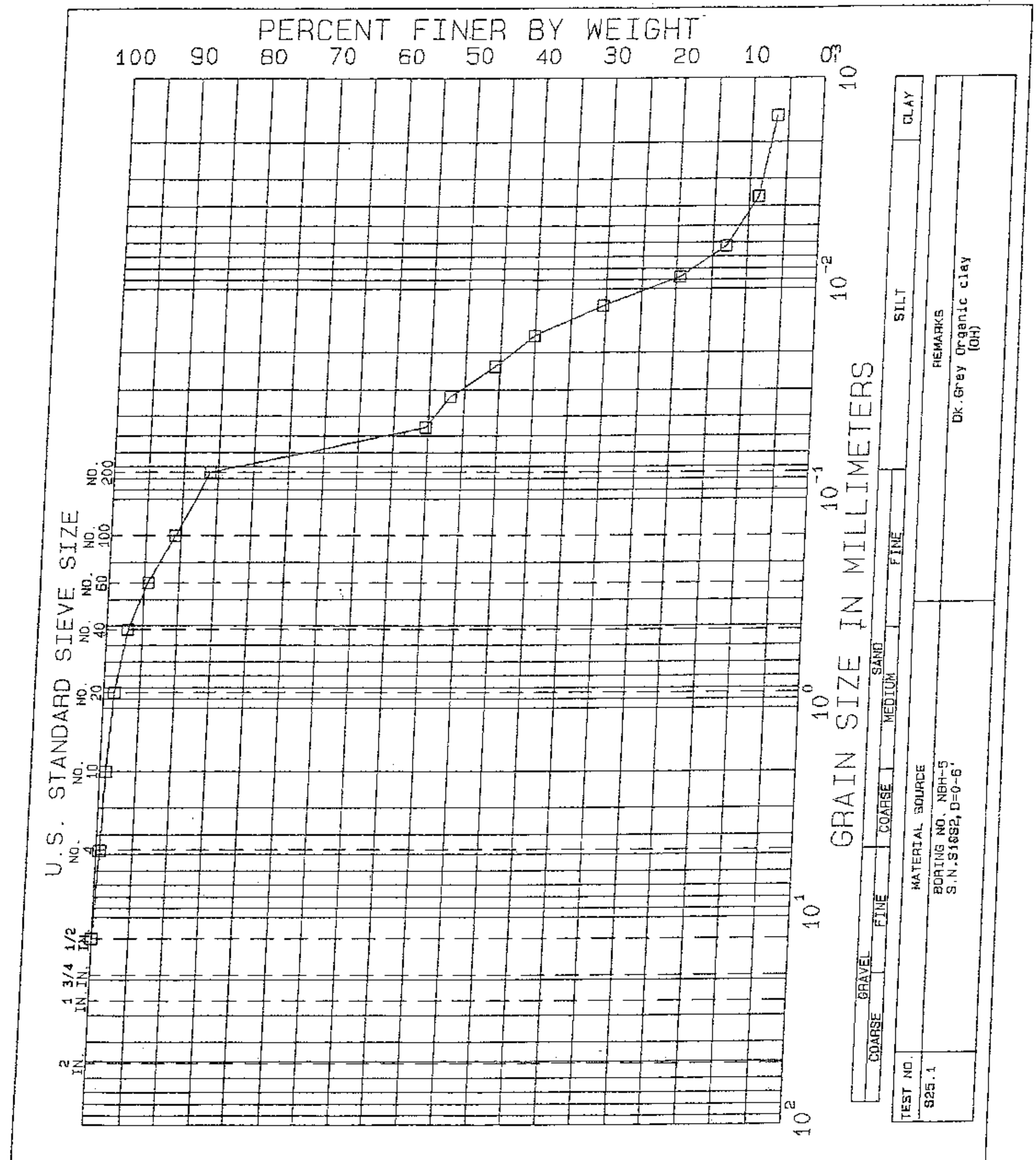
NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-4
SAMPLE S5&S6
DEPTH 21-29'
TECH. mst
REVIEWER MCM

TEST SERIES NO. 24
DATE SEPT. 01

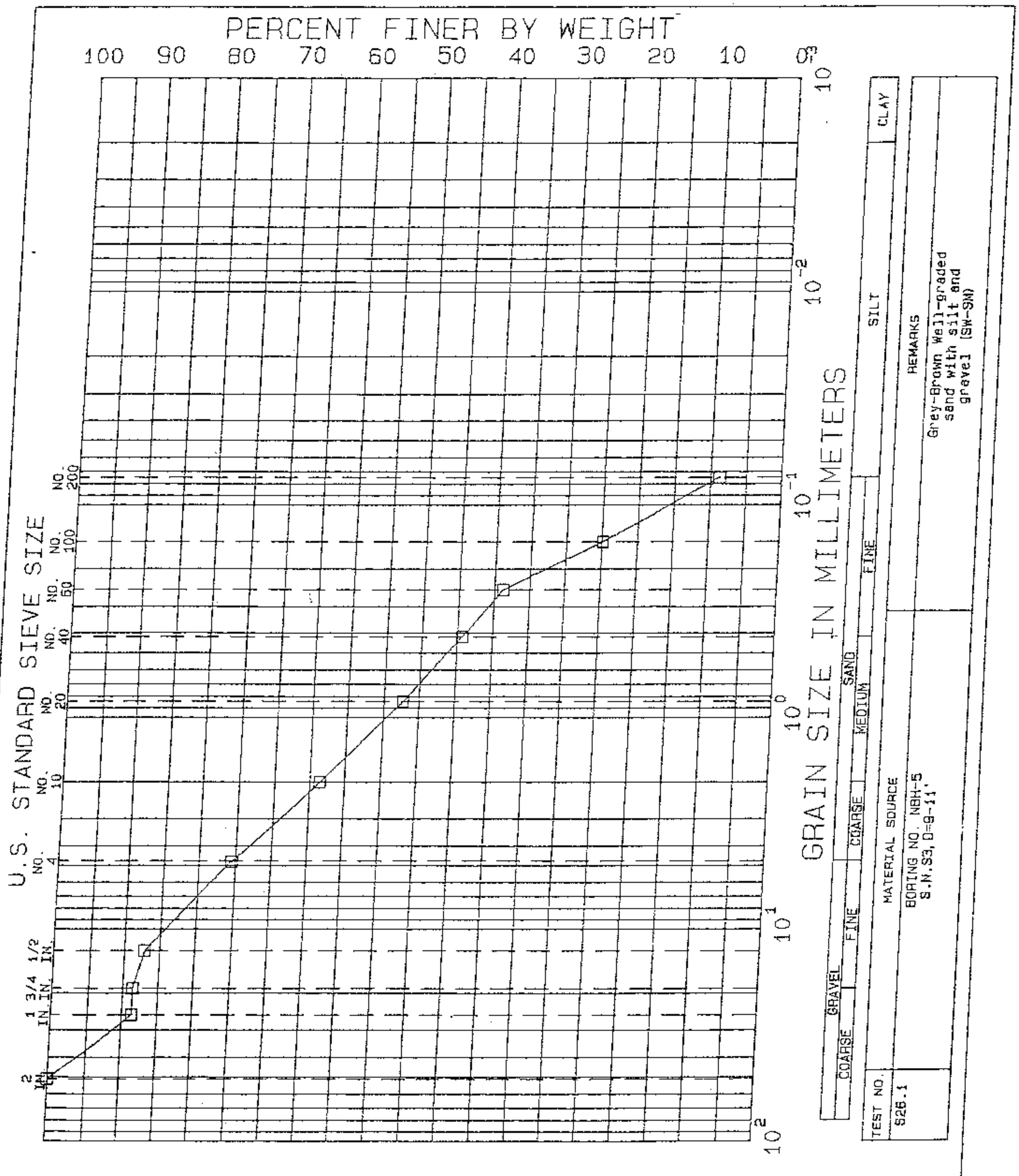
FILE L16928



NEW BEDFORD HARBOR FEASIBILITY
STUDY, NEW BEDFORD, MA.

GRADATION TESTS

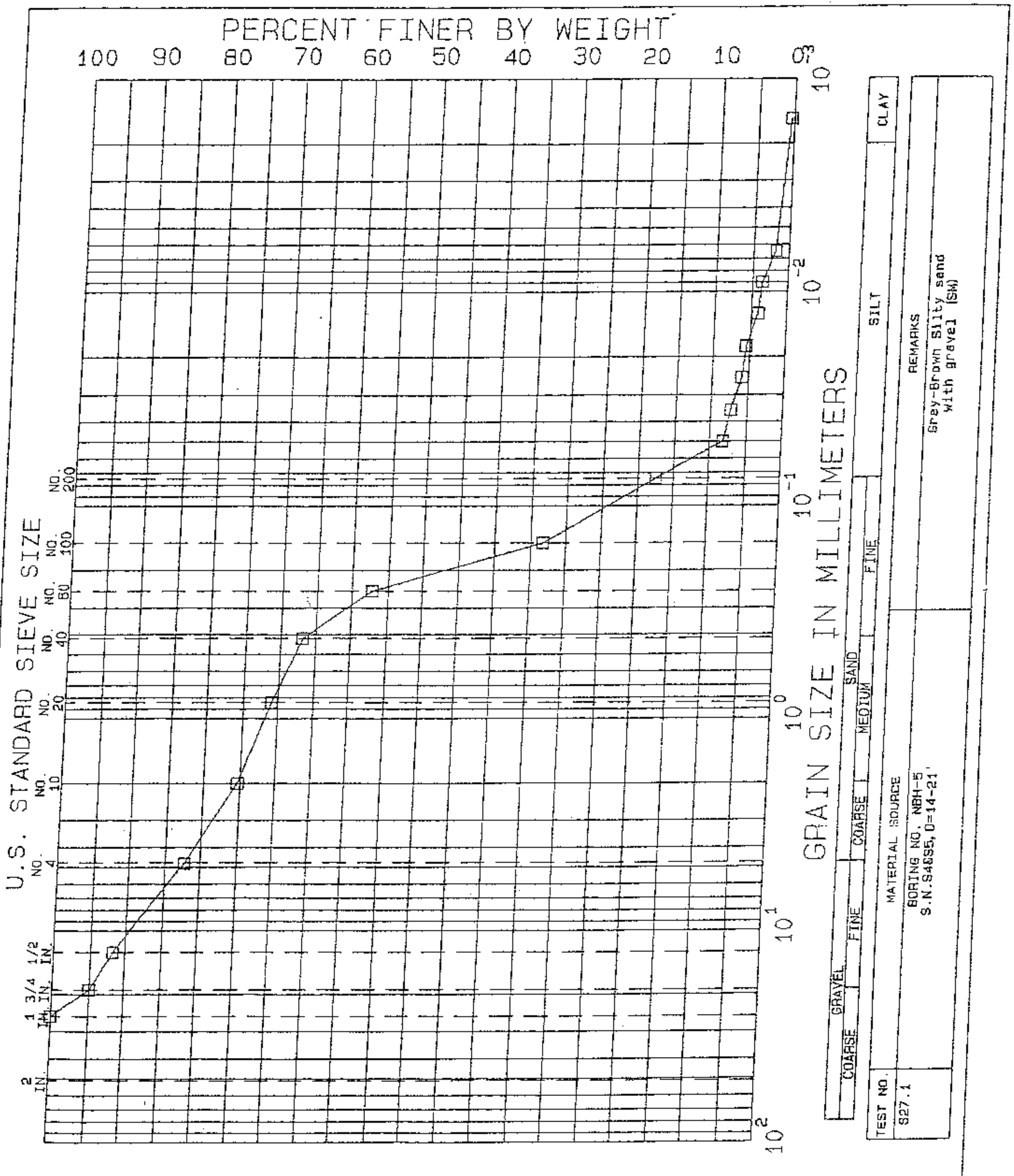
BORING NO.NBH-5	TEST SERIES
SAMPLE S1&S2	NO. 25
DEPTH 0-6"	DATE SEPT. 01
TECH. mst	
REVIEWER MCM	FILE L16928



NEW BEDFORD HARBOR FEASIBILITY
STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-5	TEST SERIES
SAMPLE S3	NO. 26
DEPTH 9-11'	DATE SEPT. 01
TECH. mst	
REVIEWER MCM	FILE L16928



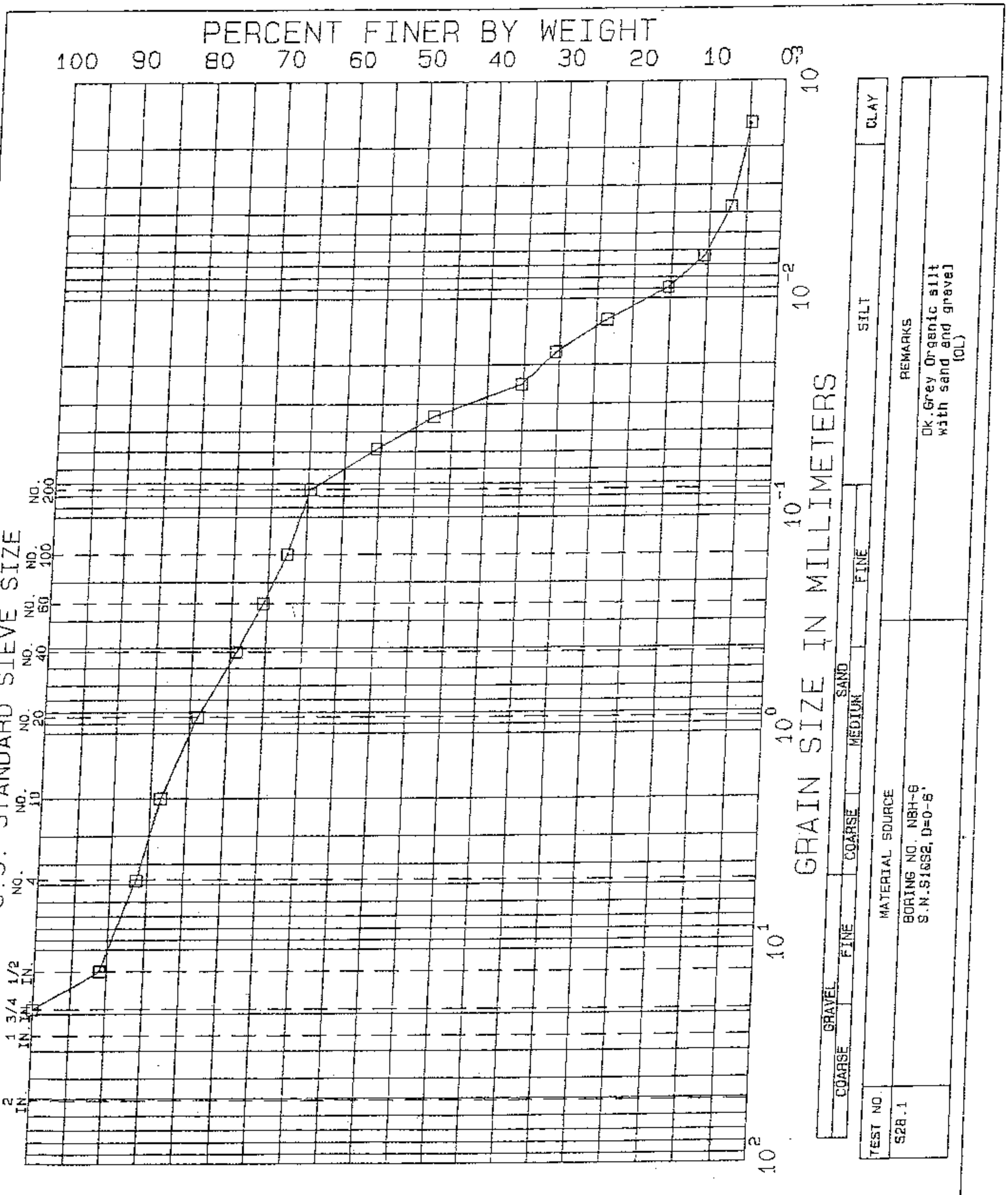
NEW BEDFORD HARBOR FEASIBILITY
STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-5
SAMPLE S4&S5
DEPTH 14-21'
TECH. mst
REVIEWER MCM

TEST SERIES
NO. 27
DATE SEPT. 01

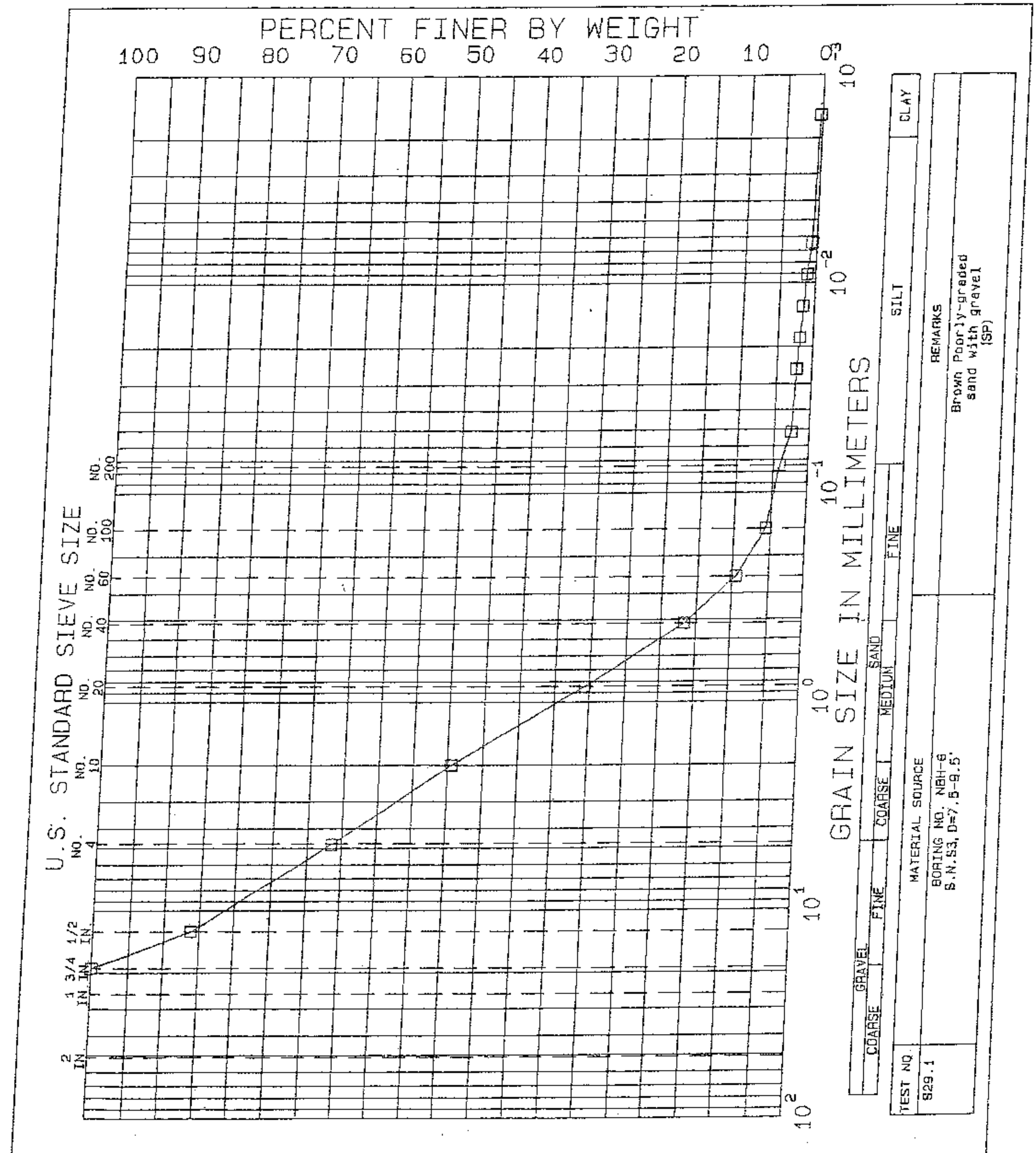
FILE L16928



NEW BEDFORD HARBOR FEASIBILITY
STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-6	TEST SERIES
SAMPLE S1-S2	NO. 28
DEPTH 0-6'	DATE SEPT. 01
TECH. mst	
REVIEWER MCM	FILE L16928



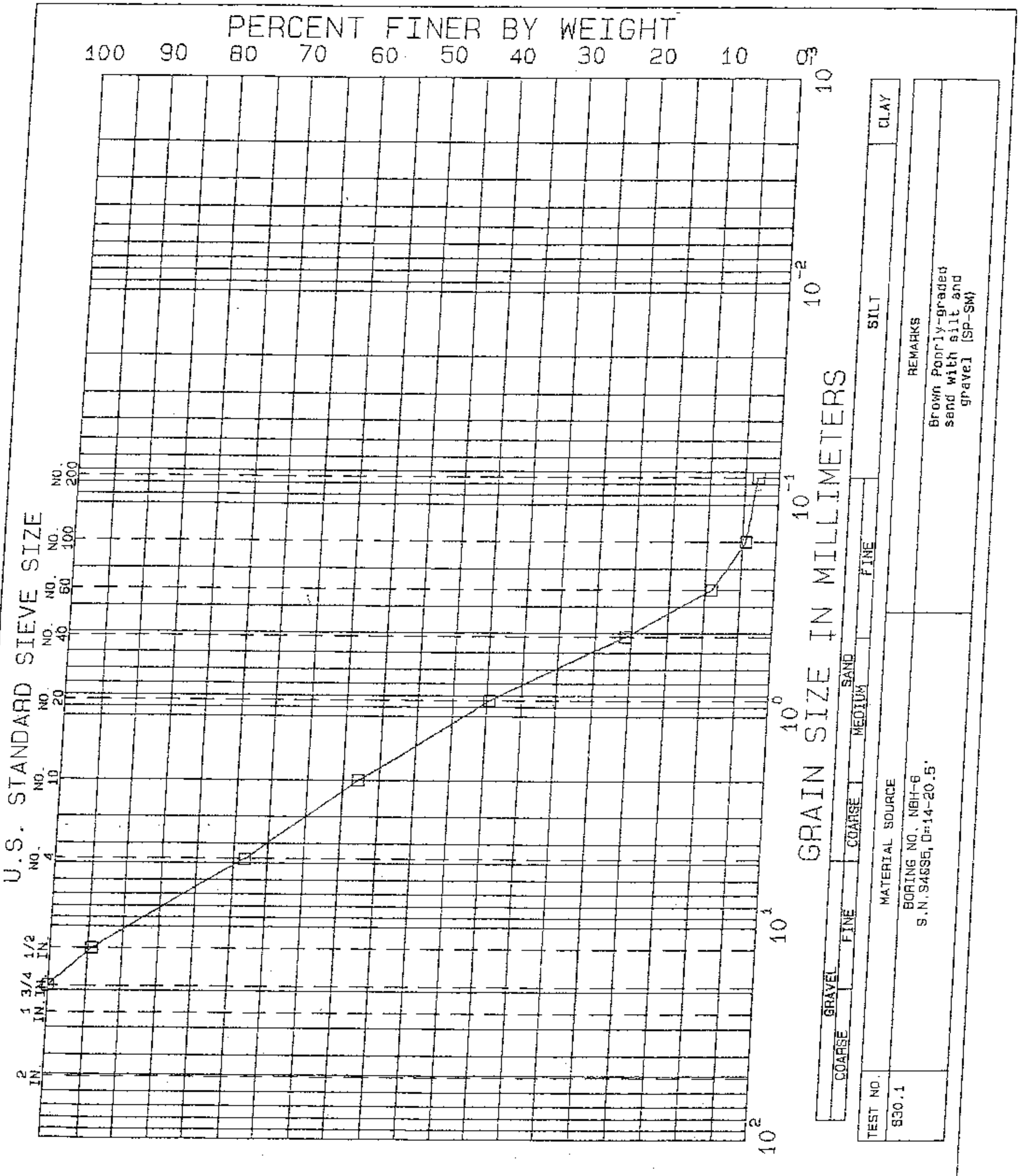
NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-6
SAMPLE S3
DEPTH 7.5-9.5'
TECH. mst
REVIEWER MCM

TEST SERIES NO. 29
DATE SEPT. 01

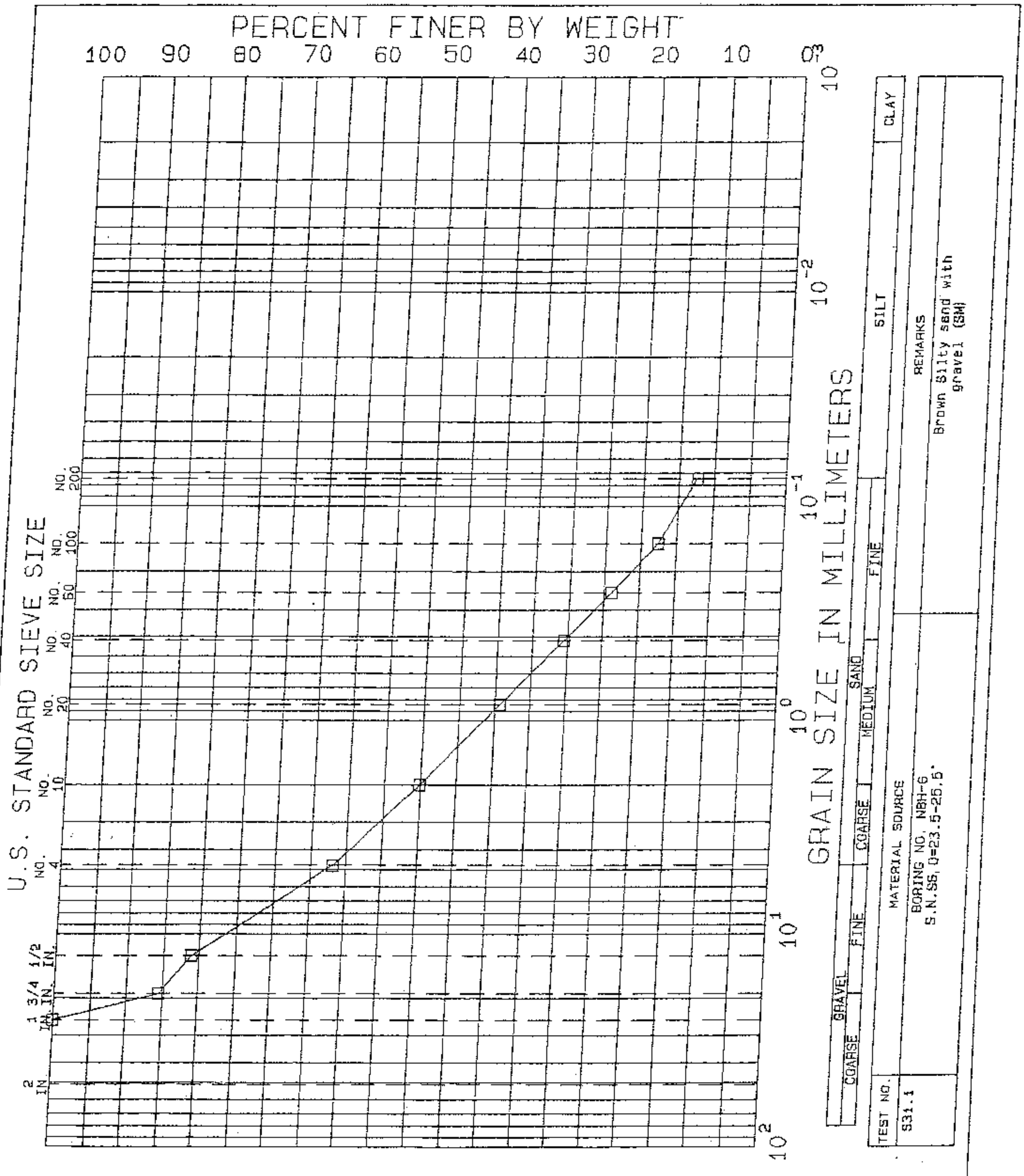
FILE L16928



NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

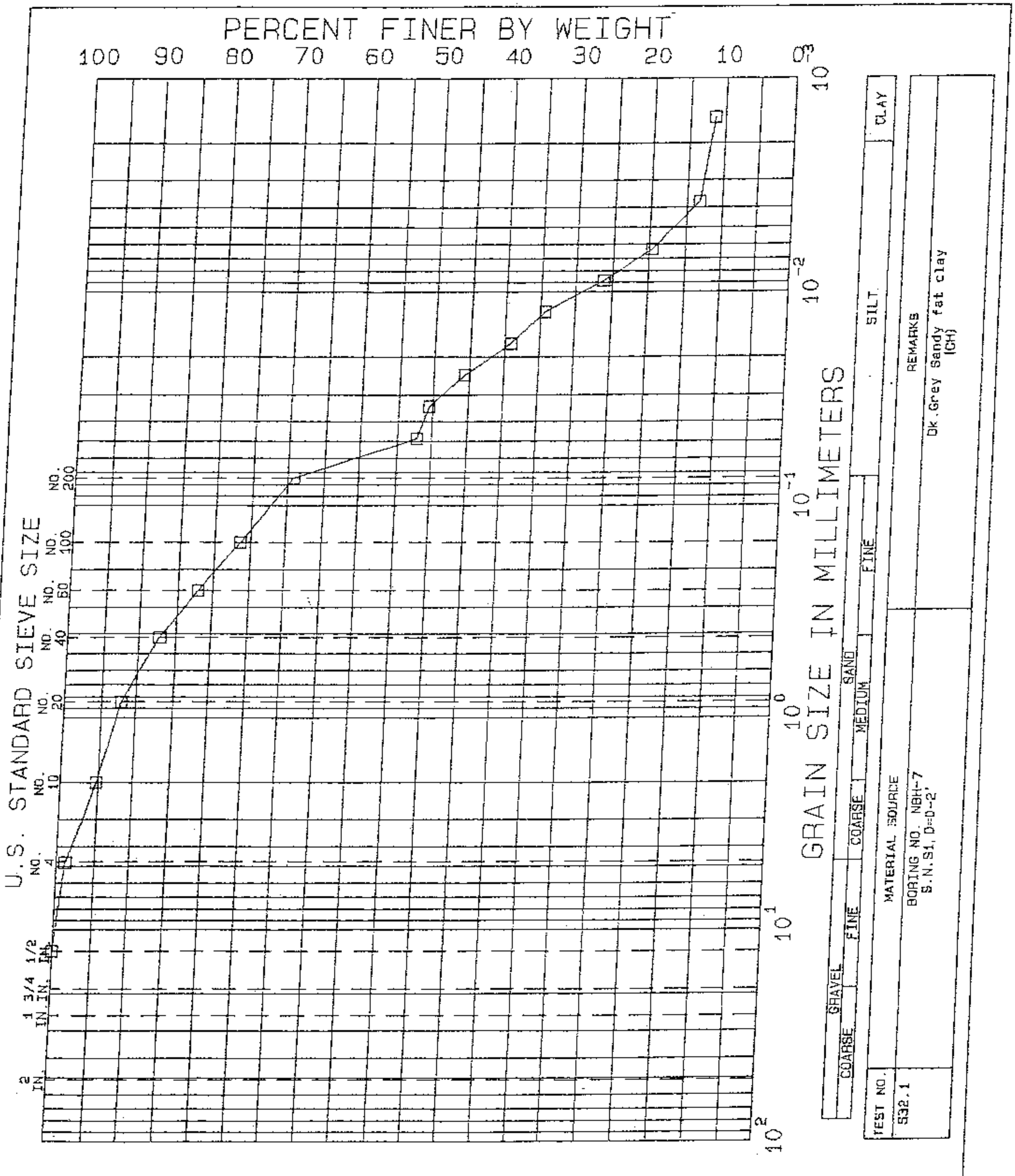
BORING NO. NBH-6	TEST SERIES
SAMPLE S4&S5	NO. 30
DEPTH 14-20.5'	DATE SEPT. 01
TECH. mst	
REVIEWER MCM	FILE L15928



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



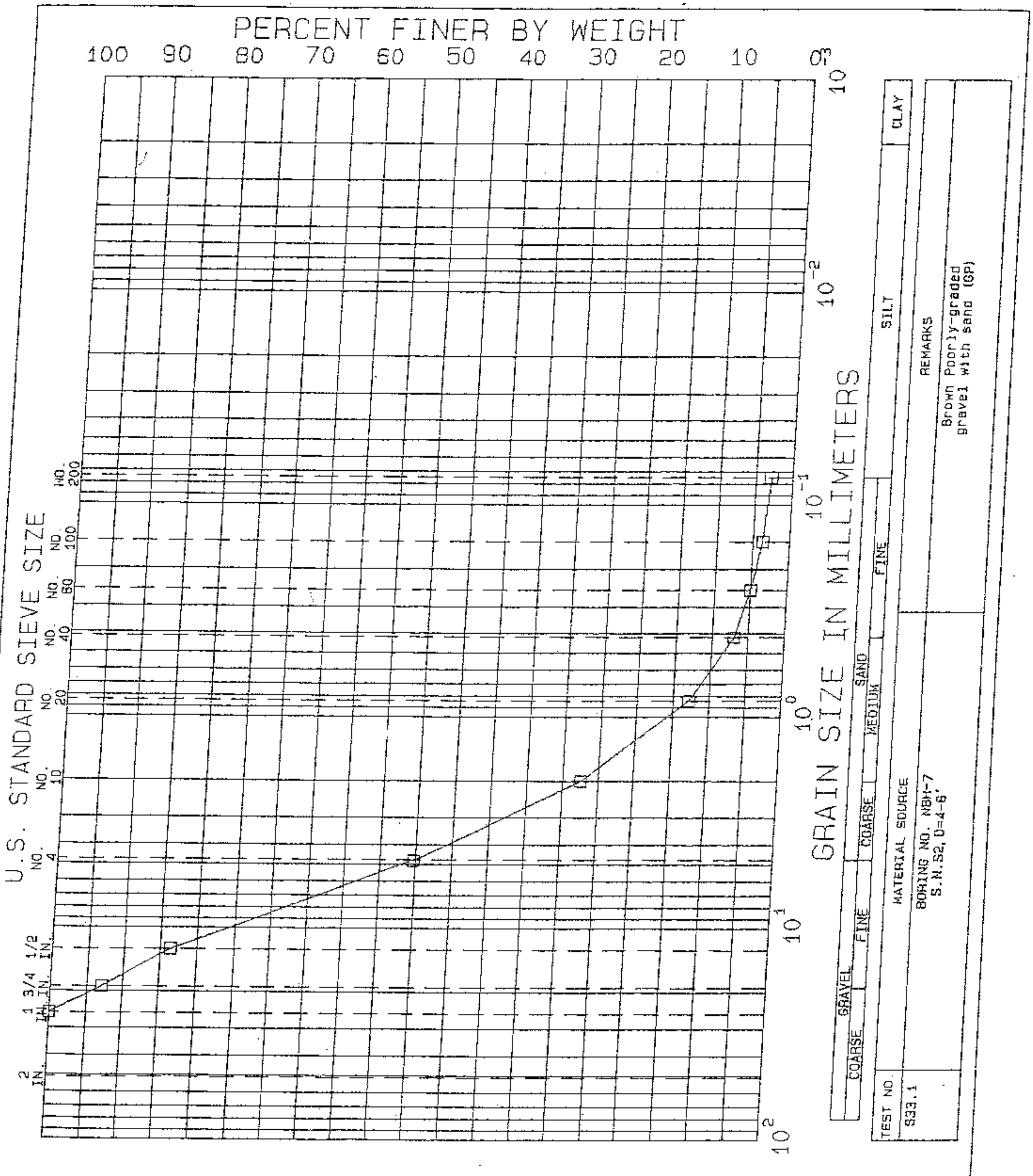
NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-7
SAMPLE S1
DEPTH 0-2'
TECH. mst
REVIEWER MCM

TEST SERIES NO. 32
DATE SEPT. 01

FILE L16928

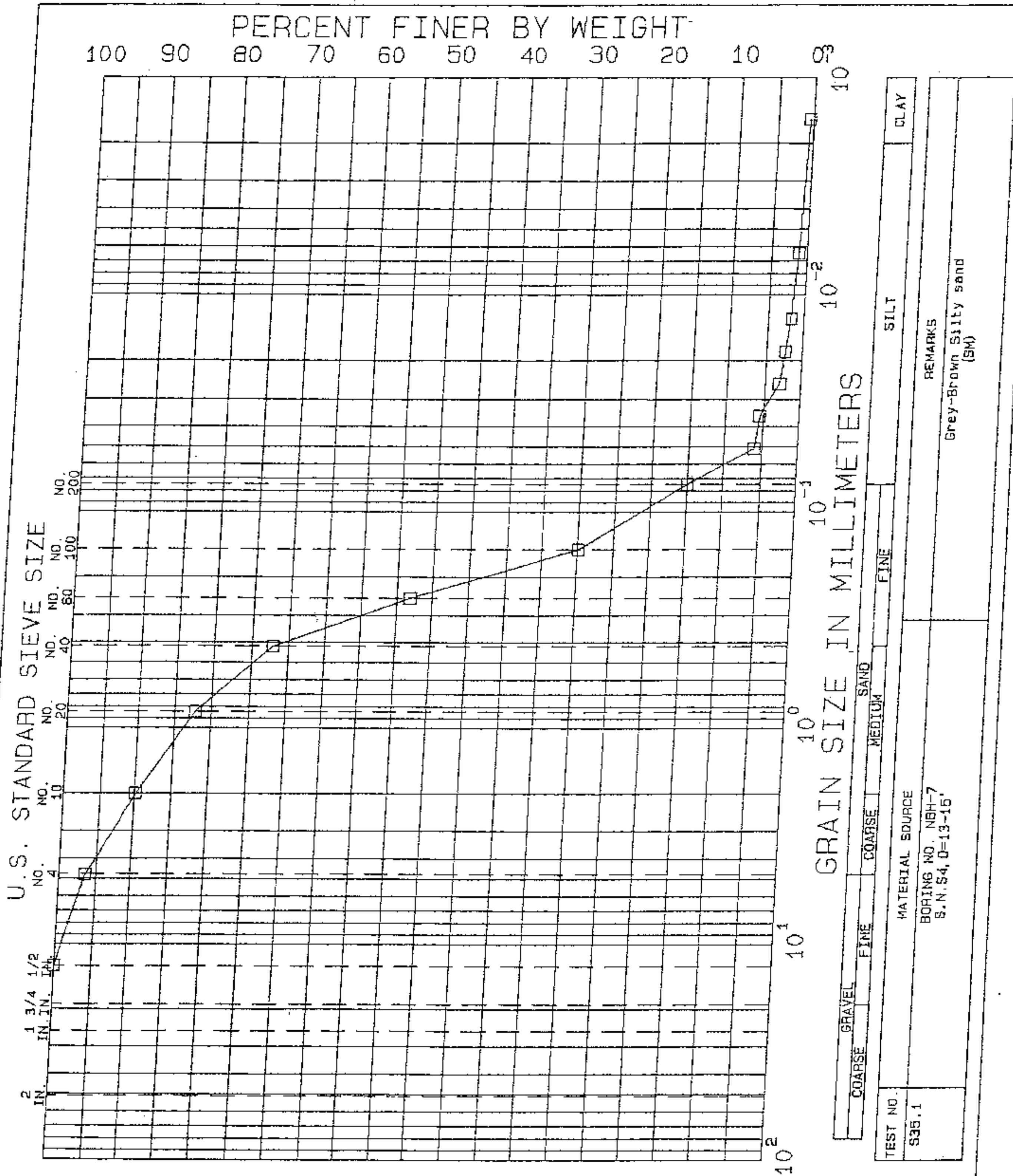


NEW BEDFORD HARBOR FEASIBILITY

STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-7	TEST SERIES
SAMPLE S2	NO. 33
DEPTH 4-6'	DATE SEPT. 01
TECH. mst	
REVIEWER MCM	FILE L16928



NEW BEDFORD HARBOR FEASIBILITY
STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-7
SAMPLE S4
DEPTH 13-15'
TECH. mst
REVIEWER MCM

TEST SERIES
NO. 35
DATE SEPT. 01

FILE L16928

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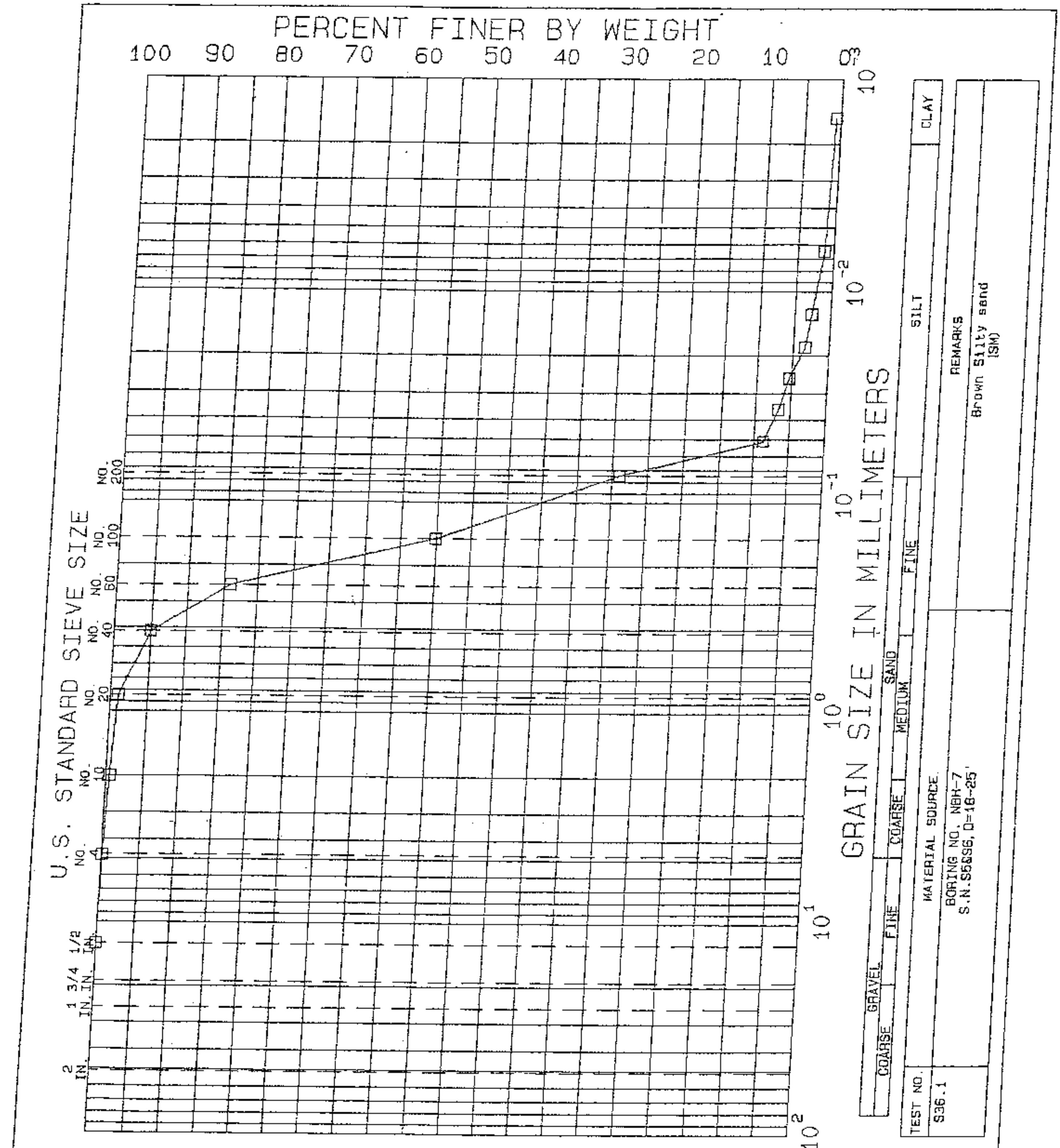
ENGINEERS AND SCIENTISTS



NEW BEDFORD HARBOR FEASIBILITY STUDY, NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-7
SAMPLE S5&S6
DEPTH 18-25'
TECH. mst
REVIEWER MCM

TEST SERIES
NO. 36
DATE SEPT. 01

FILE L16928

Project Name NEW BEDFORD HARBOR
NEW BEDFORD, MASS.
Project No. L17571
Project Engineer D. SCHULZE

LABORATORY TESTING DATA SHEET

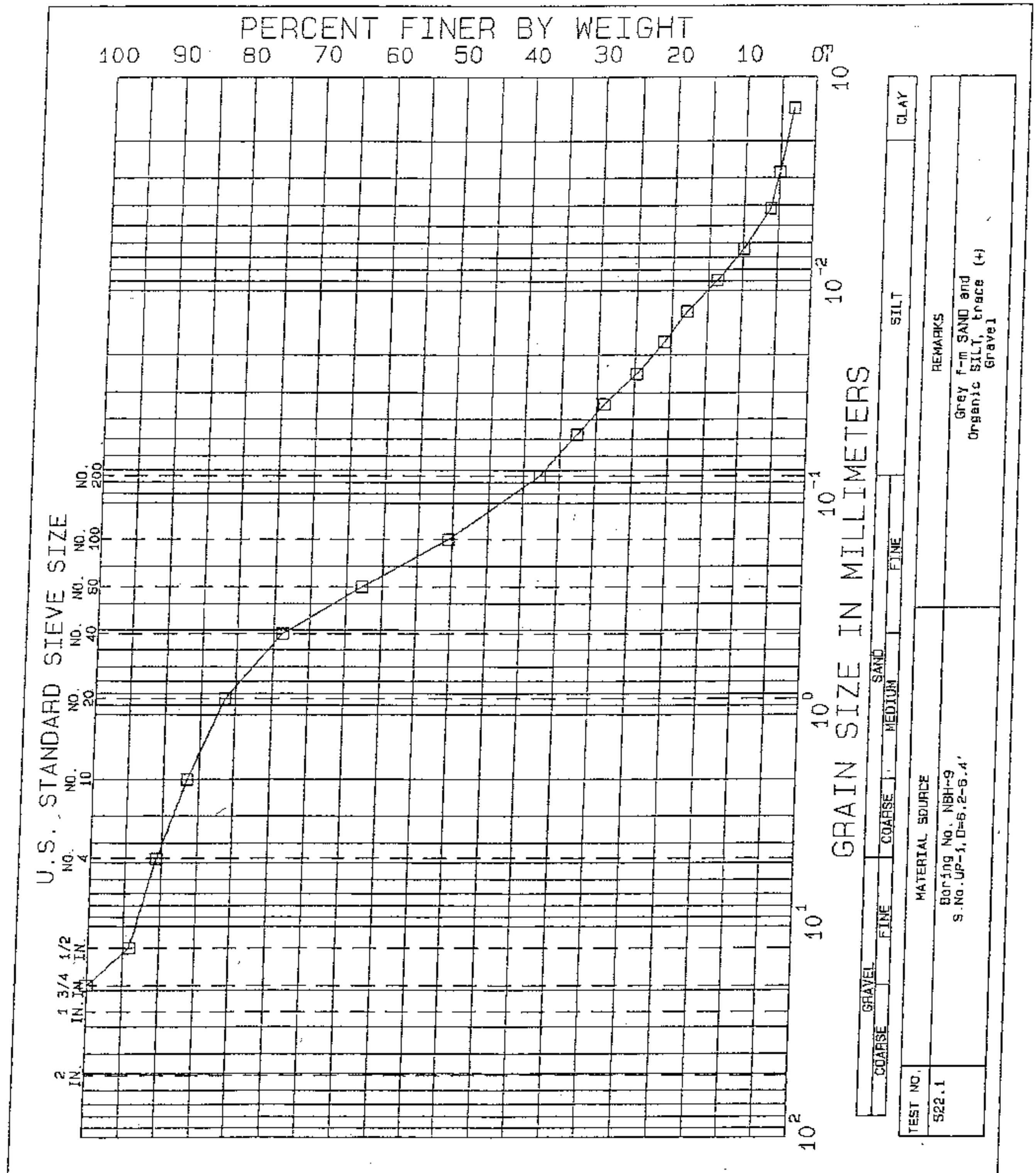
Assigned By D. NACCI
Date DEC.02

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} (%)	Perme-ability cm/sec	Strength Tests: Torvane or Type Test	$\bar{\sigma}_c$ psf	Failure Criteria	$\sigma_1 - \sigma_3$ or τ psf	Strain %	Consol. $\frac{}{1+e_0}$	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											

GZA GeoEnvironmental, Inc.
Q:\NEWTON\LAB\LABFORM7.XLS

labform1.xls

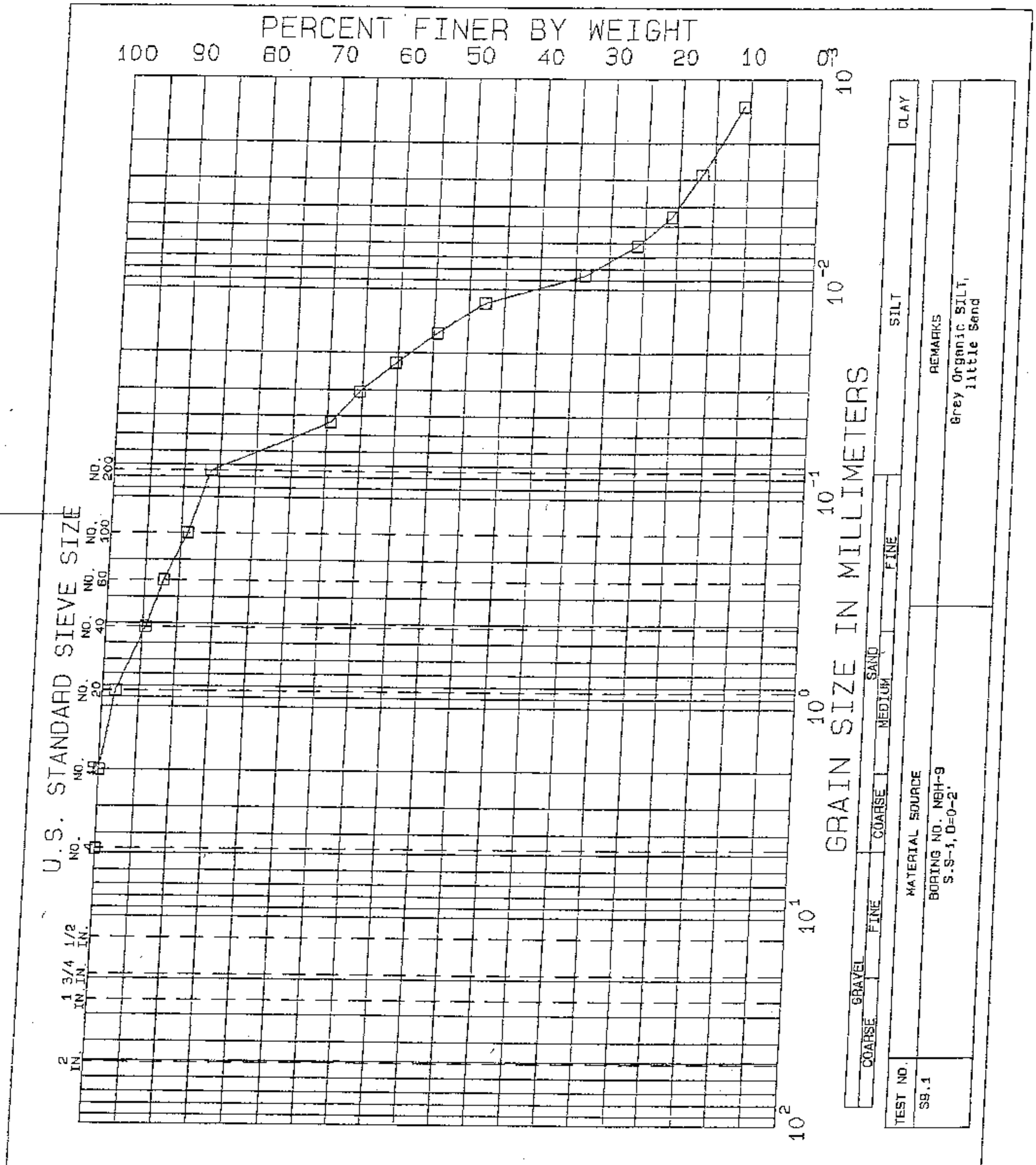


NEW BEDFORD HARBOR

NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-9	TEST SERIES
SAMPLE UP-1	NO. 22
DEPTH 6.2-6.4'	DATE DEC.02
TECH. mst	
REVIEWER DAS	FILE L17571

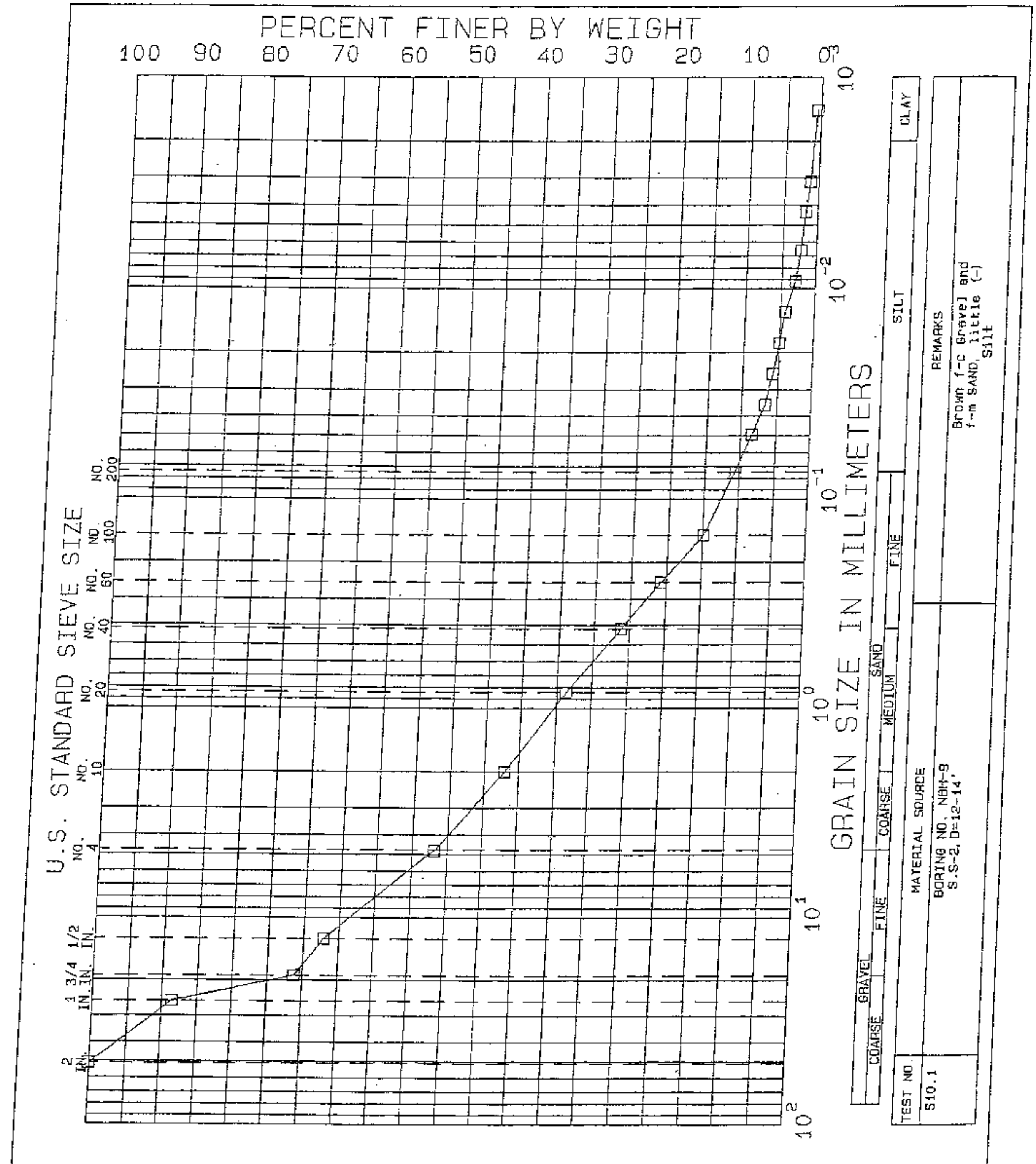


NEW BEDFORD HARBOR

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

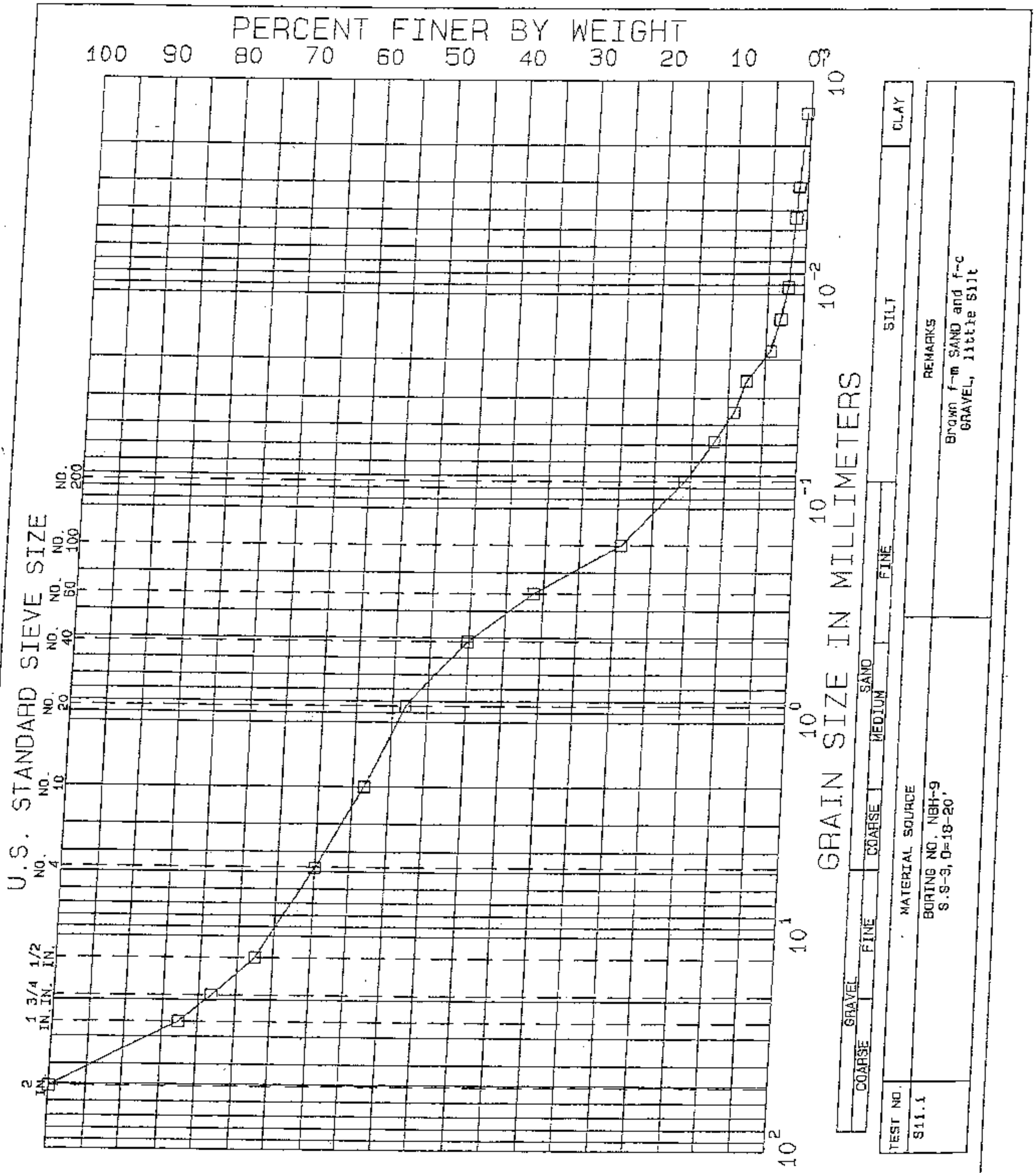


NEW BEDFORD HARBOR

NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-9	TEST SERIES
SAMPLE S-2	NO. 10
DEPTH 12-14'	DATE Jan.03
TECH. MST	
REVIEWER MCM	FILE L17571



NEW BEDFORD HARBOR
NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-9
SAMPLE S-3
DEPTH 18-20'
TECH. MST
REVIEWER MCM

TEST SERIES
NO. 11
DATE Jan.03

FILE L17571

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS

Project Name NEW BEDFORD HARBOR
NEW BEDFORD, MA.
Project No. L17571
Project Engineer D. SCHULZE

LABORATORY TESTING DATA SHEET

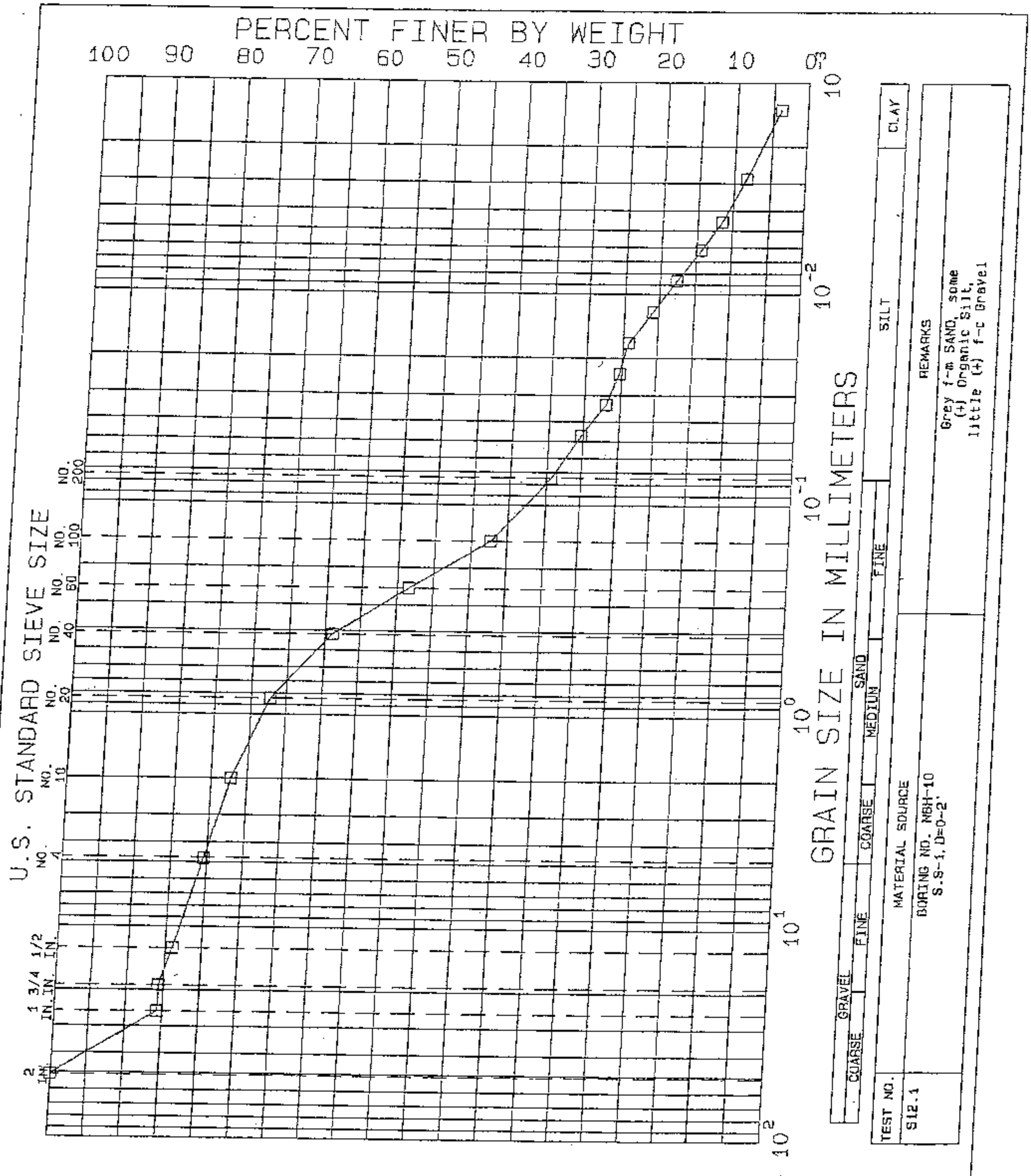
Assigned By D. NACCI
Date DEC.02

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} (%)	Perme-ability 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

GZA GeoEnvironmental, Inc.
Q:\NEWTON\LAB\LABFORM7.XLS

labform1.xls



NEW BEDFORD HARBOR

NEW BEDFORD, MA.

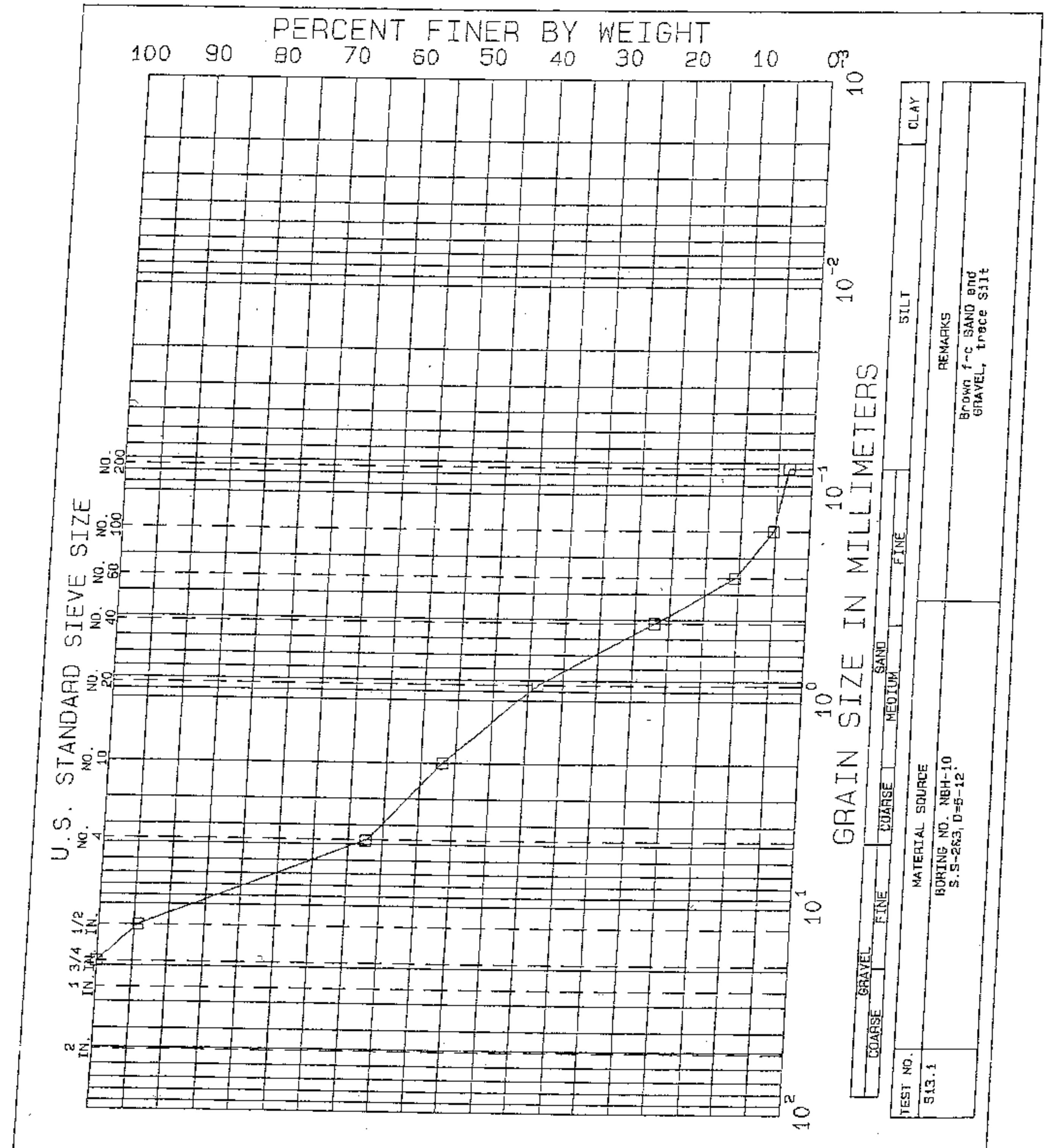
GRADATION TESTS

BORING NO. NBH-10
SAMPLE S-1
DEPTH 0-2'
TECH. MST
REVIEWER MCM

TEST SERIES
NO. 12
DATE Jan.03

FILE L17571

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS



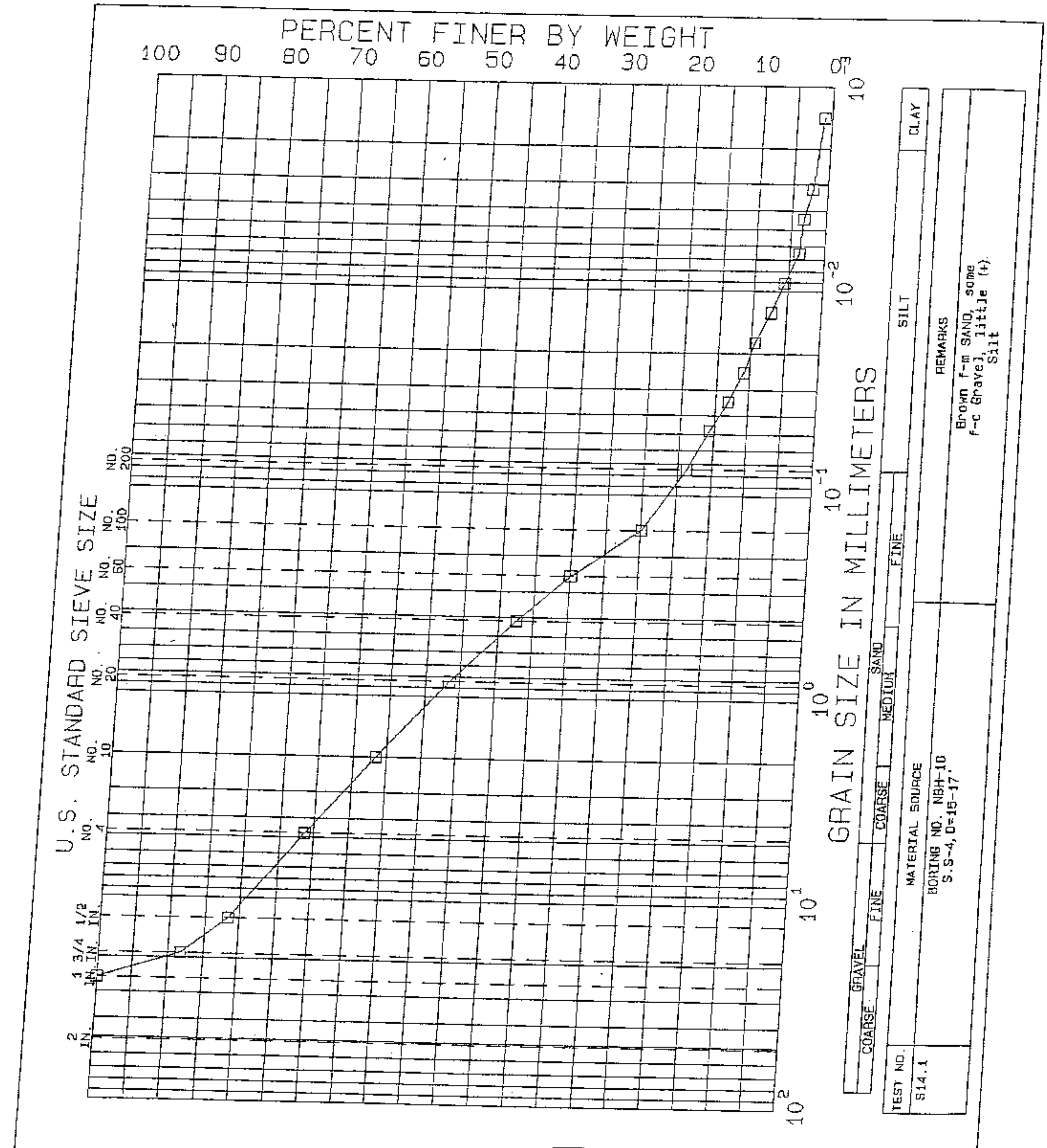
NEW BEDFORD HARBOR
NEW BEDFORD, MA.

GRADATION TESTS

BORING NO. NBH-10
SAMPLE S-2&3
DEPTH 5-12'
TECH. MST
REVIEWER MCM

TEST SERIES
NO. 13
DATE Jan.03

FILE L17571



NEW BEDFORD HARBOR

NEW BEDFORD, MA.

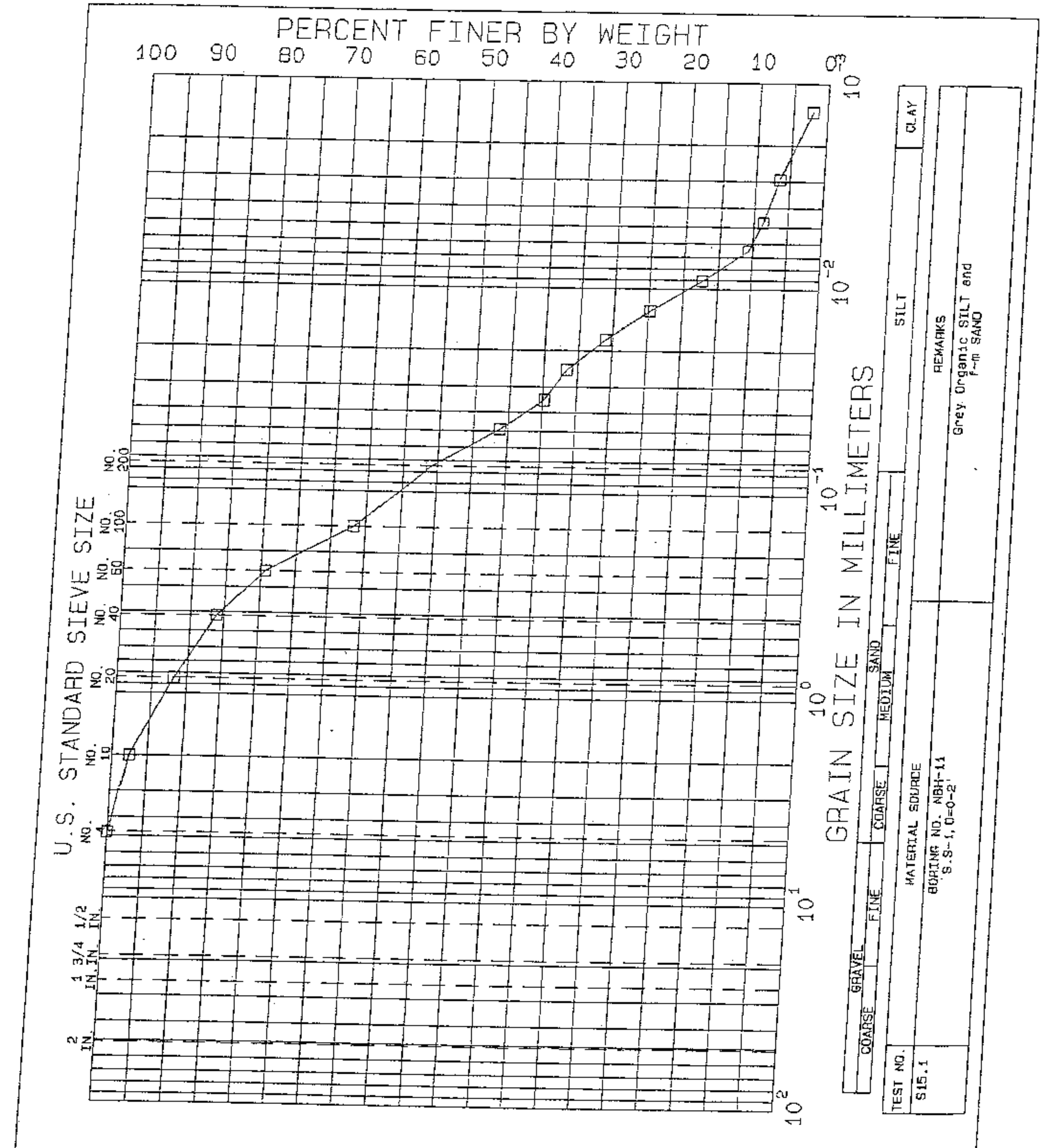
GRADATION TESTS

BORING NO. NBH-10
SAMPLE S-4
DEPTH 15-17'
TECH. MST
REVIEWER MCM

TEST SERIES
NO. 14
DATE Jan.03

FILE L17671

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS



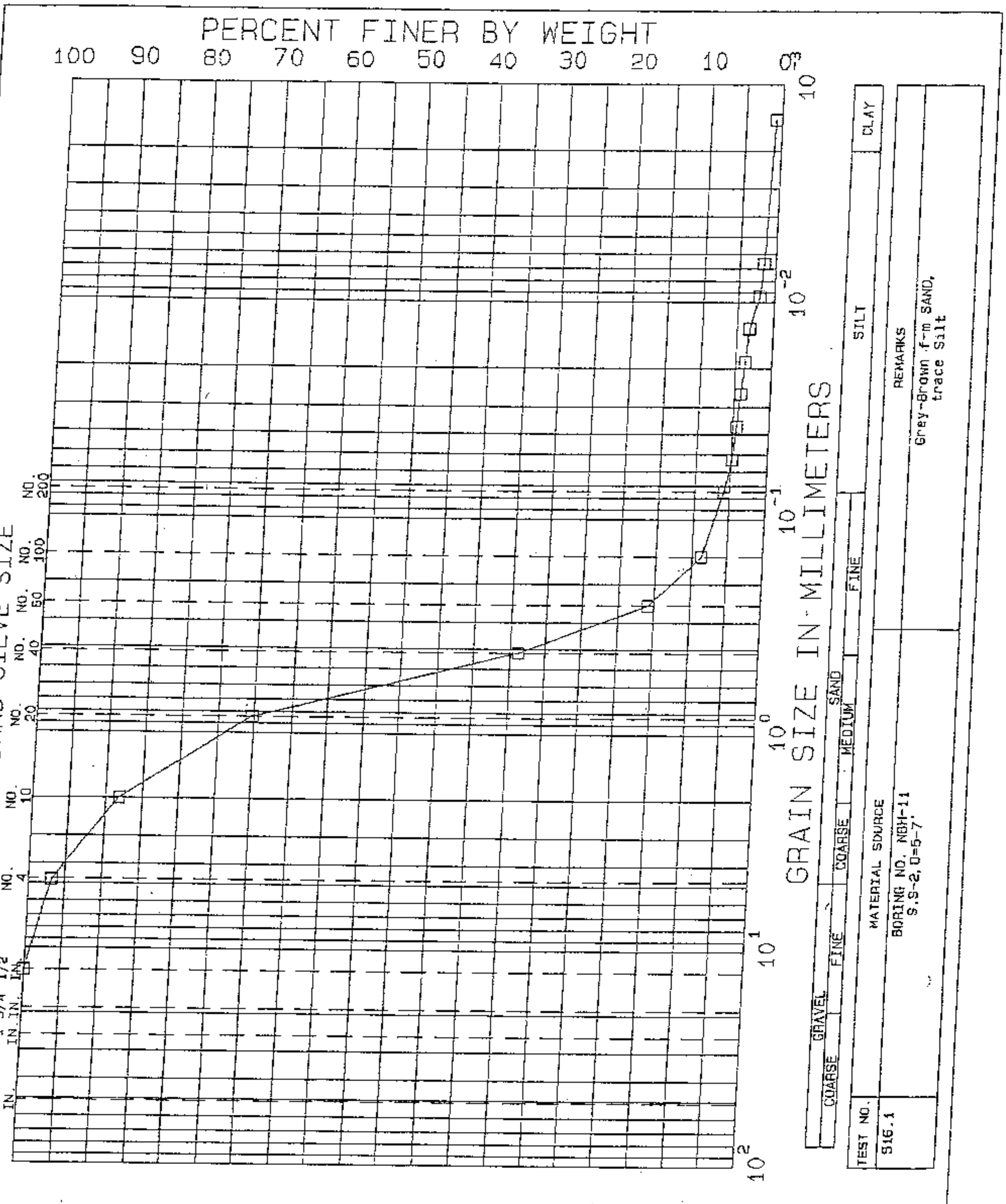
NEW BEDFORD HARBOR
NEW BEDFORD, MA.
GRADATION TESTS

BORING NO. NBH-11
SAMPLE S-1
DEPTH 0-2'
TECH. MST
REVIEWER MCM

TEST SERIES
NO. 15
DATE Jan.03

FILE L17571

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS

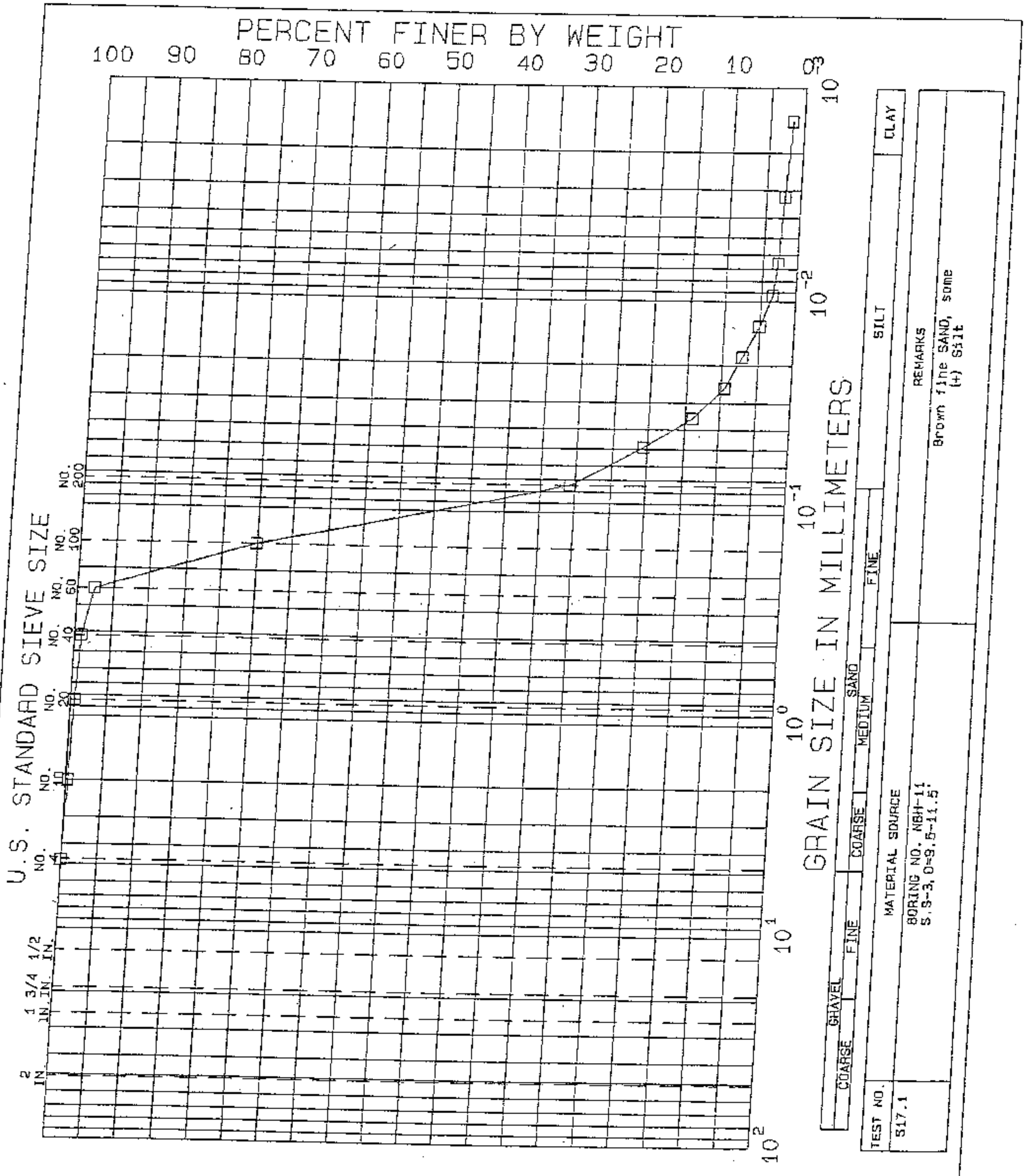


NEW BEDFORD HARBOR

NEW BEDFORD, MA.

GRADATION TESTS

BORING NO.	NBH-11	TEST SERIES	
SAMPLE	S-2	NO.	16
DEPTH	5-7'	DATE	Jan.03
TECH.	MST		
REVIEWER	MCM	FILE	L17571



NEW BEDFORD HARBOR

NEW BEDFORD, MA.

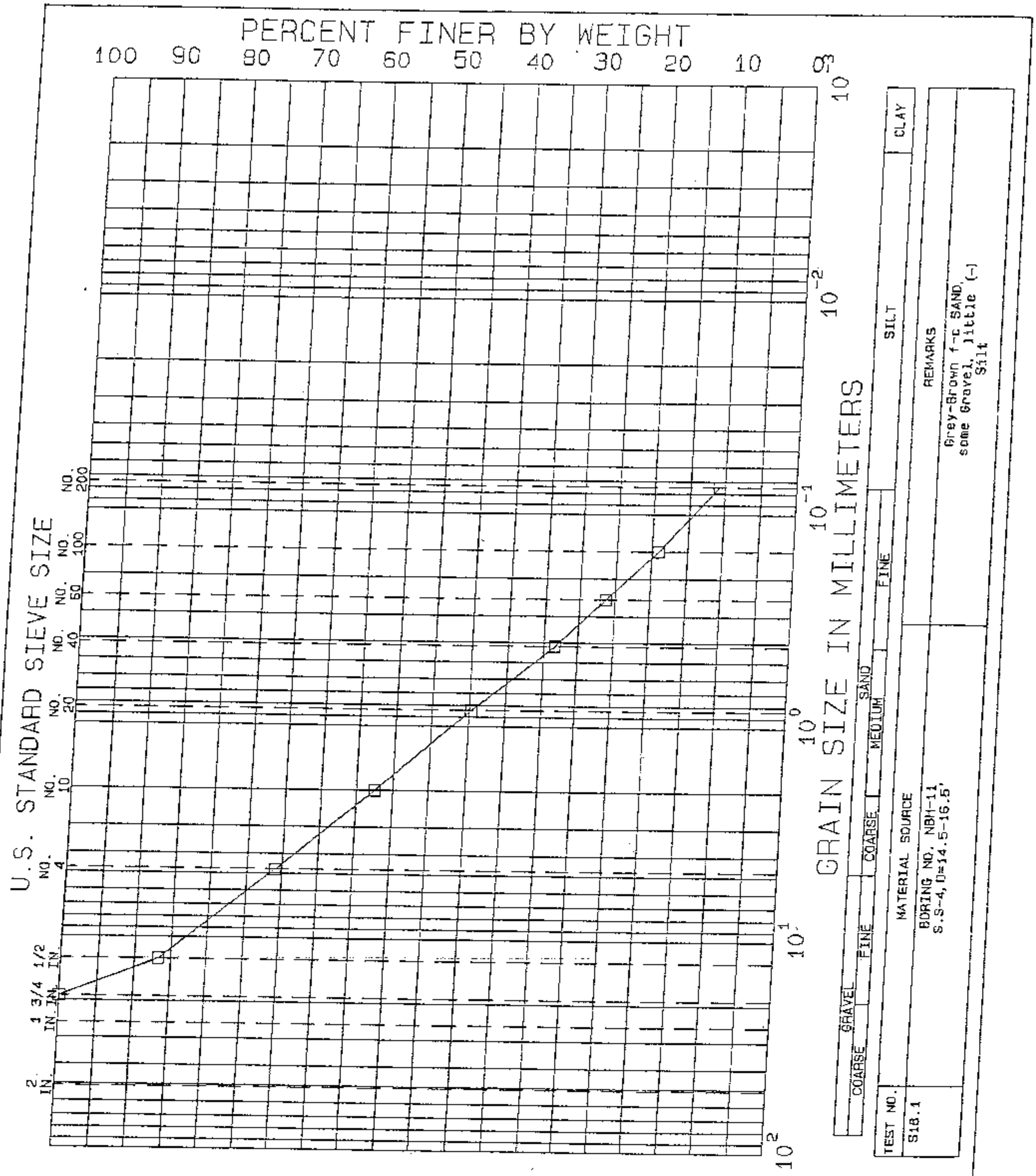
GRADATION TESTS

BORING NO. NBH-11
SAMPLE S-3
DEPTH 9.5-11.5'
TECH. MST
REVIEWER MCM

TEST SERIES
NO. 17
DATE Jan.03

FILE L17571

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS



NEW BEDFORD HARBOR

NEW BEDFORD, MA.

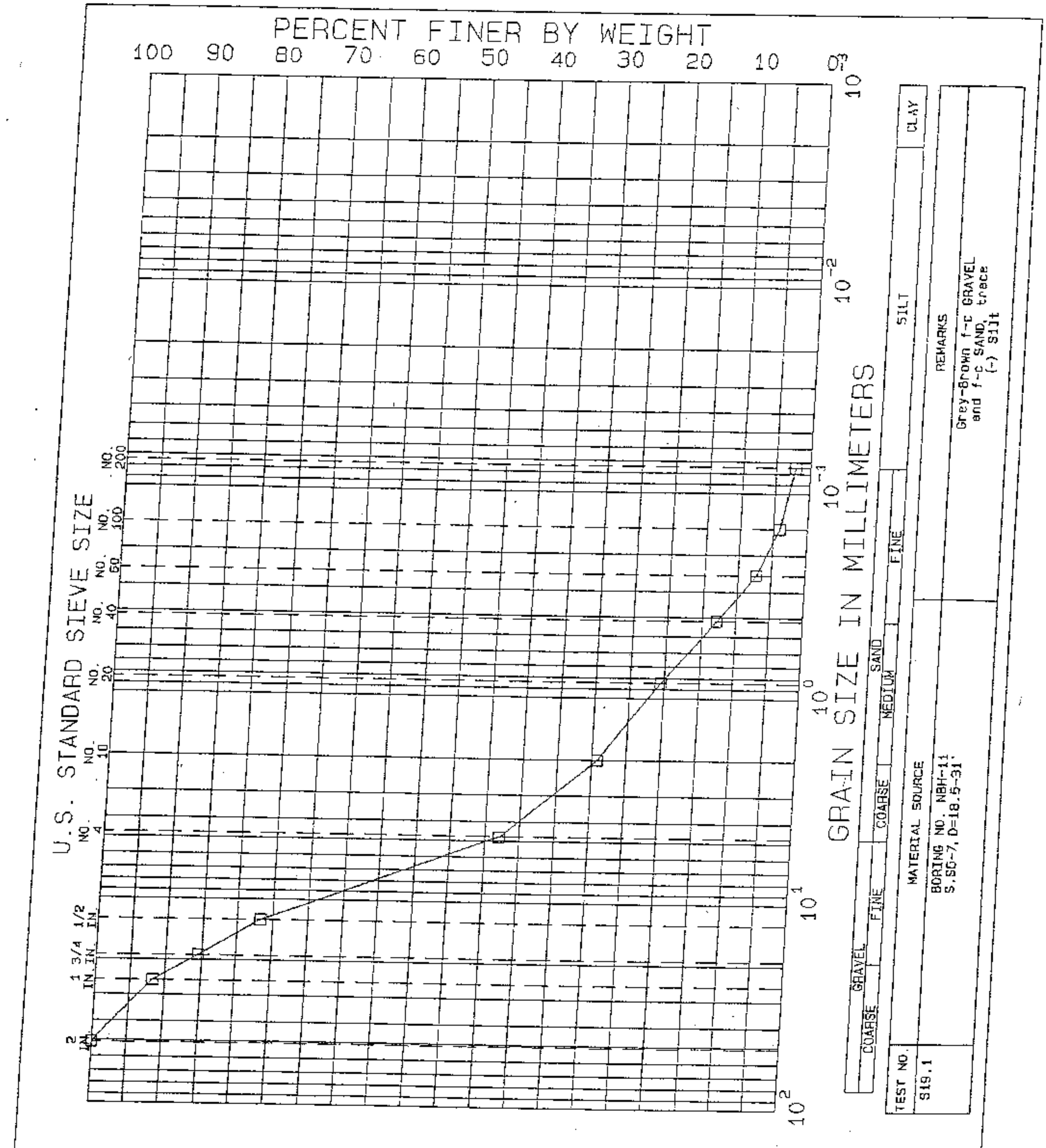
GRADATION TESTS

BORING NO. NBH-11
SAMPLE S-4
DEPTH 14.5-16.5'
TECH. MST
REVIEWER MCM

TEST SERIES
NO. 18
DATE Jan.03

FILE L17571

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS



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).

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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."*

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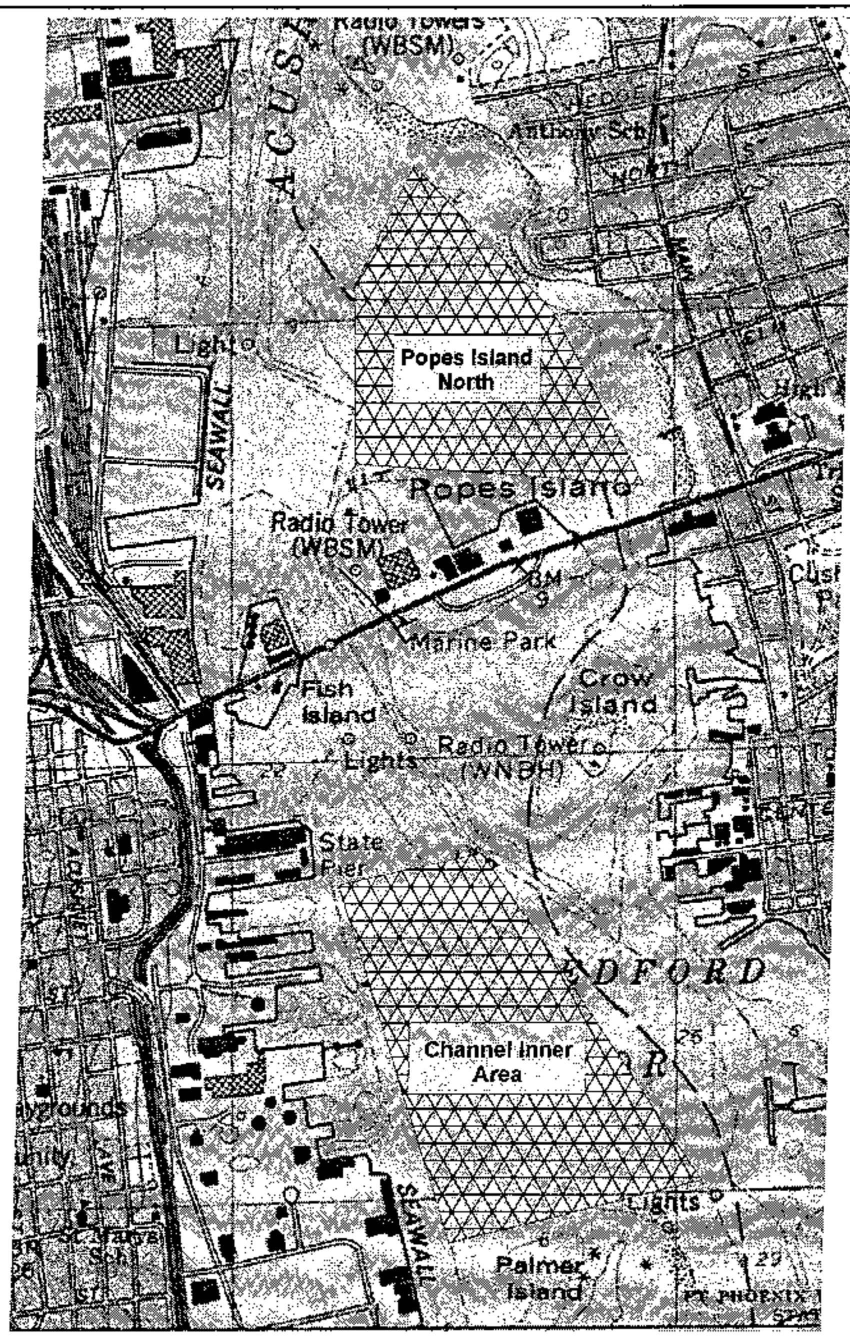

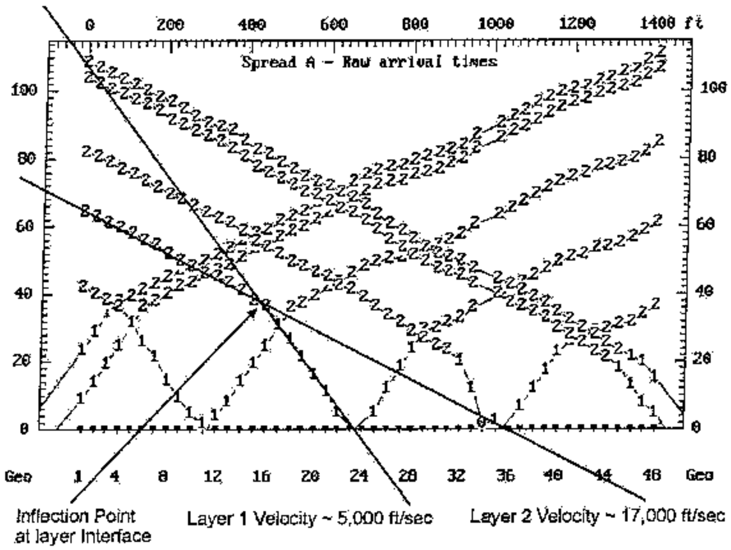

Illustration 1
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Section 5.0 presents the limitations of the program.

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RE-INTERPRETATION AND ADDITION OF NEW INFORMATION

Calibration Data

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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)

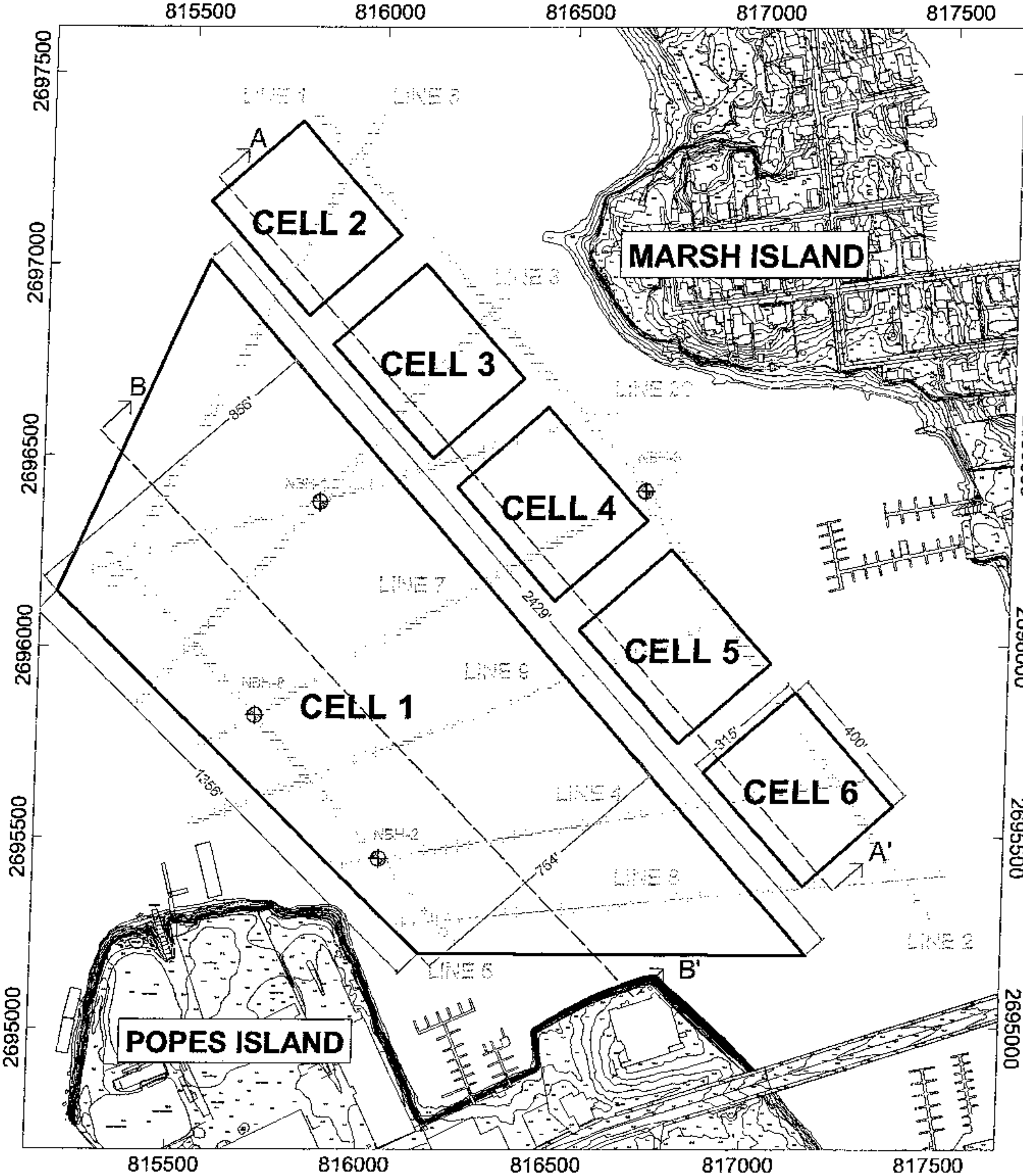
Table Assumptions:

- 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 503
Boston MA 02210
617 728-0070

SCALE: 1" = 400'	DRAWN:	DESIGN:	CHECKED:	
	TDM	TDM	JAB	SHEET 1 OF 1

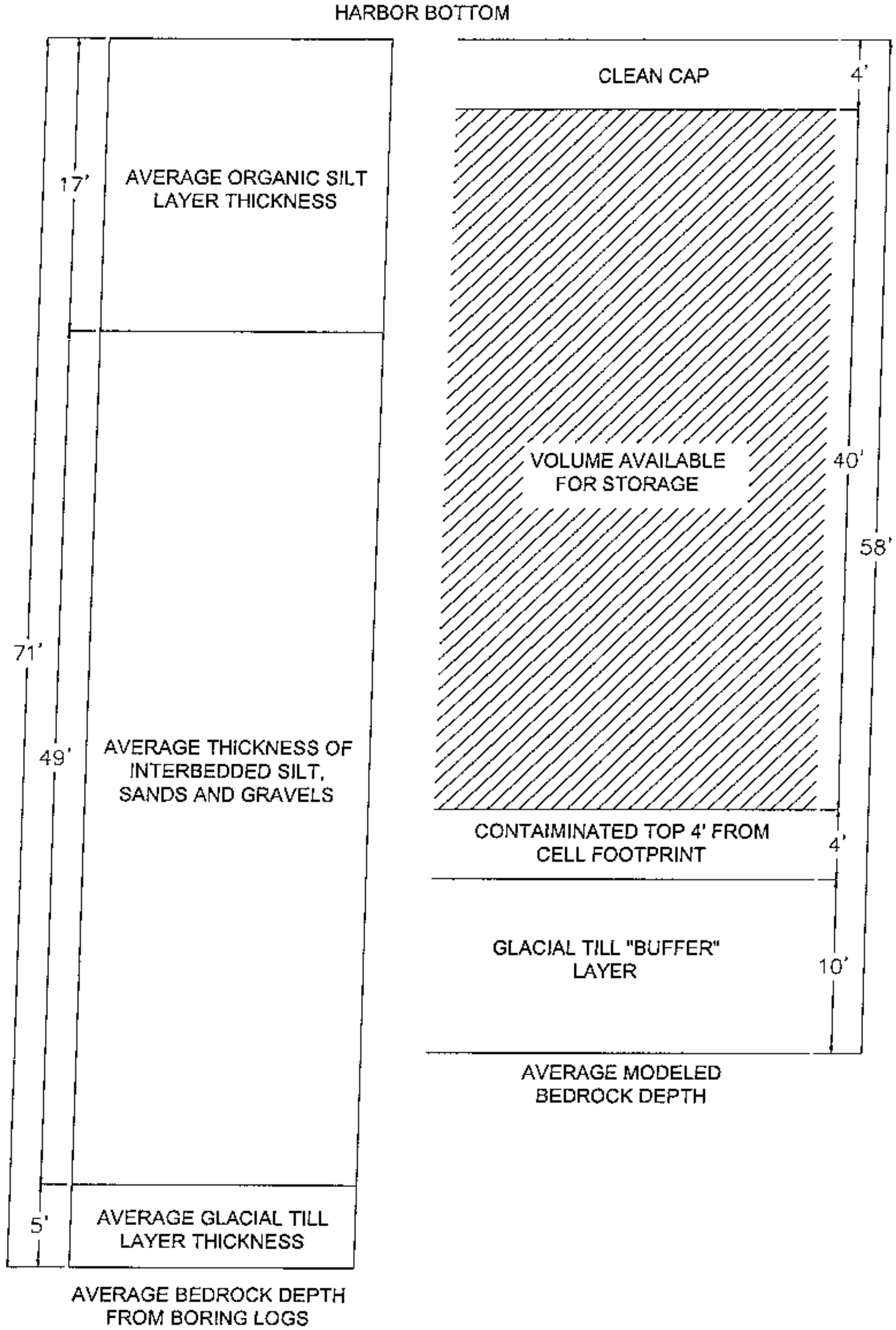


Illustration 3
Breakdown of the division of available storage capacity and an average geological cross section from the borings conducted in the Popes Island Area.

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

Submitted by:

Maguire Group Inc.

July 2003

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Revision	Date	Prepared By	Approved By	Pages Affected
1	8/25/03	T. Mannering	J. Borkland	All

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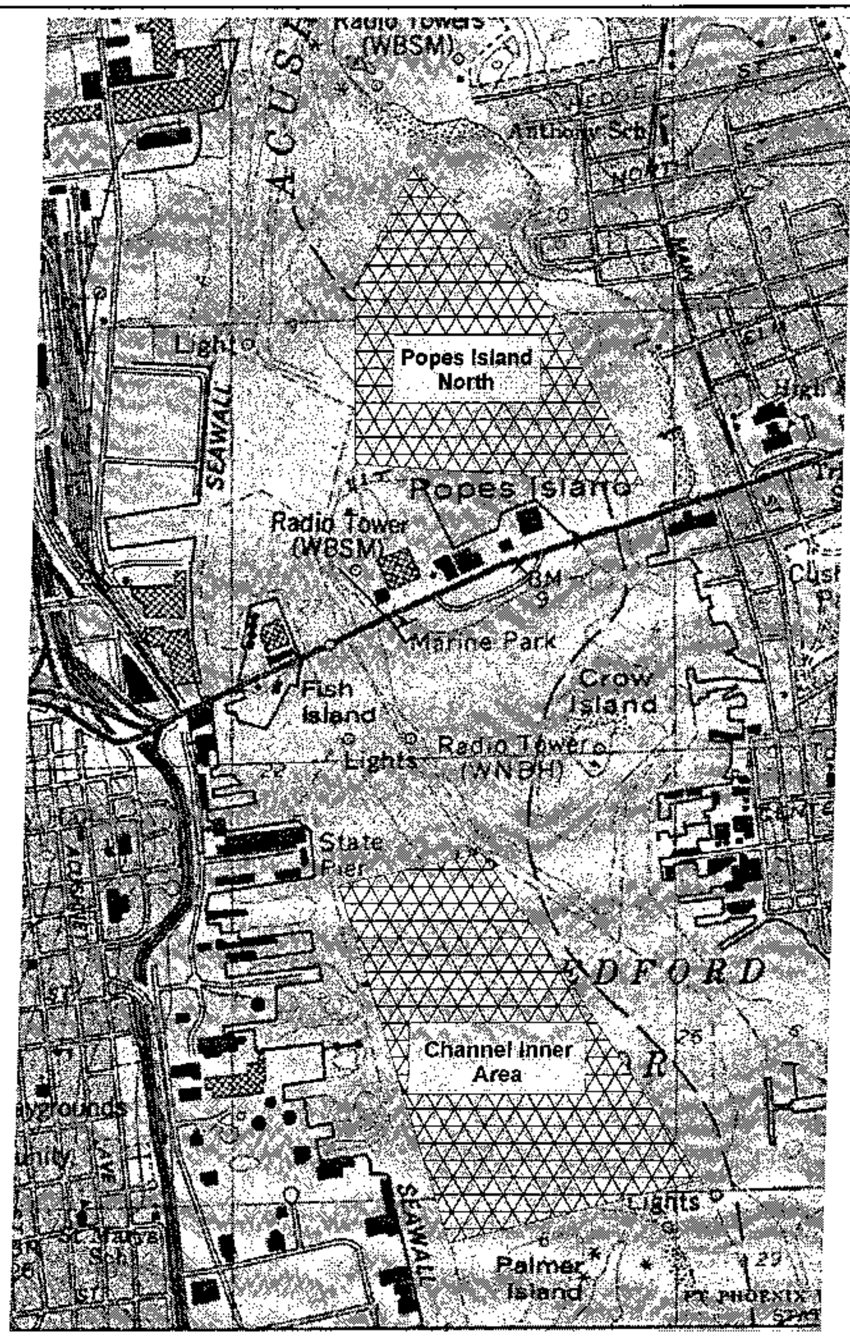

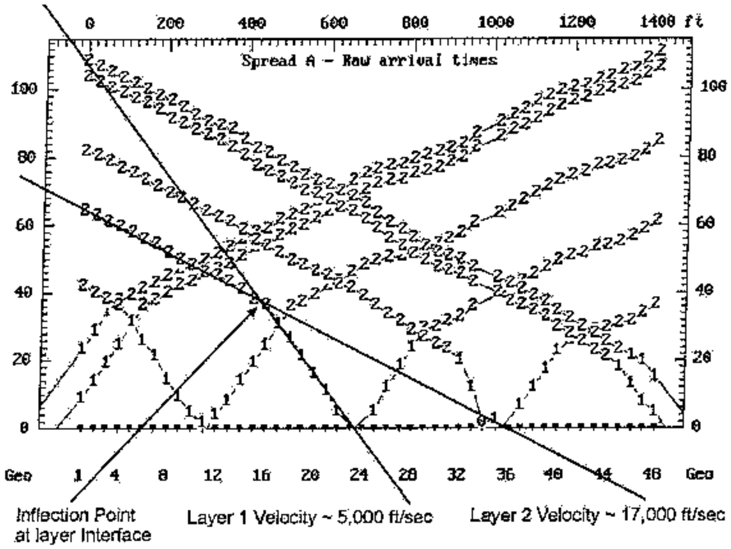

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Both Phase I & II geotechnical drilling programs were conducted with a barge mounted drill rig in the harbor. Samples of soil were collected during the drilling program using a split-spoon sampler. Rock-core samples were collected from the borings 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)

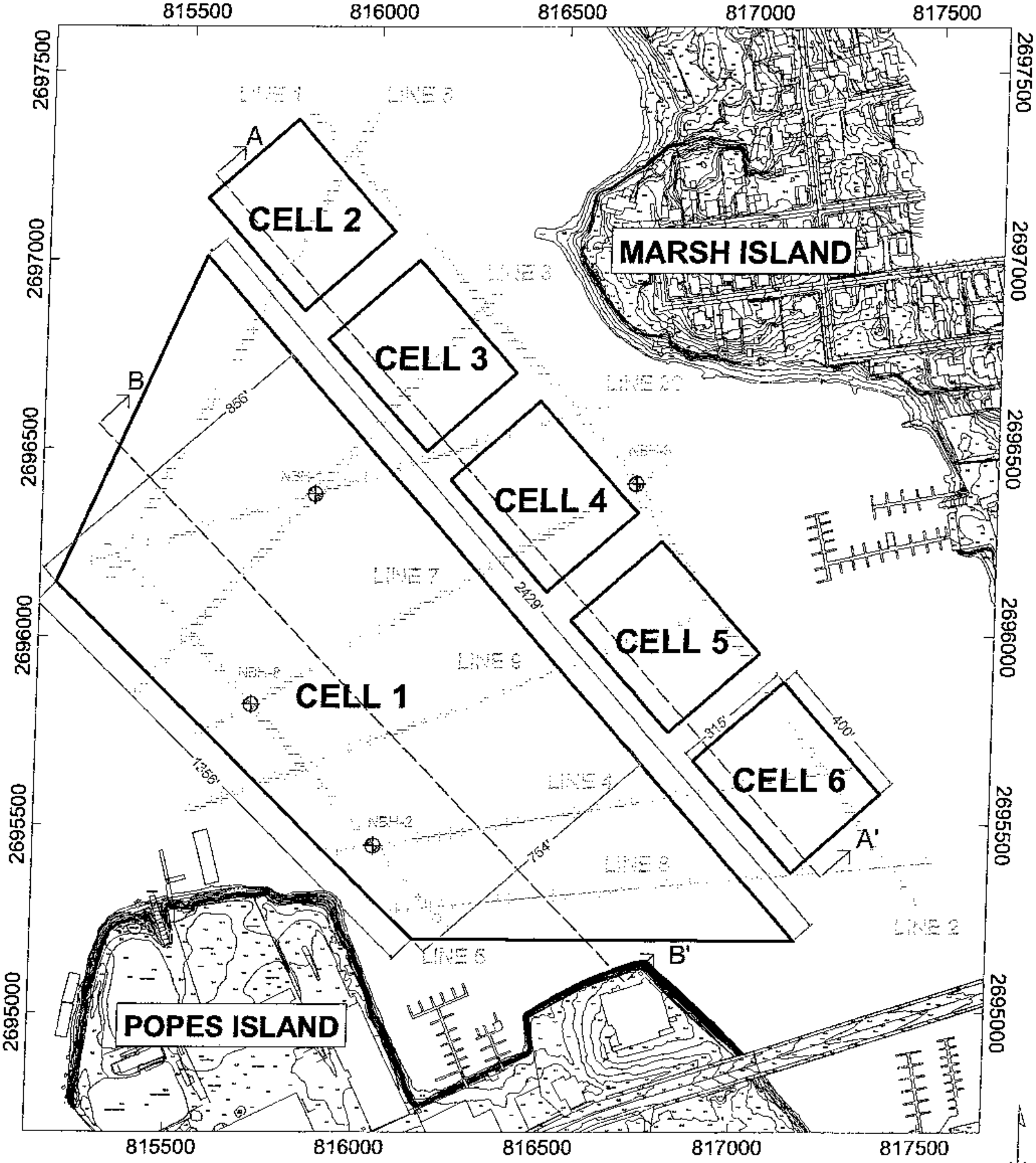
Table Assumptions:

- 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 503
Boston MA 02210
617 728-0070

SCALE: 1" = 400'	DRAWN:	DESIGN:	CHECKED:	
	TDM	TDM	JAB	SHEET 1 OF 1

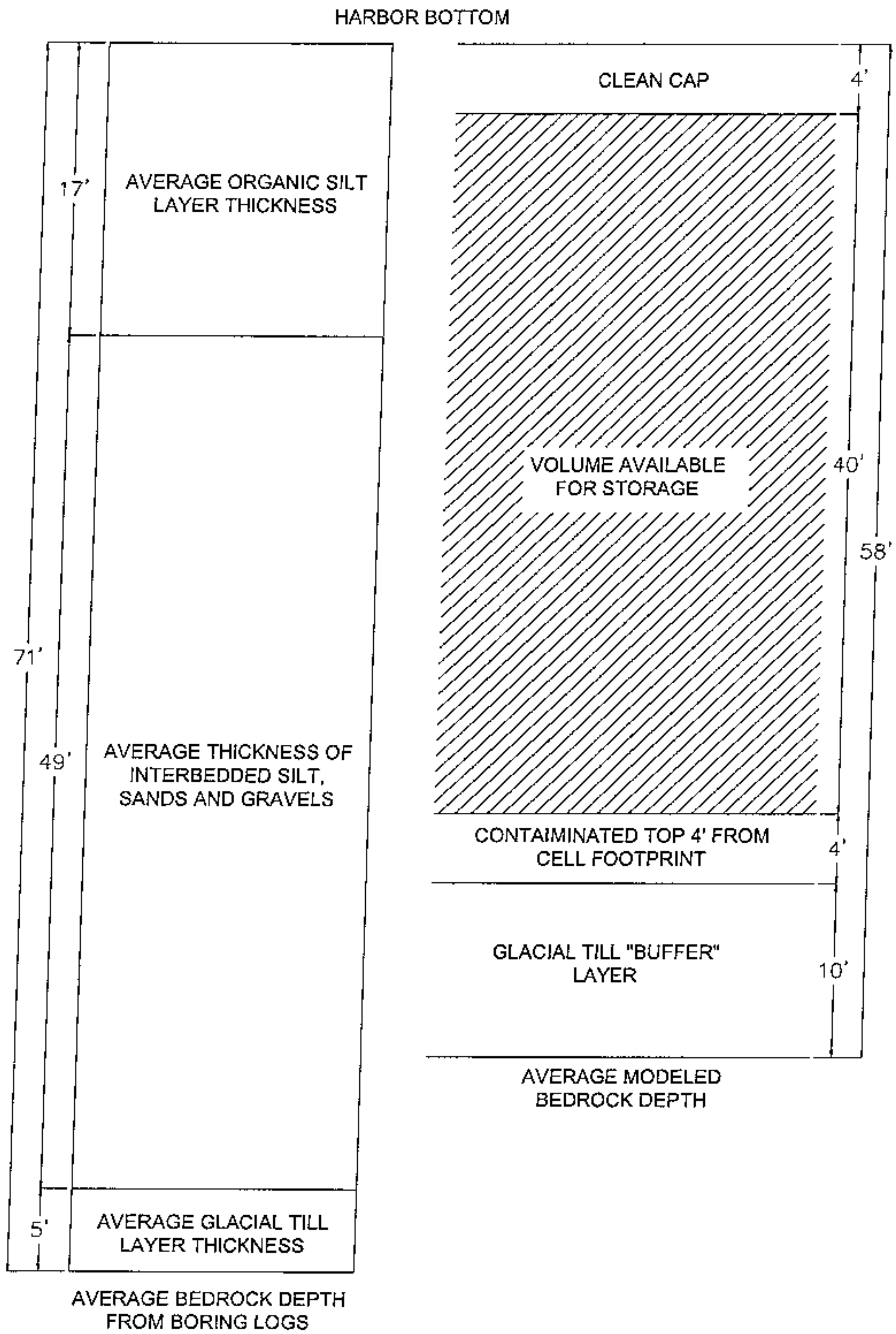


Illustration 3
Breakdown of the division of available storage capacity and an average geological cross section from the borings conducted in the Popes Island Area.

Illustration 4 Popes Island Area Cross Section Profile A-A'

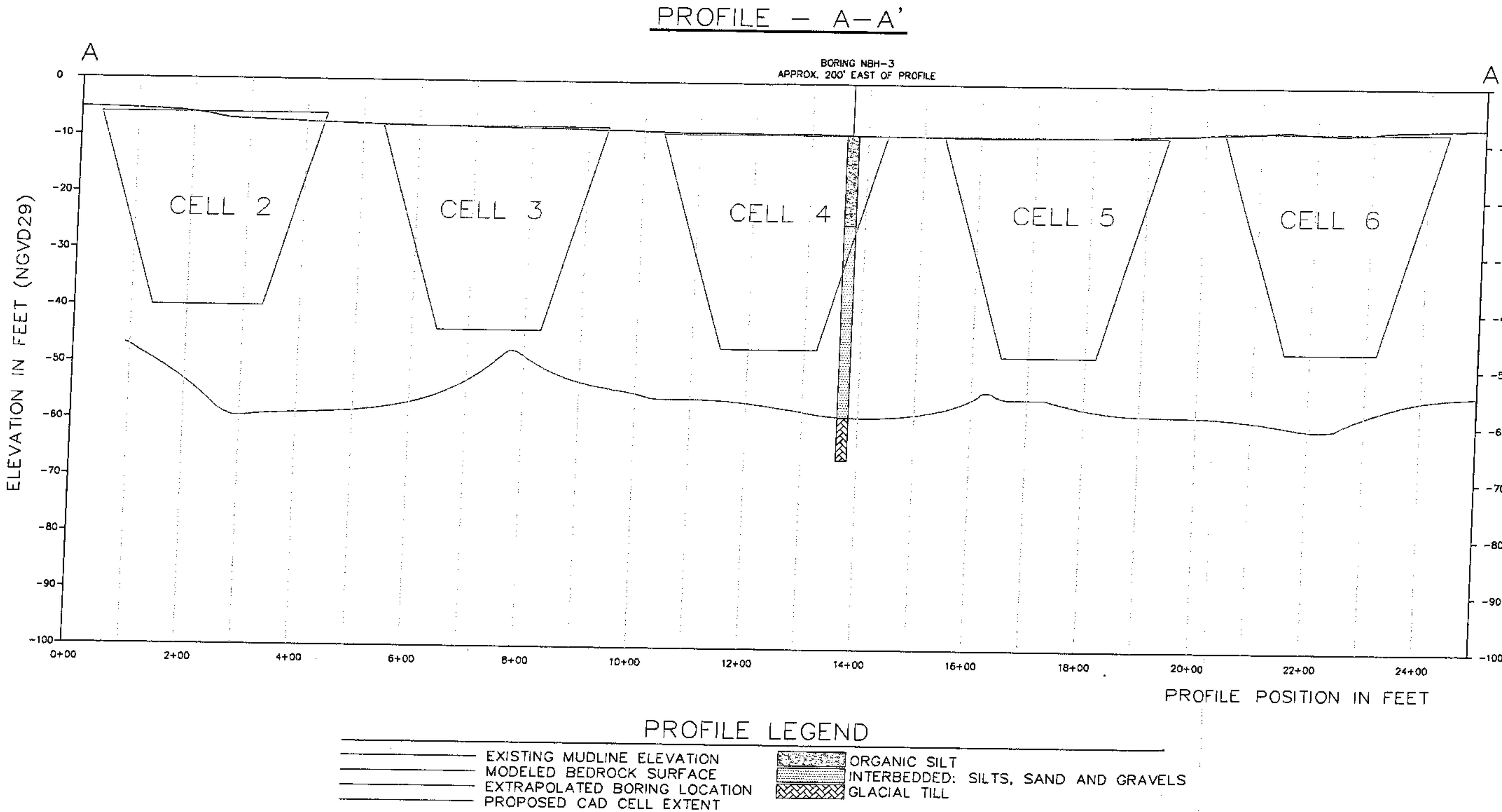


ILLUSTRATION 4 POPES ISLAND PROFILE A-A'.
Stratagraphic cross section was extracted from a profile cut through proposed CAD Cells 2 - 6 (A-A'). The cross section digitizes the modeled bedrock surface and the bathymetric surface over the length of the profile shown on Illustration 2. Proposed CAD cells 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'

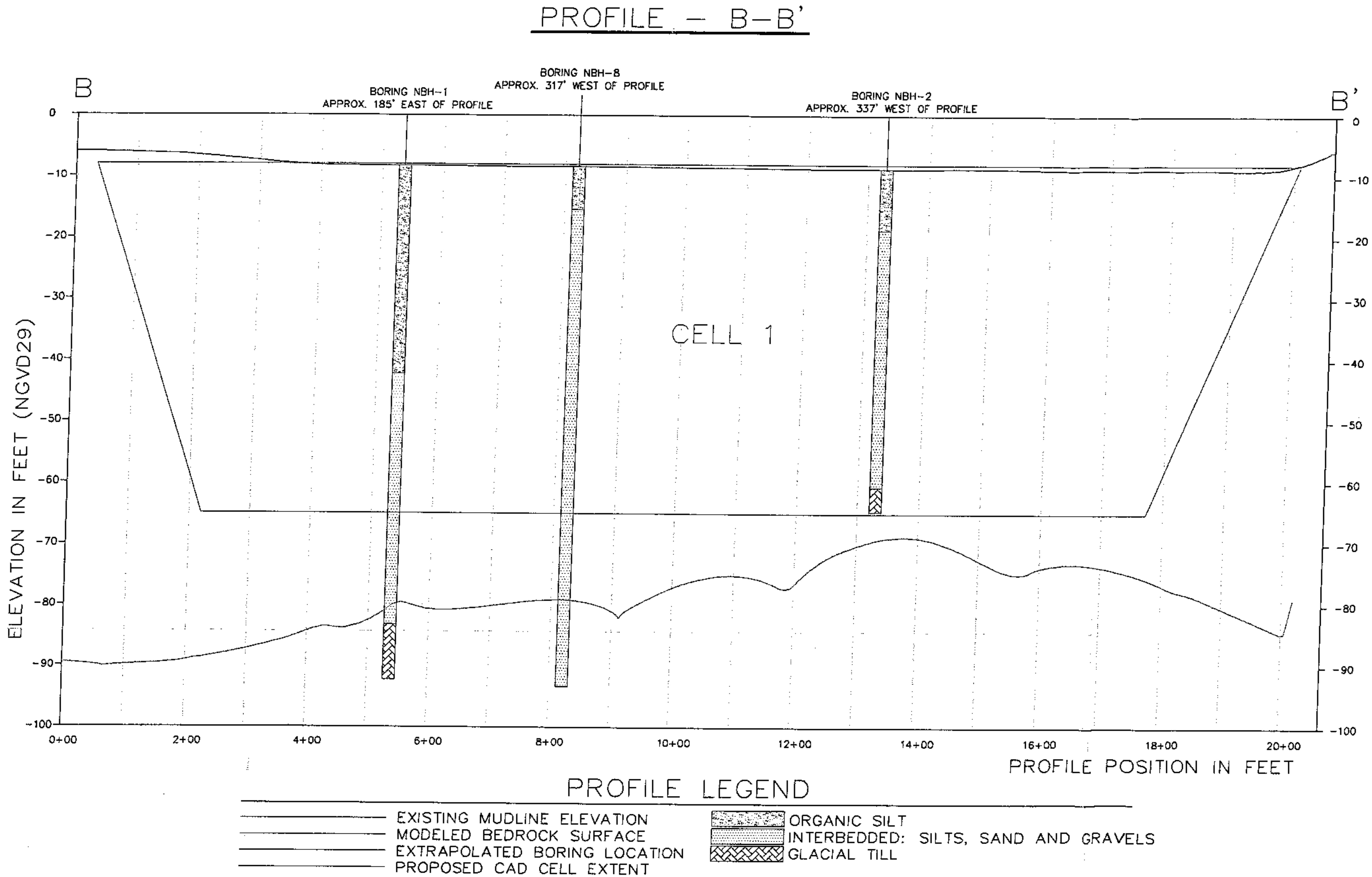


ILLUSTRATION 5 POPES ISLAND PROFILE B-B'.
Stratagraphic cross section was extracted from a profile cut through proposed CAD Cell 1 (B-B'). The cross section digitizes the modeled bedrock surface and the bathymetric surface over the length of the profile shown on Illustration 2. Proposed CAD cells used 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)

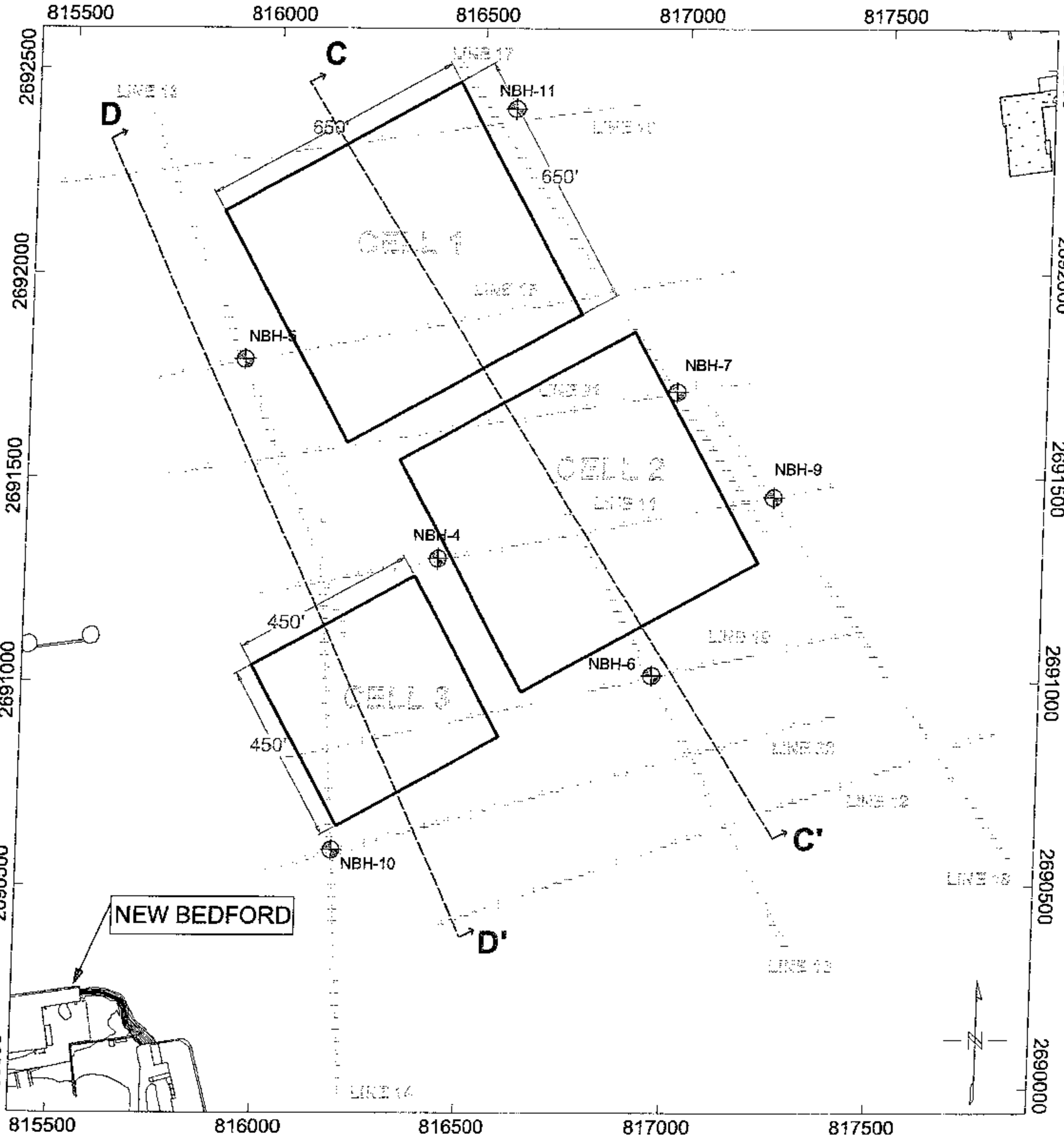
Table Assumptions:

- 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# 810.001.01
	TDM	TDM	JAB	

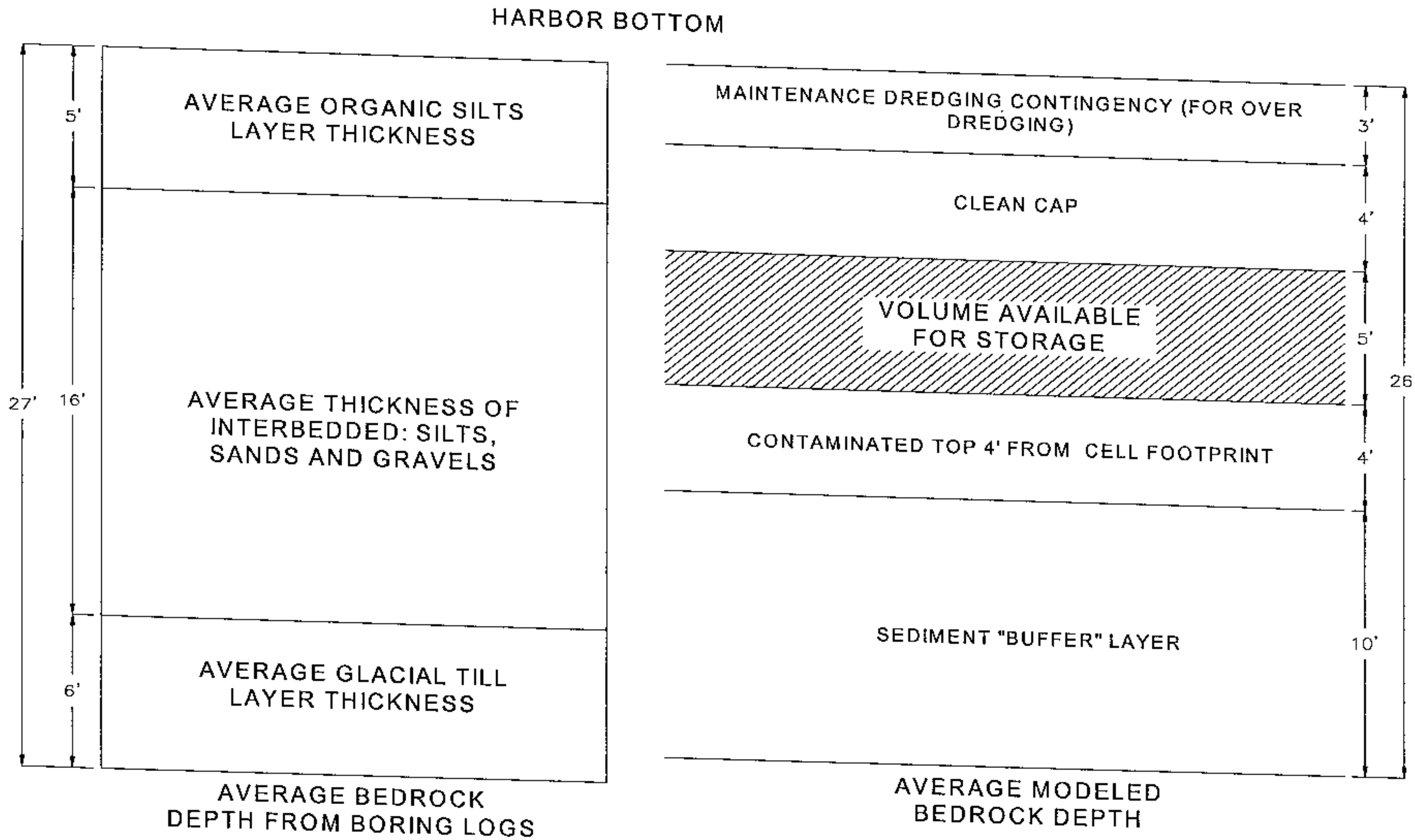


Illustration 7
Breakdown of the division of available storage capacity and average geological cross section as seen in the borings conducted in the Channel Inner Area

Illustration 8 Channel Inner Area Cross Section Profile C-C'

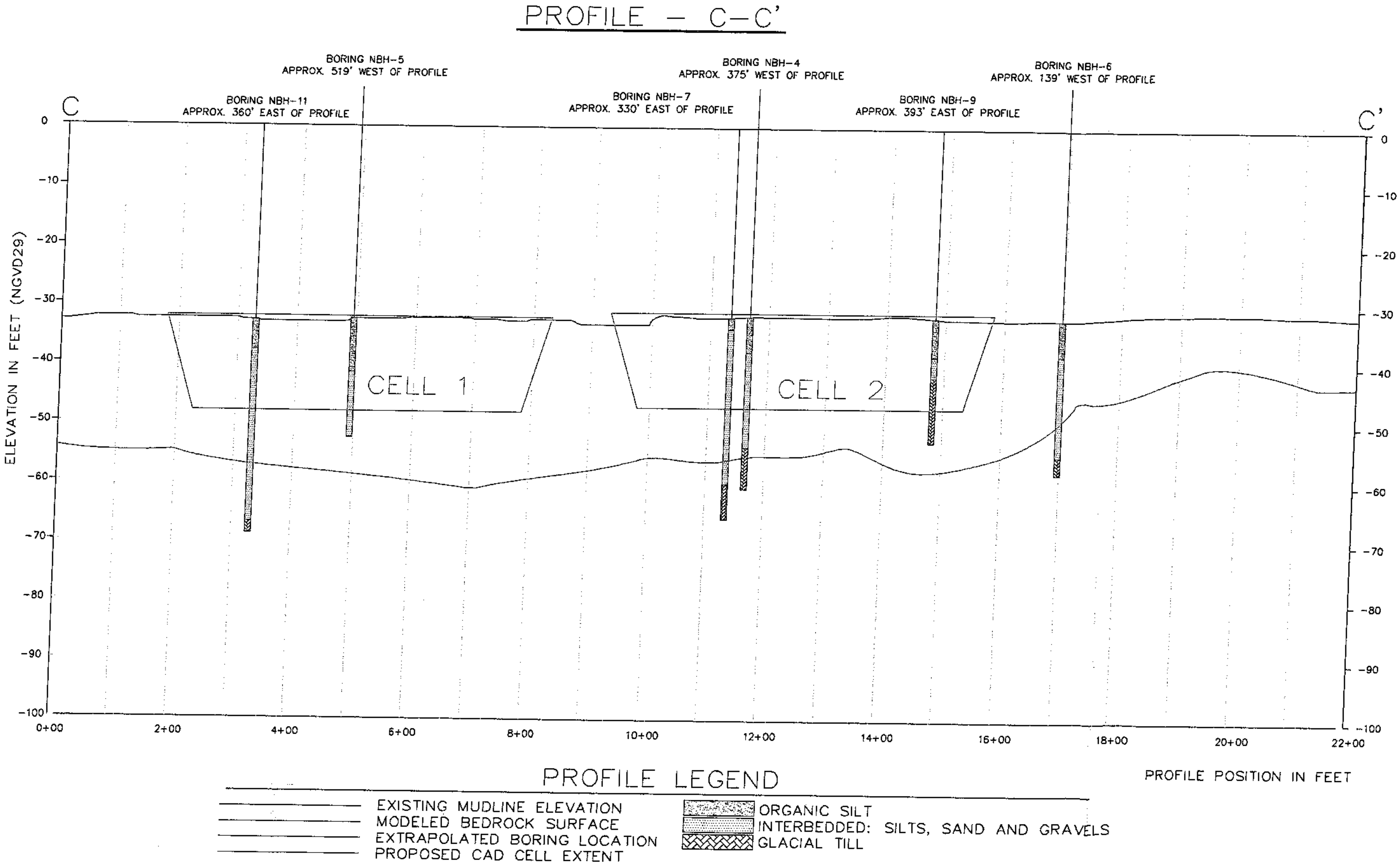


ILLUSTRATION 8 CHANNEL INNER AREA PROFILE C-C'.
Stratagraphic cross section was extracted from a profile cut through proposed Channel Inner Area CAD Cells 1 and 2 (C-C'). The cross section digitizes the modeled bedrock surface and the bathymetric surface over the length of the profile shown on Illustration 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''

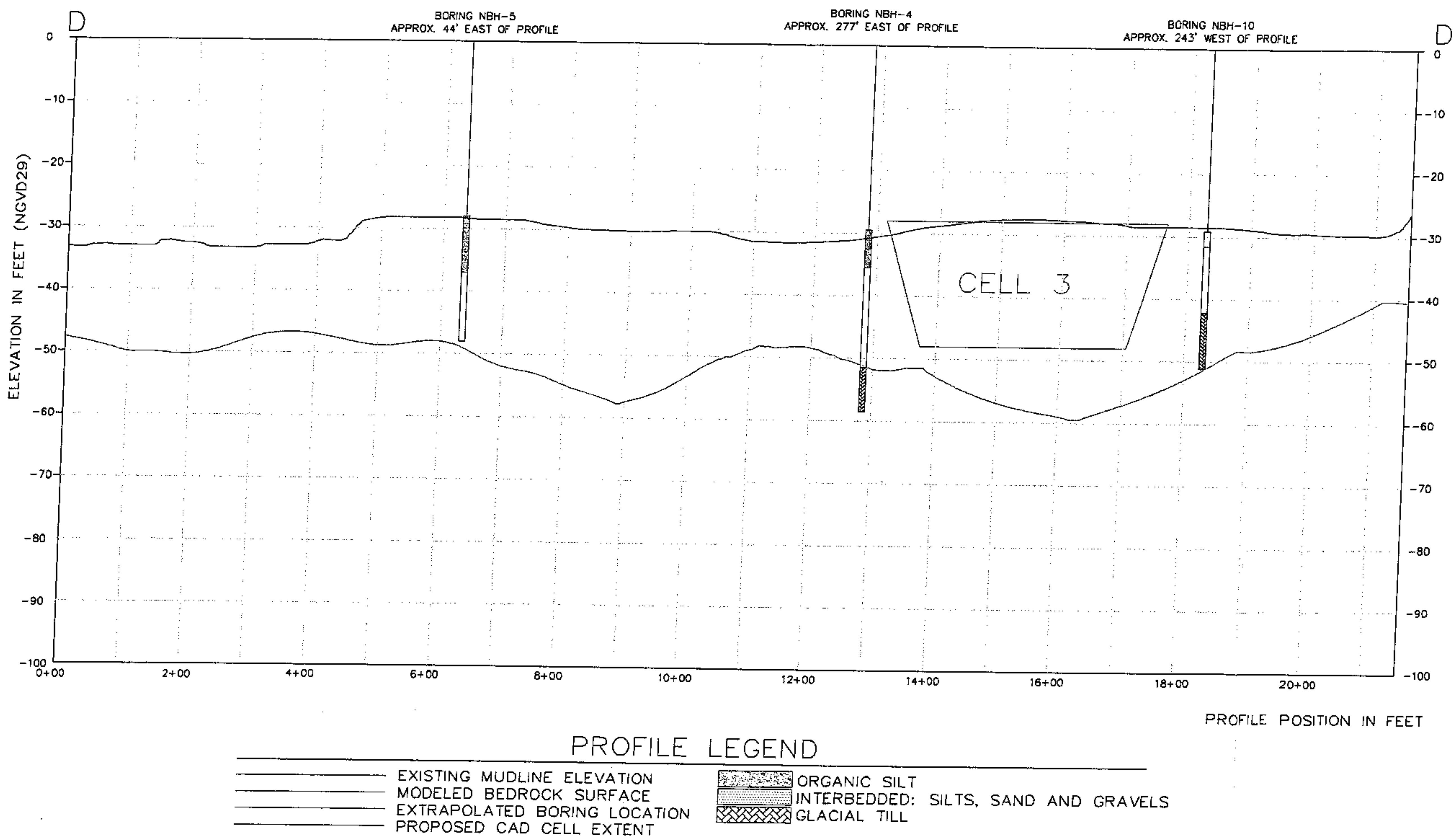


ILLUSTRATION 9 CHANNEL INNER AREA PROFILE D-D'.
Stratagraphic cross section was extracted from a profile cut through proposed Channel Inner Area CAD Cell 3 (D-D'). The cross section digitizes the modeled bedrock surface and the bathymetric surface over the length of the profile shown on Illustration 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).

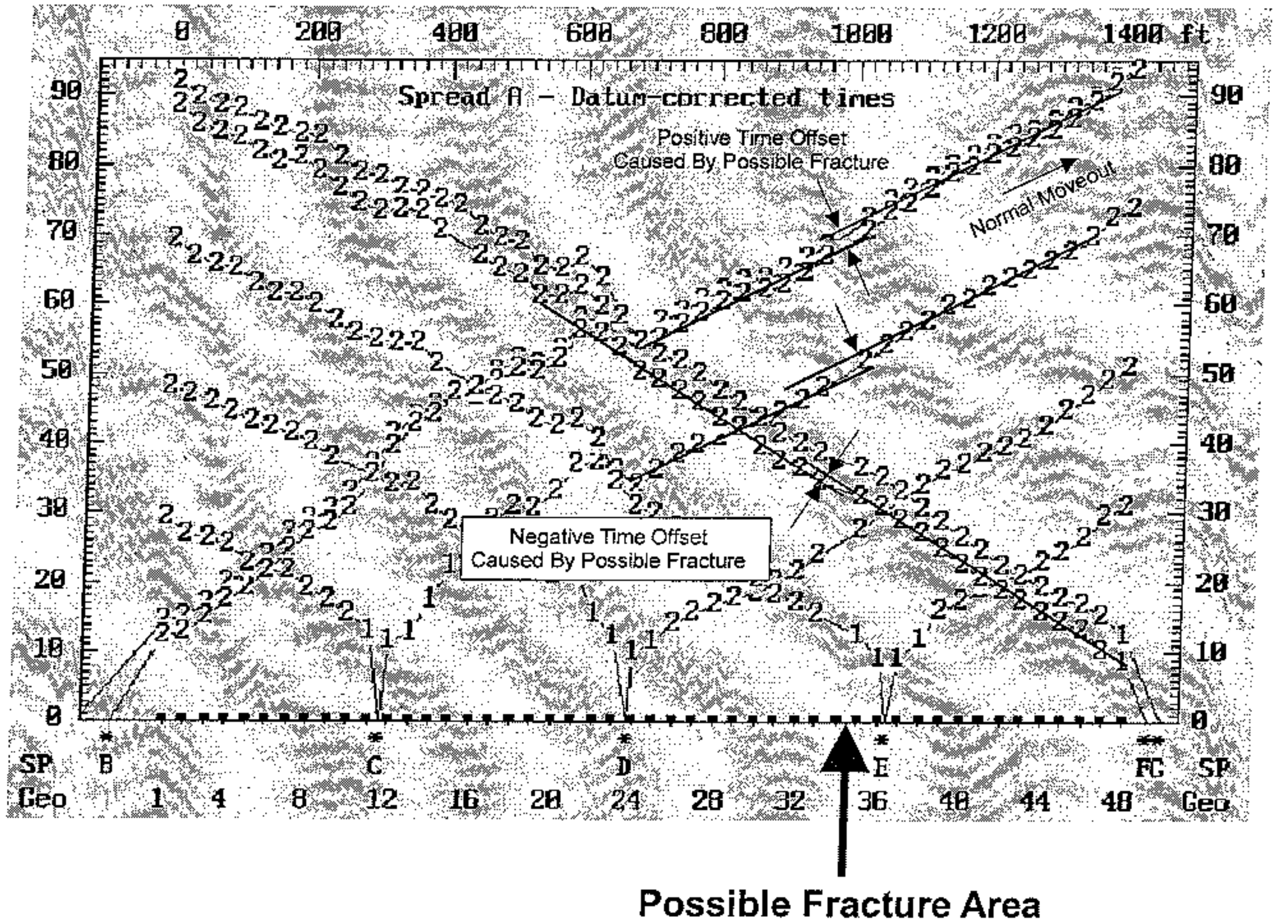


Illustration 10.
Time-Distance Plot Showing Areas of Possible Fracturing

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.

REFERENCES

Goldsmith, Richard, 1978, Geologic Map of the Fall River – New Bedford Area, Massachusetts, U.S. Geological Survey Open File Map 78-484, Department of the Interior, U.S. Geological Survey, publications center, Lakewood, CO.

Hatch, N.L., (ed.), 1991, *The Bedrock Geology of Massachusetts*, publication of the U.S. Geological Survey, USGS - Department of the Interior; Reston, VA, 106 p.

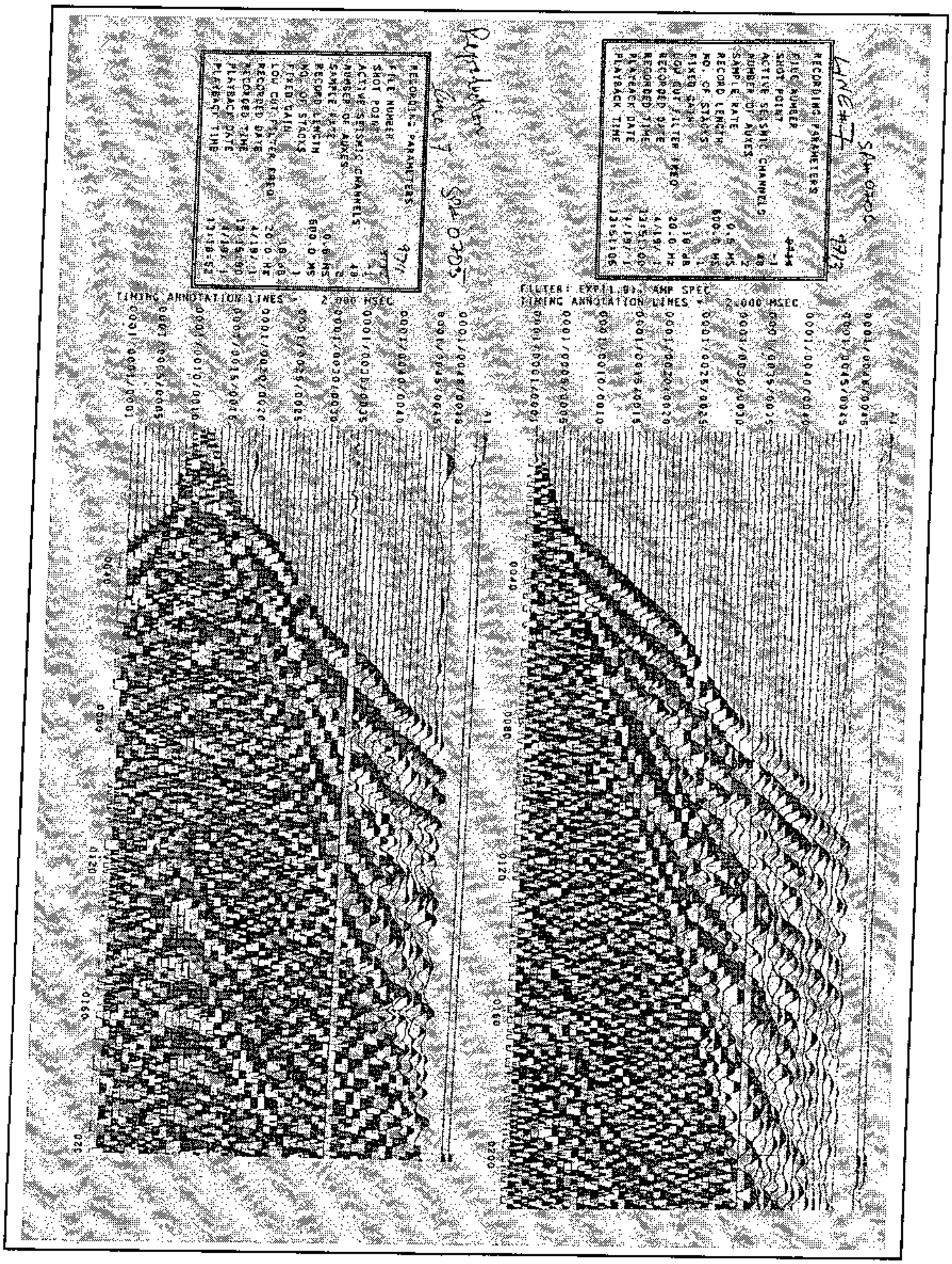
Zen, E-an (editor), 1983, Bedrock Geologic Map of Massachusetts (3 sheets), state Bedrock Geologic Maps publication of the U.S. Geological Survey, U.S. Department of the Interior, U.S. Geological Survey, publications center, Lakewood, CO.

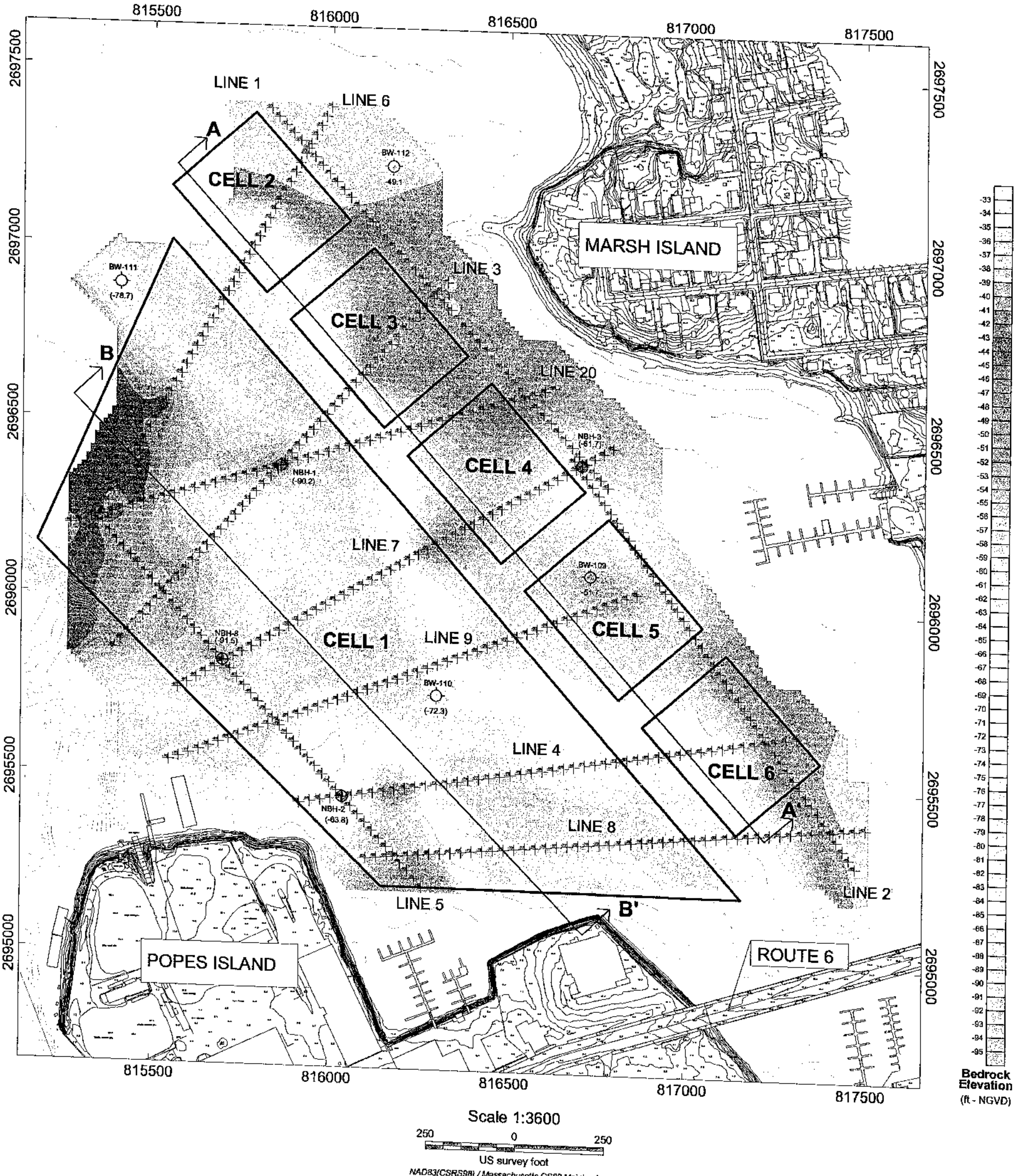
Ebasco Services, Inc. 1988, *Final Draft – Preliminary Geotechnical Investigation of Engineering Properties – New Bedford Harbor*, US Environmental Protection Agency Region I, Records Center, Canal St, Boston, MA.

US Army Corps of Engineers, 1960, *Hurricane Projection Project: New Bedford-Fairhaven Hurricane Barrier (Design Memorandum No.2 Site Geology)*, US Army Corps of Engineers New England District, Waltham, MA.

Foster Wheeler Environmental Corporation, 2001, *Report Of Marine Geophysical Surveys: Phase I Uniboom & Seismic Refraction And Phase II Seismic Refraction, New Bedford Harbor Superfund Site Operable Unit #1*, Foster Wheeler Environmental Corporation, Boston, MA.

APPENDIX A
Example Seismograph Record





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

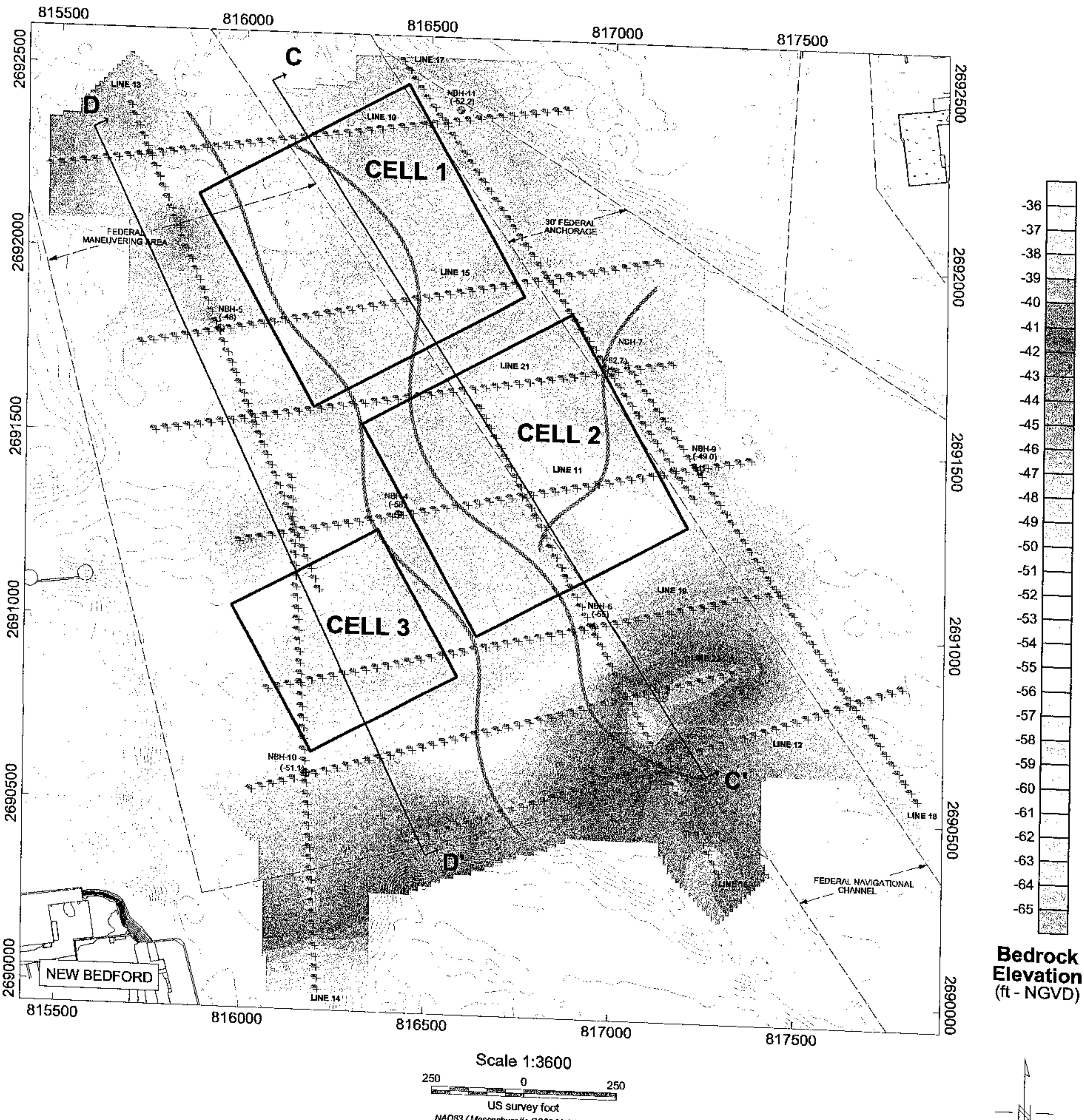
FIGURE 2 - BEDROCK ELEVATION

POPES ISLAND NORTH AREA
SEISMIC REFRACTION - REVISED MODEL

MIDDLE NEW BEDFORD HARBOR
BRISTOL COUNTY, NEW BEDFORD, MASSACHUSETTS

Apex
374 Congress St
Suite 500
Boston MA 02210
617 728-0070

SCALE: 1" = 100'	DRAWN:	DESIGN:	CHECKED:	PROJECT# 6510.001.01
	TDM	TDM	JAB	



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

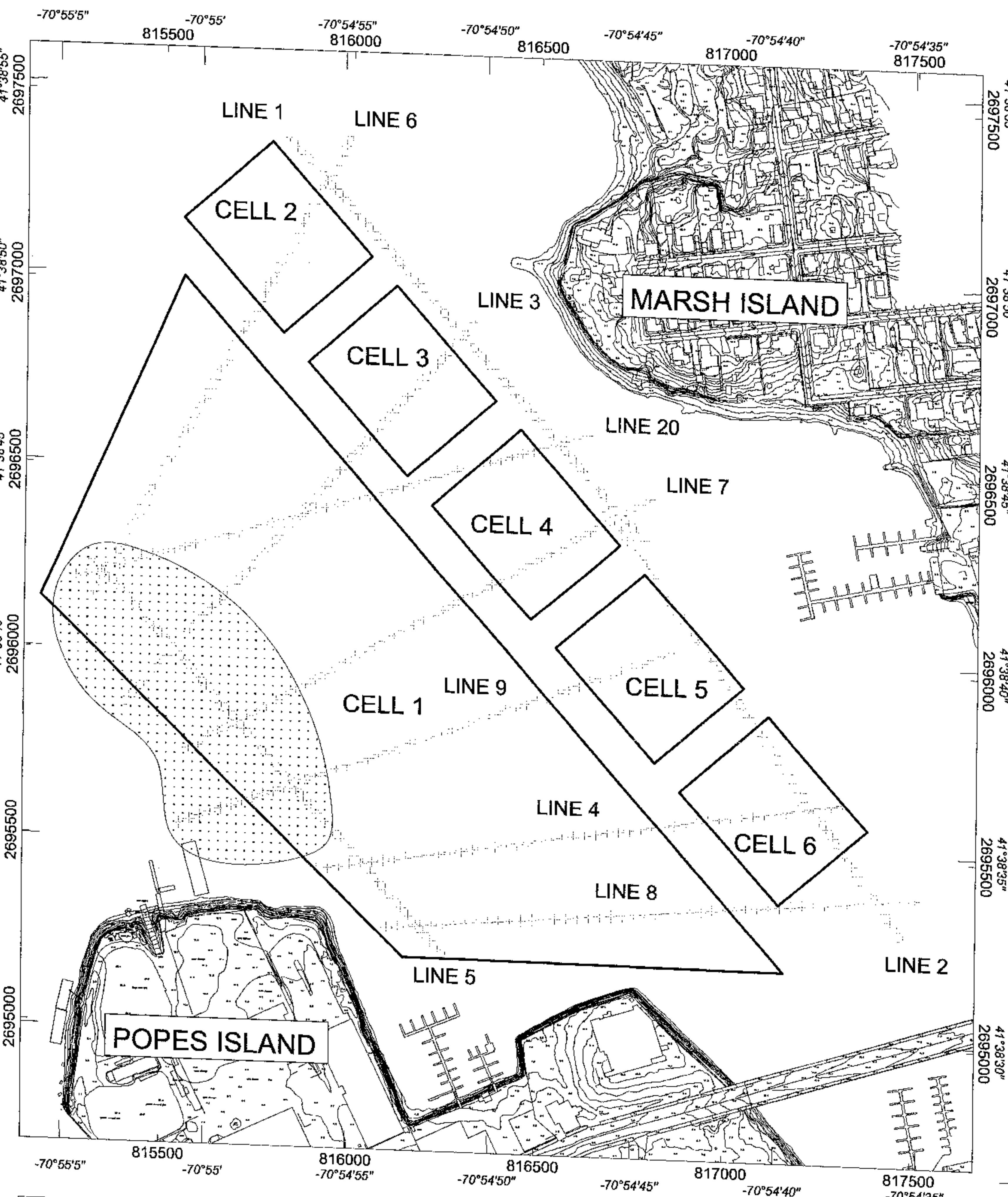
FIGURE 3 - BEDROCK ELEVATION

CHANNEL INNER AREA
SEISMIC REFRACTION - REVISED MODEL

LOWER NEW BEDFORD HARBOR
BRISTOL COUNTY, NEW BEDFORD, MASSACHUSETTS

Apex
374 Congress St
Suite 500
Boston MA 02210
617 728-0070

SCALE:	DRAWN:	DESIGN:	CHECKED:	PROJECT# 6510.021.01
	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

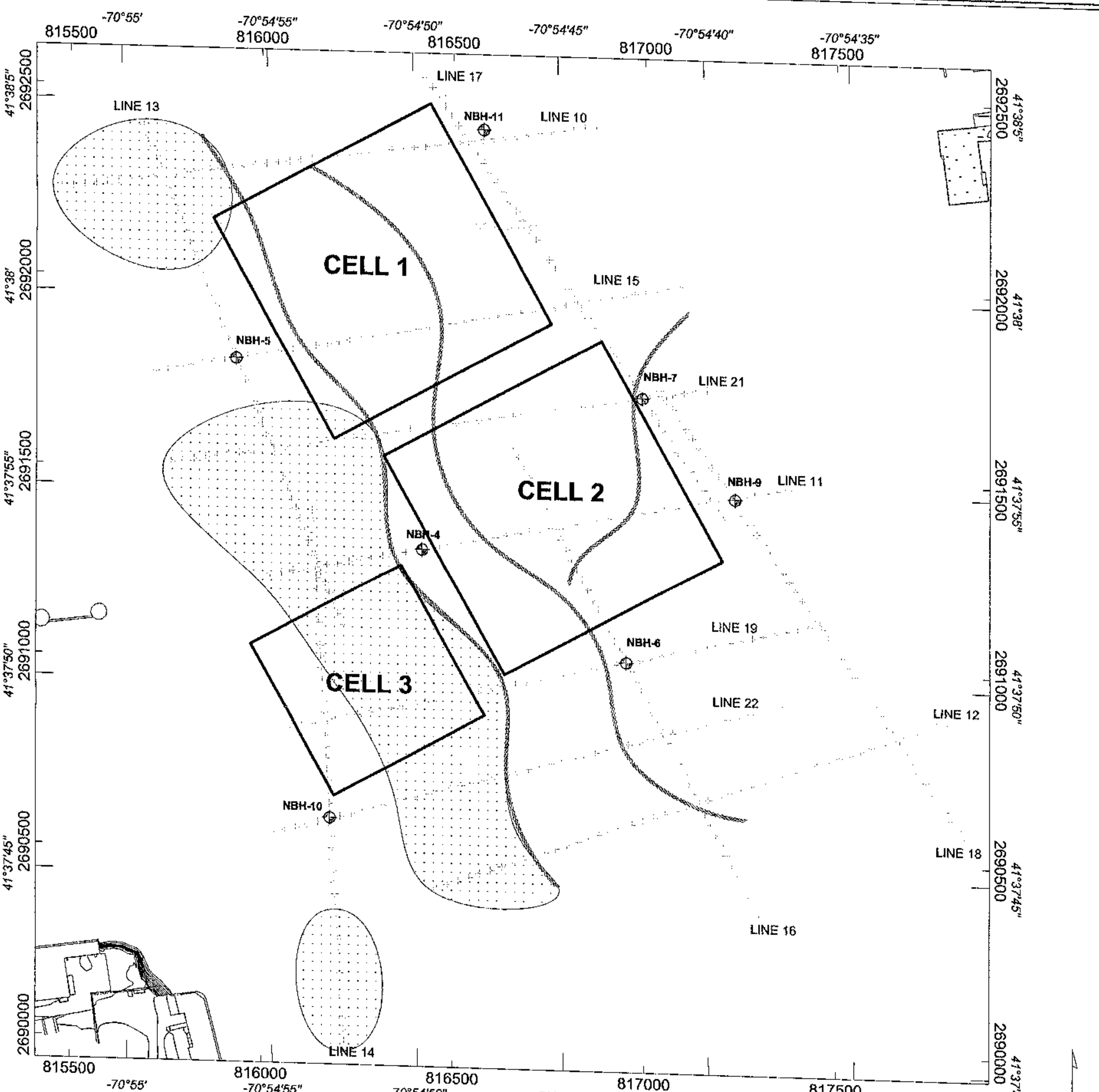
FIGURE 4

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

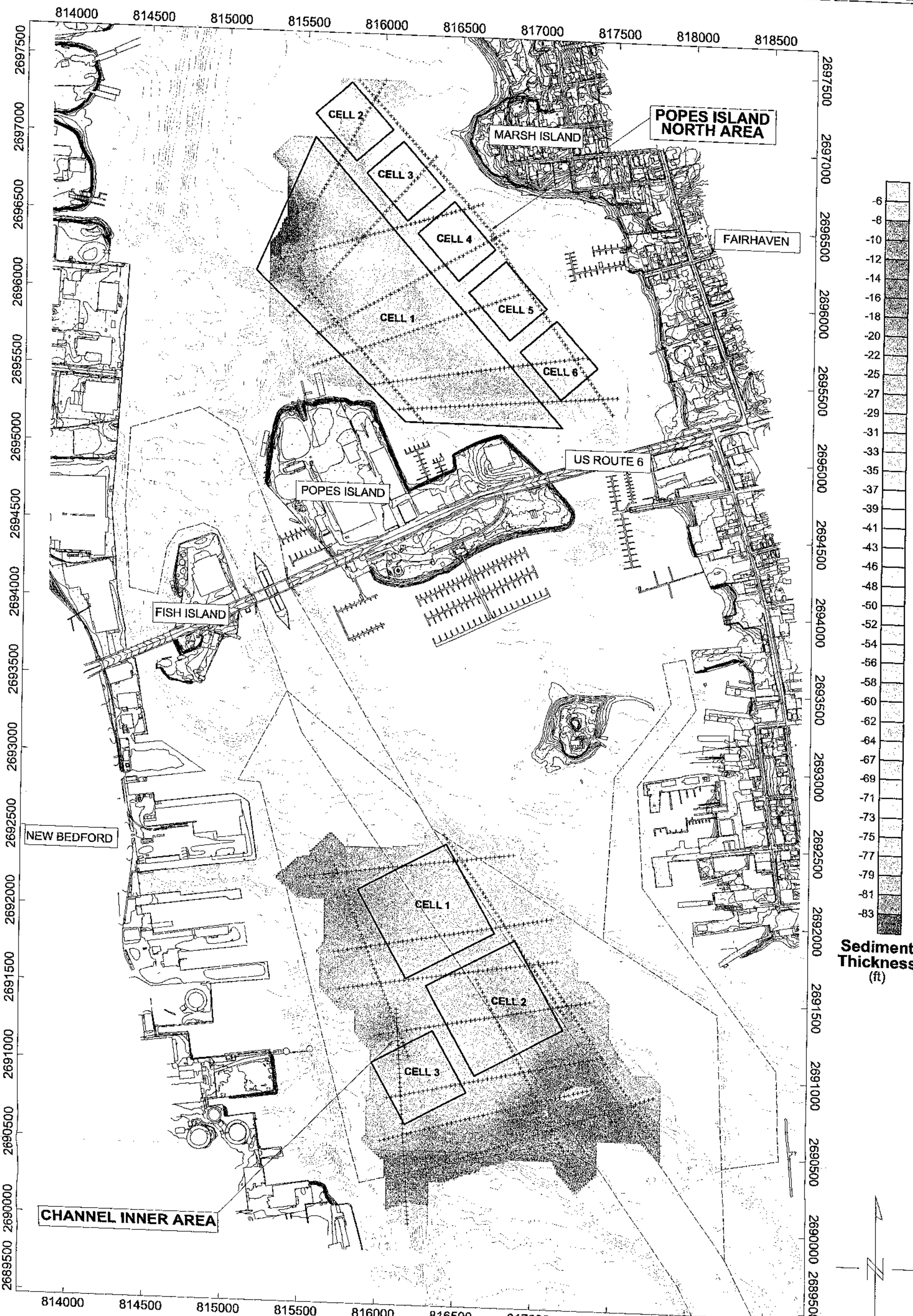
CHANNEL INNER AREA - CONFIDENCE LEVELS
SEISMIC REFRACTION - REVISED MODEL

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# 5519.001.01
	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

CZM

Submitted by:

Maguire Group Inc.

MAGUIRE GROUP

July 2003

UNDERWATER ARCHEOLOGICAL & HAZARDS ANALYSIS
REMOTE SENSING SURVEY

DREDGED MATERIAL MANAGEMENT PROGRAM (DMMP)
NEW BEDFORD, MASSACHUSETTS SITE

Prepared for:

Maguire Group Inc.

MAGUIRE GROUP

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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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.

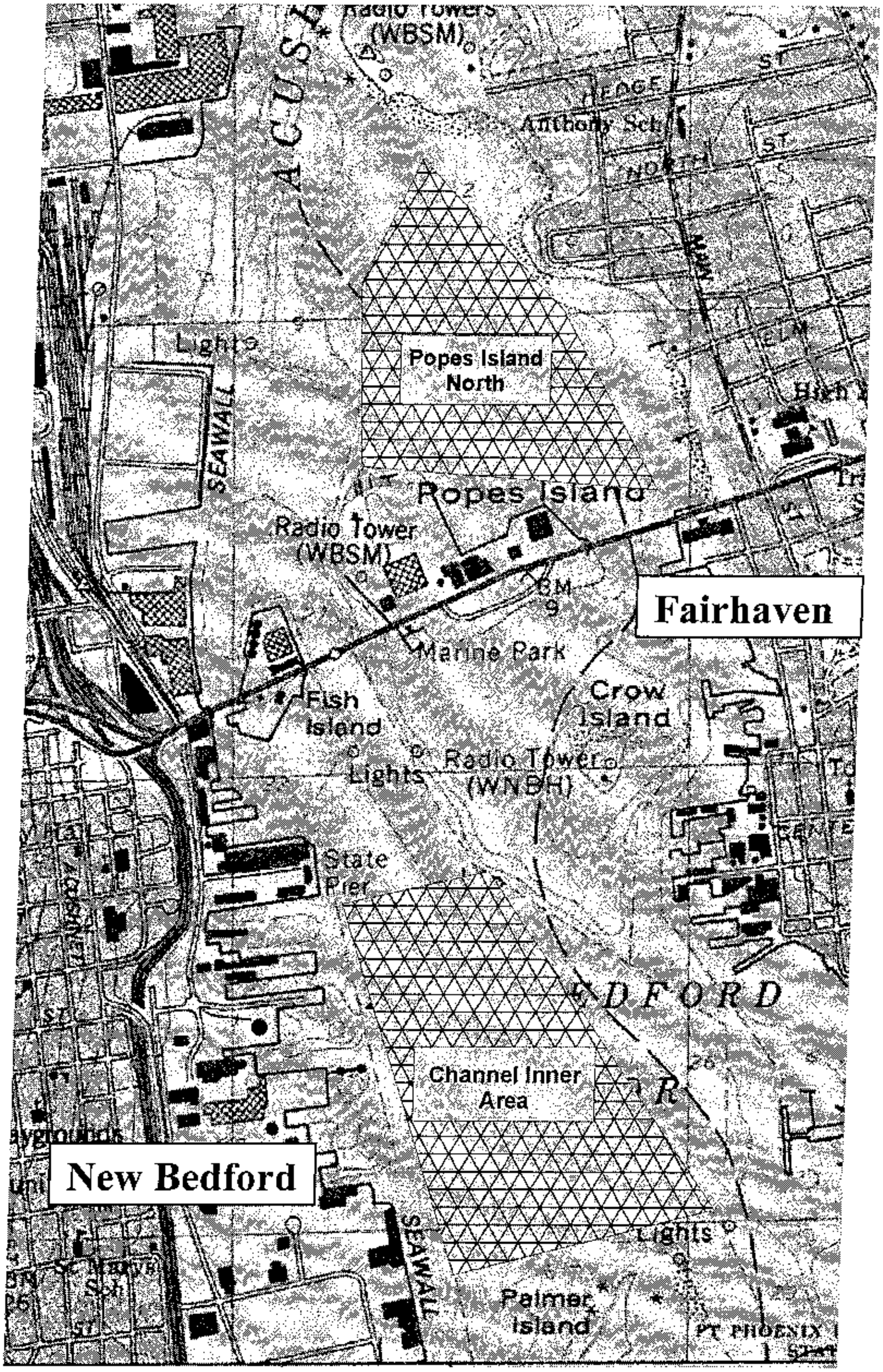


Illustration I - Overview of the Survey Area
New Bedford, Massachusetts

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	*No Duty on Tea*, Brig
Spaniard, Ship	*Sally*, Schooner
Caesar, Ship	*Bowers*, Sloop
Nanny, Barque	*Sally* (12 guns), Sloop
Rosin, Brig	*Ritchie*, Brig
Sally, Fishing Brig	*Dove*, Brig
Simeon, Snow	*Holland*, Brig
Sally, Continental Brig	*Joseph R*, Sloop
Adventure, Schooner	*Bociron*, Sloop
Loyalty, Continental Schooner	*Pilot Fish*, Sloop
Nelly, Sloop	*The Other Side*, Schooner
Fly Fish, Sloop	*Sally*, Brig
Captain Lawrence, Sloop	*Retaliation*. Sloop
Defiance, Schooner	*J. Brown's*, Sloop
Captain Jenny, Schooner	*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.

REFERENCES CITED

Baker, William Avery

1980 "Vessel Type of Colonial Massachusetts." In *Seafaring in Colonial Massachusetts*, The Colonial Society of Massachusetts, Volume 52. Boston.

Berman, Bruce

1972 *Encyclopedia of American Shipwrecks*. The Mariners Press, Boston.

Cembrola, Robert

1989 "Draft Report on Marine Archaeology." Report submitted to Camp, Dresser and McKee, Inc. Report on file with the BUAR. Boston.

Cox, J. Lee

2001 "New Bedford Harbor Superfund Site, New Bedford, Massachusetts, Underwater Archaeology Remote Sensing Survey." Report submitted by John Milner Associates to Foster Wheeler Environmental Corporation and the USACE (New England Division).

2001a "Documentation of Derelict Vessels at Melville Shipyard, New Bedford Harbor Superfund Site, Bristol County, Massachusetts." Report submitted by John Milner Associates to Foster Wheeler Environmental Corporation and the USACE (New England Division).

2001b "Submerged Cultural Resources Investigation New Bedford State Pier Dredge Project,
New Bedford Harbor, Massachusetts." Report submitted by Apex Environmental, Boston.

Crapo, William

1876 Centennial in New Bedford. E. Anthony & Sons, New Bedford.

Foster, George and Peter Weiglin

1989 *Splendor Sailed the Sound, The New Haven Railroad and The Old Fall River Line*. Potentials Group, Inc., San Mateo.

Foster Wheeler Environmental Corporation (FWENC)

2001 "Report of Marine Geophysical Surveys: Side Scan Sonar, Sub-Bottom Profiler, and Magnetics, New Bedford HarborSuperfund Site Operable Unit #1, New Bedford, Massachusetts." Report submitted to the USACE (New England Division).

Kugler, Richard

1980 "The Whale Oil Trade, 1750-1775." In *Seafaring in Colonial Massachusetts*, The Colonial Society of Massachusetts, Volume 52. Boston.

McAdam, Roger
1972 *Floating Palaces, New England to New York on the Old Fall River Line.* Mowbray Company. Providence.

Morison, Samuel Eliot
1921 *Maritime History of Massachusetts, 1783-1860.* Houghton Mifflin Company, Boston.

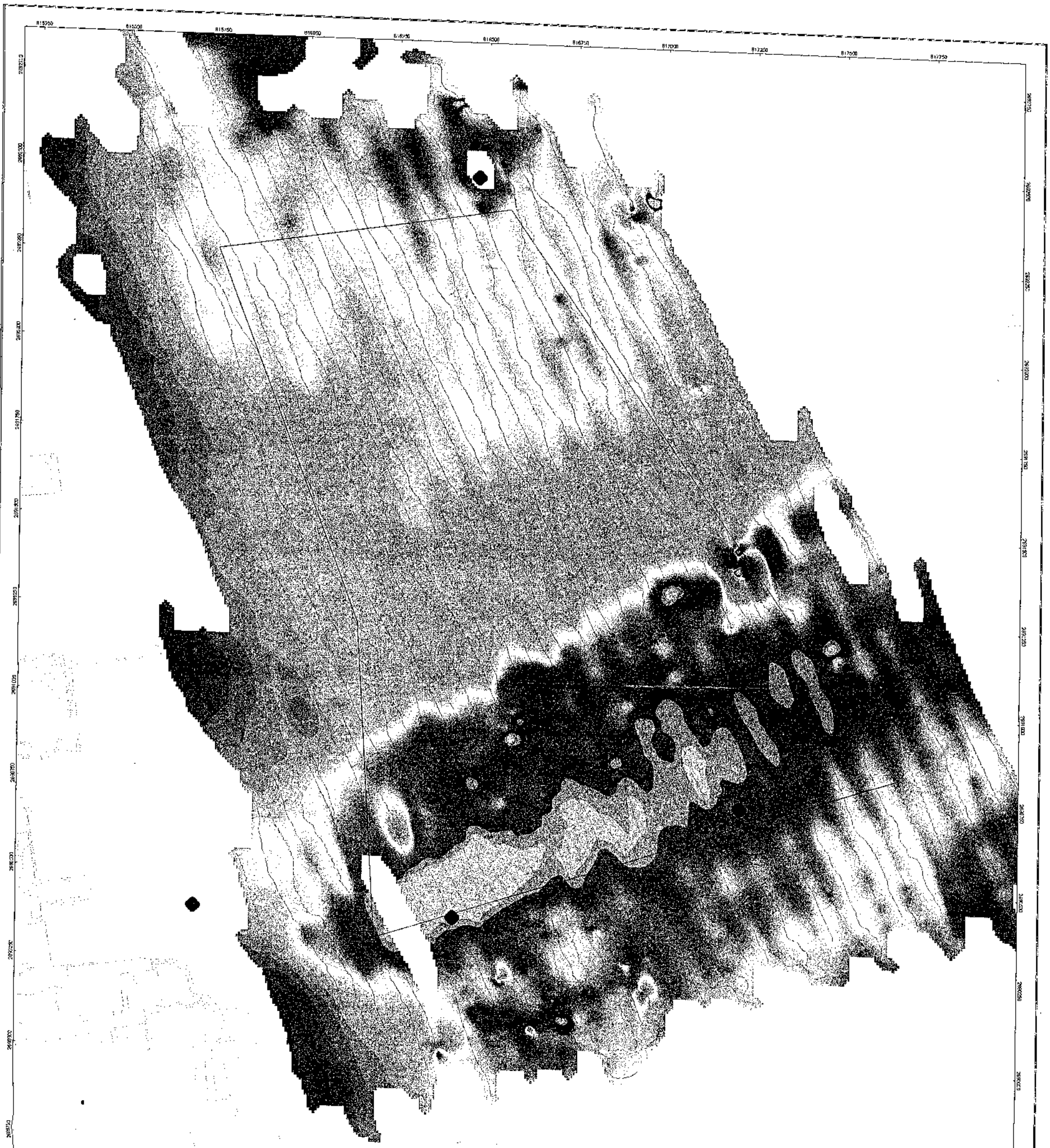
Parson, Brinckerhoff, Quade & Douglas, Inc. (Parsons)
1989 "Vessel Removal & Disposal, New Bedford and Fairhaven Massachusetts." Report submitted to the Massachusetts Department of Environmental Management. Report on file with BUAR, Boston.

Quinn, William
1988 *Shipwrecks Along the Atlantic Coast.* Arcata Graphics-Halliday, Braintree.

Ricketson, Daniel
1858 *The History of New Bedford, Bristol County Massachusetts: Including a History of the Old Township of Dartmouth and the Present Townships of Westport, Dartmouth, and Fairhaven From Their Settlement to the Present Time.* Published by the Author, New Bedford.

Sayer, William, editor
1889 *New Bedford, Massachusetts, Its History, Industries, Institutions, and Attractions.* Mercury Publishing, New Bedford.

Whitman, Nicholas
1994 *A Window Back, Photography in a Whaling Port.* Spinner Publications. New Bedford.



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

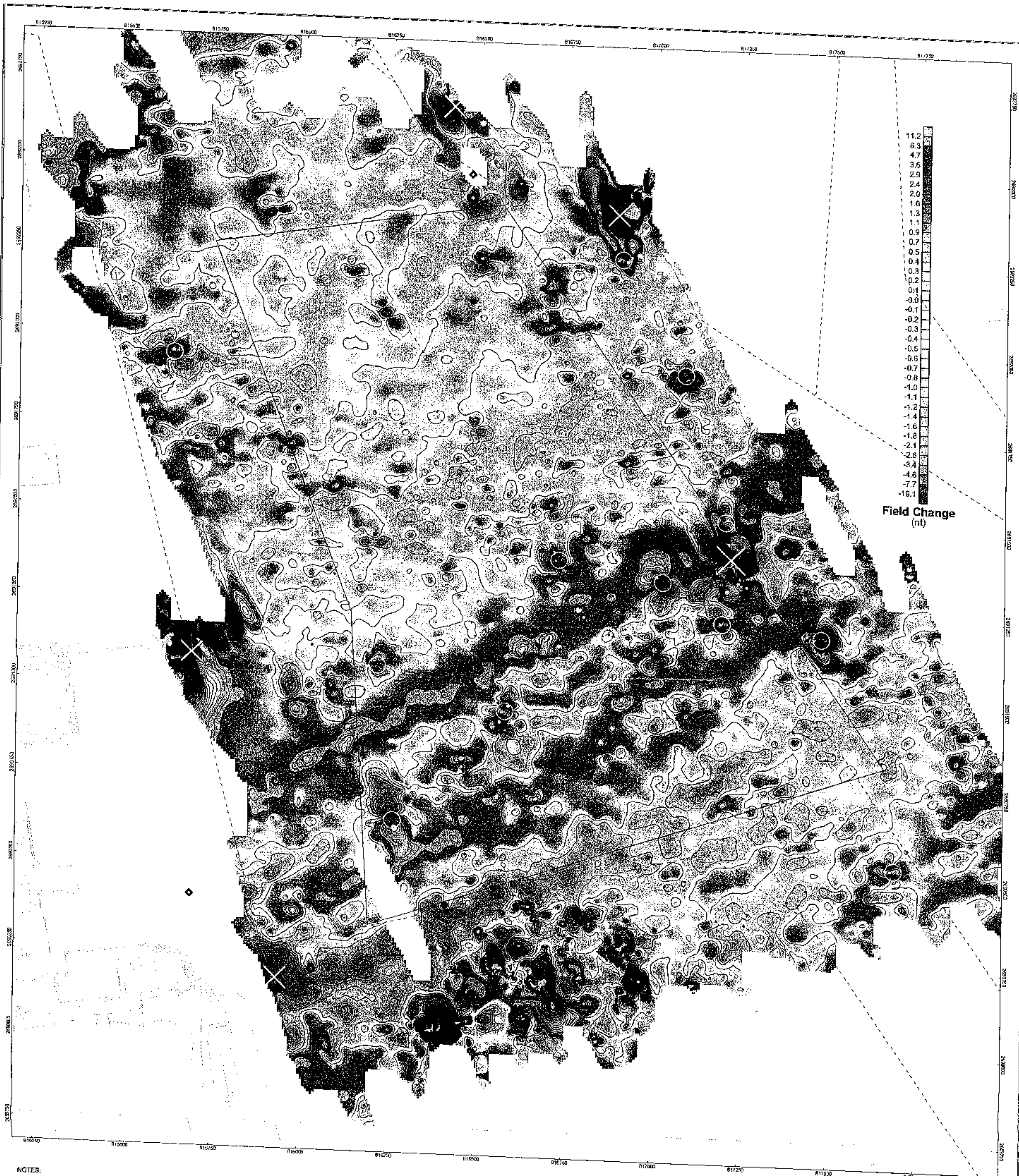
HAZARDS & CULTURAL IDENIFICATION - MAGNETICS

CHANNEL INNER AREA
NEW BEDFORD HARBOR, MA

TOTAL MAGNETIC INTENSITY (TMI)

Apex
374 Congress St
Suite 500
Boston MA 02210
(617) 728-0070

SCALE: 1"=300'	DRAWN BY:	DESIGN BY:	CHECKED BY:	PROJECT:
DATE: 12.20.02			JAB	SHEET 1 OF 6



NOTES;

1. Base Plan of the New Bedford harbor area 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. 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

HAZARDS & CULTURAL IDENIFICATION - MAGNETICS

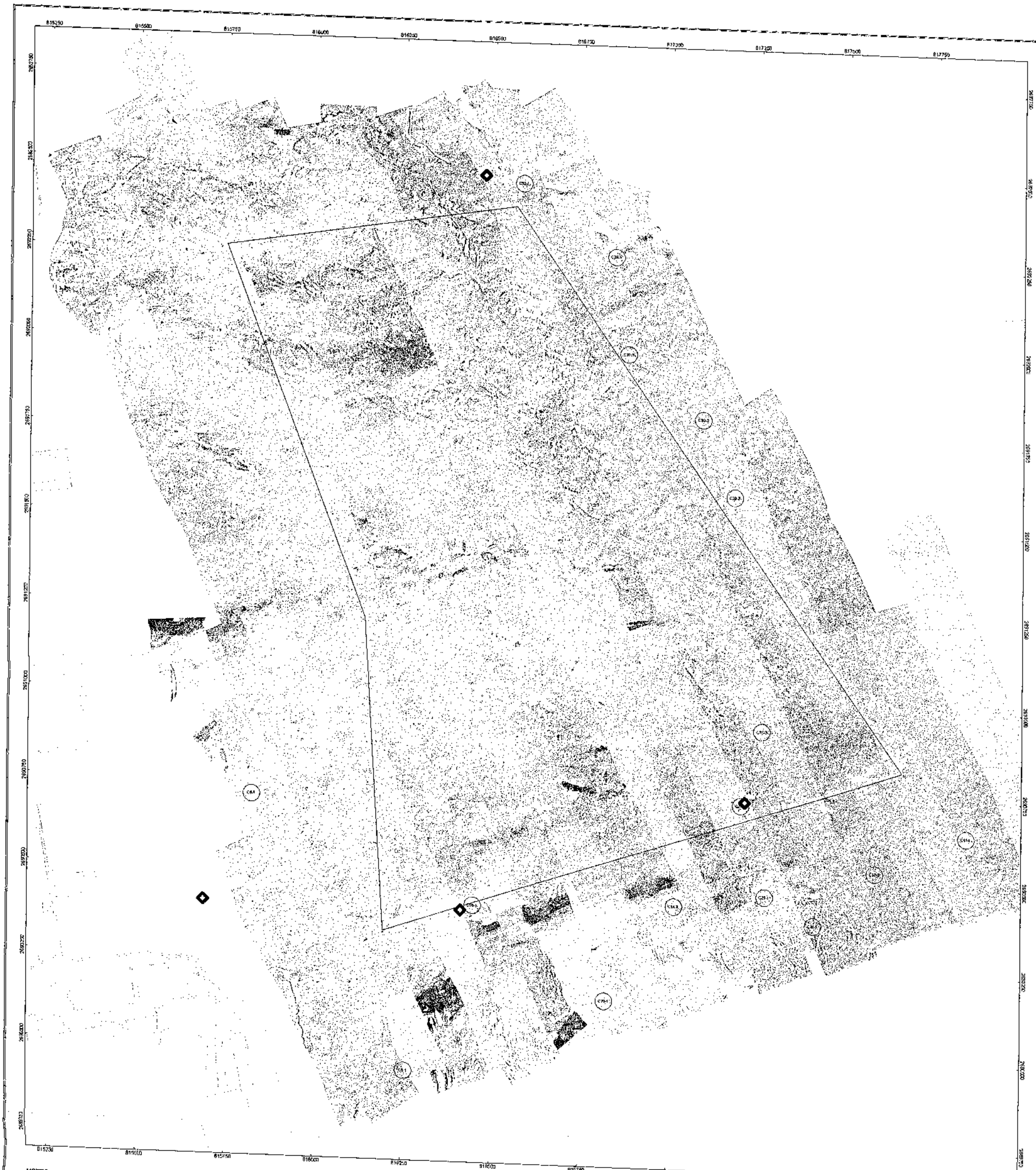
CHANNEL INNER AREA
NEW BEDFORD HARBOR, MA

CHANGE IN TOTAL MAGNETIC INTENSITY

Apex

374 Congress St
Suite 300
Boston MA 02210
(617) 728 0070

SCALE: 1"=300'	DRAWN BY:	DESIGN BY:	CHECKED BY:	PROJECT: 6510.002
DATE: 12-20-02	TM	TM	JAB	SHEET 7 OF 8



NOTES:

1. Base Plan of the New Bedford harbor area 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. Data was collected over a four day period between October 21-24, 2002 using an EdgeTech 272TD towfish operating at 500kHz 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

Scale 1:3600

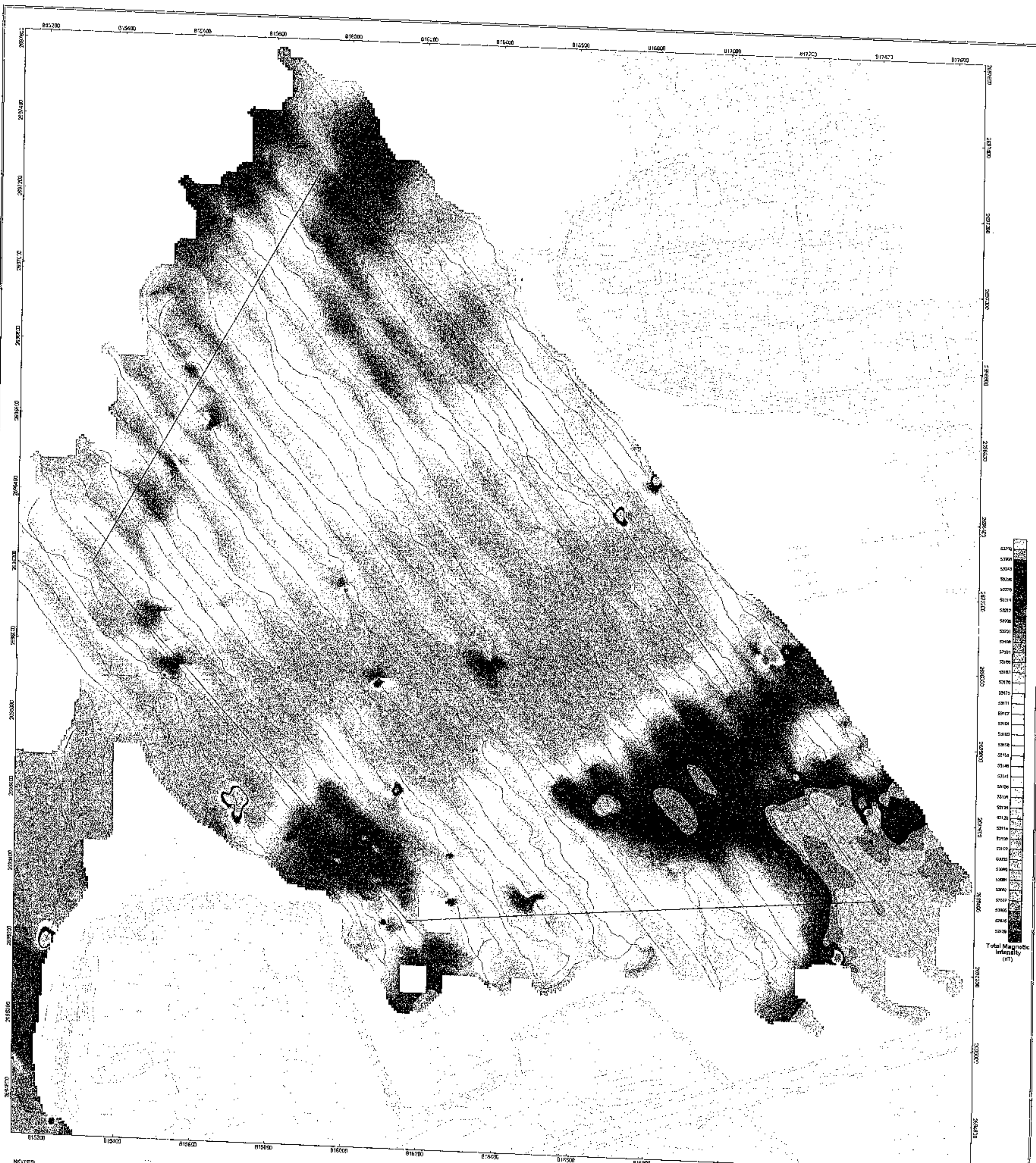
HAZARDS & CULTURAL IDENIFICATION - SIDE SCAN

CHANNEL INNER AREA
NEW BEDFORD HARBOR, MA

SIDE SCAN SONAR MOSAIC

Apex

SCALE: 1"=300'	DRAWN BY:	DESIGN BY:	CHECKED BY:	PROJECT: 6519.002
DATE: 12.20.02	TM	TM	JAB	SHEET 3 OF 8



NOTES

1. Base Plan of the New Bedford harbor area 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. 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"=300'

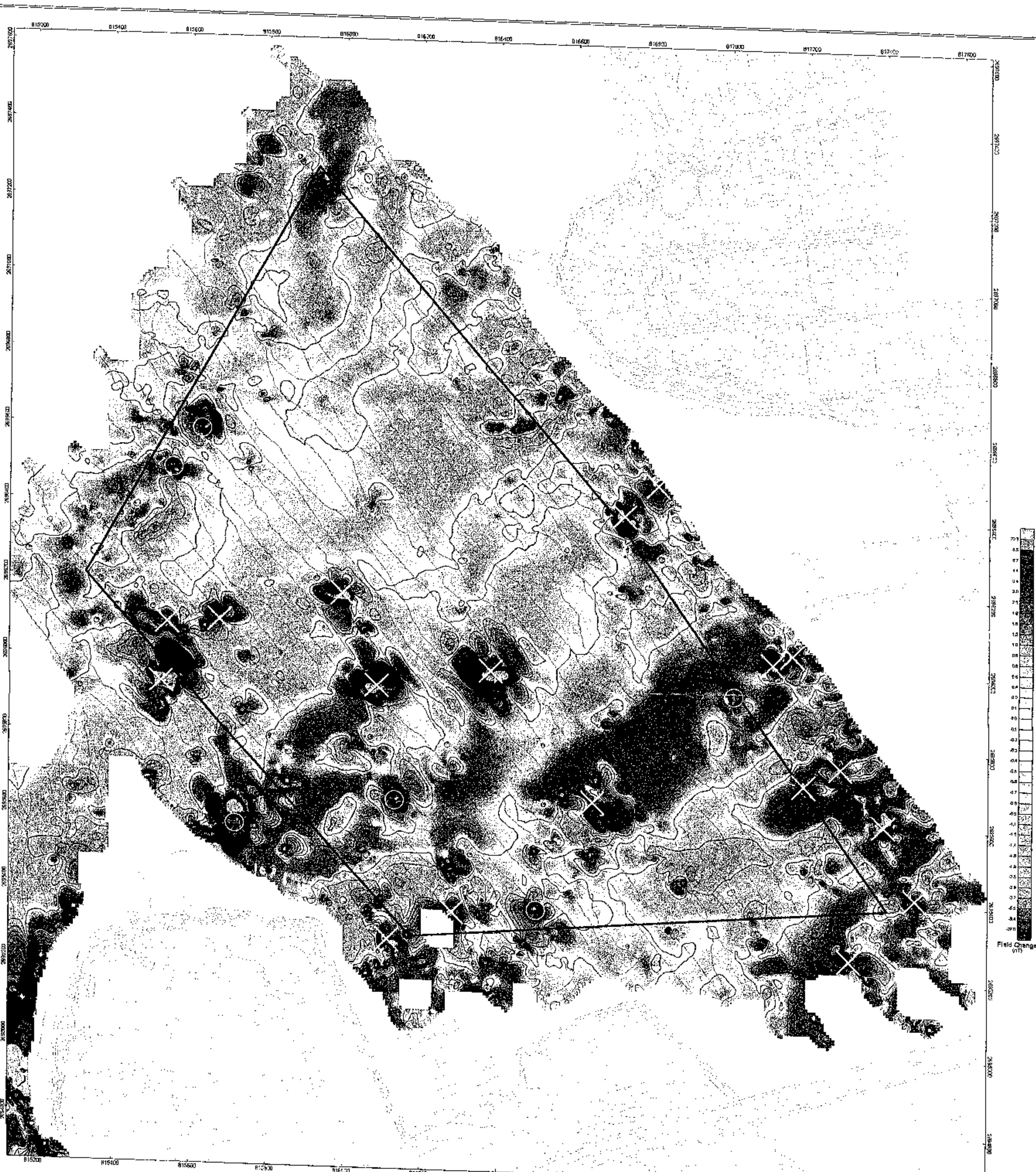
HAZARDS & CULTURAL IDENTIFICATION - MAGNETICS

POPES ISLAND NORTH AREA
NEW BEDFORD HARBOR, MA

TOTAL MAGNETIC INTENSITY (TMI)

Apex

SCALE: 1"=300'	DRAWN BY:	DESIGN BY:	CHECKED BY:	PROJECT: 6510.007
DATE: 12.20.02	IM	TB	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 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. 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

N

REV	DESCRIPTION	BY	DATE

HAZARDS & CULTURAL IDENTIFICATION - MAGNETICS

POPES ISLAND NORTH AREA
NEW BEDFORD HARBOR, MA

CHANGE IN TOTAL MAGNETIC INTENSITY

Apex

374 Congress St
Suite 500
Boston MA 02210
(617) 728-0070

SCALE: 1"=300'	DRAWN BY:	DESIGN BY:	CHECKED BY:	PROJECT: 6918.002	ISSUE
DATE: 12-20-02	TM	TM	JAR	SHEET 5 OF 6	

NOTES

1. Base Plan of the New Bedford harbor area 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. Data was collected over a four day period between October 21-24, 2002 using a Edgetech 272D towfish operating at 500kHz flown at a depth of approximately 6 feet. Planned line spacing of 100 feet

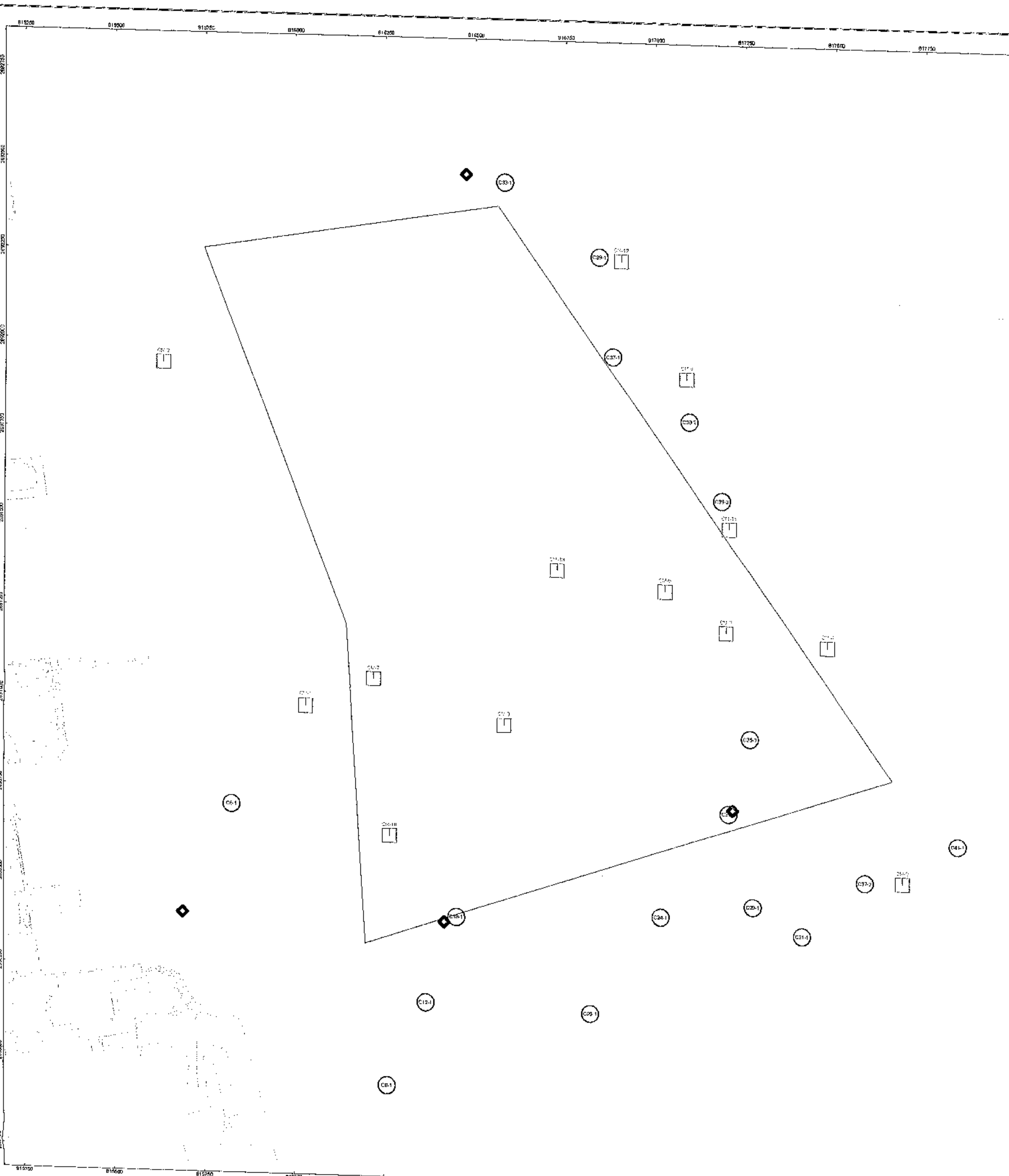
LEGEND:

AREA OF PROPOSED CAD CELL

POSSIBLE TARGET

Scale 1:3000

HAZARDS & CULTURAL IDENTIFICATION - SIDE SCAN				
POPES ISLAND NORTH AREA NEW BEDFORD HARBOR, MA				
SIDE SCAN SONAR MOSAIC				
Apex Environmental, Inc.	Boston MA 02210 (617) 728-0070			
SCALE: 1"=200' DATE: 12.04.02	DRAWN BY: TM	DESIGN BY: TM	CHECKED BY: JAB	PROJECT: 6540.002 SHEET 6 OF 6



NOTES:

1. Base Plan of the New Bedford harbor area 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:

- ◇ Aids To Navigation
- — Area of Proposed Cell
- ⬚ Magnetic Anomaly
- ○ Side Scan Soanr Target

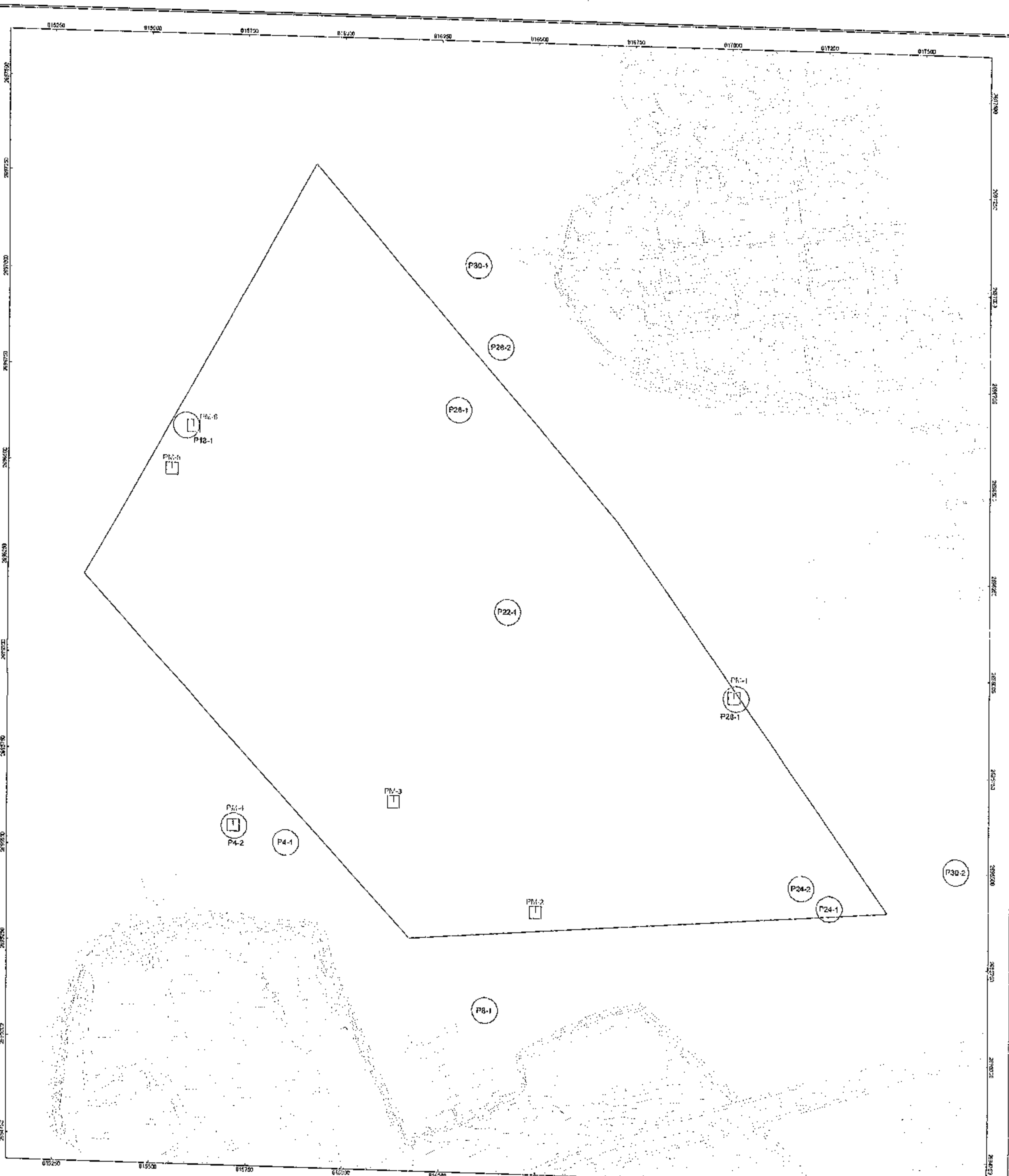
HAZARDS & CULTURAL IDENIFICATION - MAGNETICS

CHANNEL INNER AREA
NEW BEDFORD HARBOR, MA

INTERPRETED TARGETS

Apex

SCALE: 1"=300'	DRAWN BY:	DESIGN BY:	CHECKED BY:	PROJECT: 6510.002
DATE: 12-20-02	TM	TM	JAR	SHEET 7 OF 8



NOTES:

1. Base Plan of the New Bedford harbor area 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. 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

N

Scale 1:3600

HAZARDS & CULTURAL IDENTIFICATION - SUMMARY

POPES ISLAND NORTH AREA
NEW BEDFORD HARBOR, MA

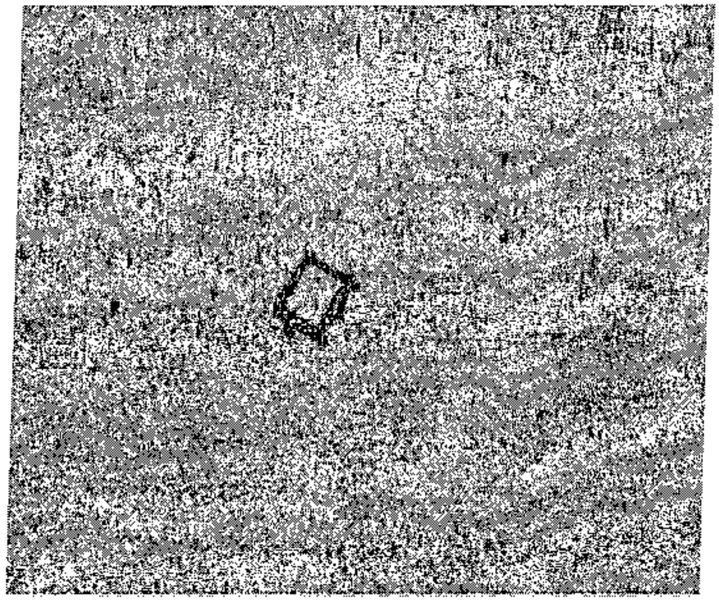
INTERPRETED TARGETS

Apex

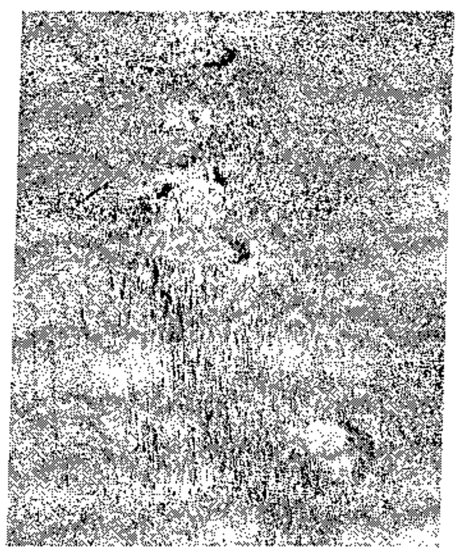
SCALE: 1"=300'	DRAWN BY:	DESIGN BY:	CHECKED BY:	PROJECT: 6510802
DATE: 12-20-02	TM	TM	JAB	SHEET 8 OF 8

APPENDIX A

Detail Side Scan Images
Channel Inner Area

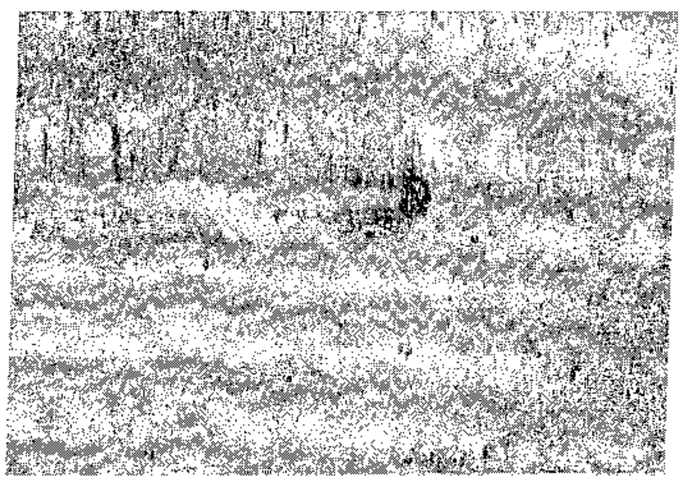


Target # C6-1
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\Channel\SlantRangeCorrected\06chan-BAC.CMN
First Target Ping Num: 2225 at 10/22/2002 20:14:13
Target Location: 41° 37.7976' N 070° 54.9543' W

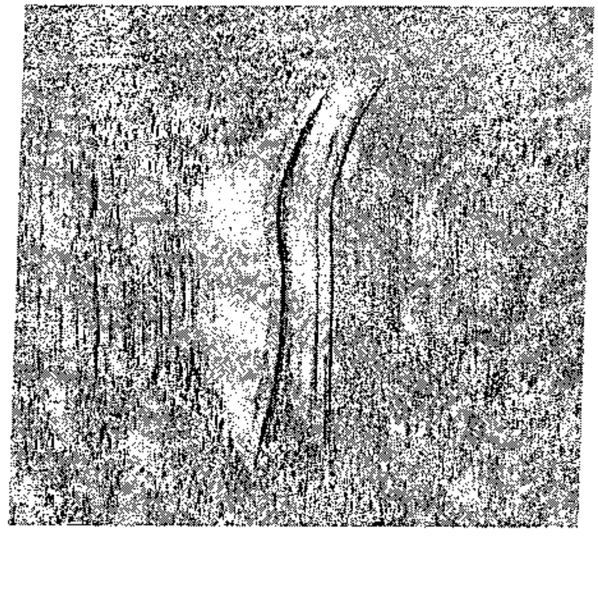


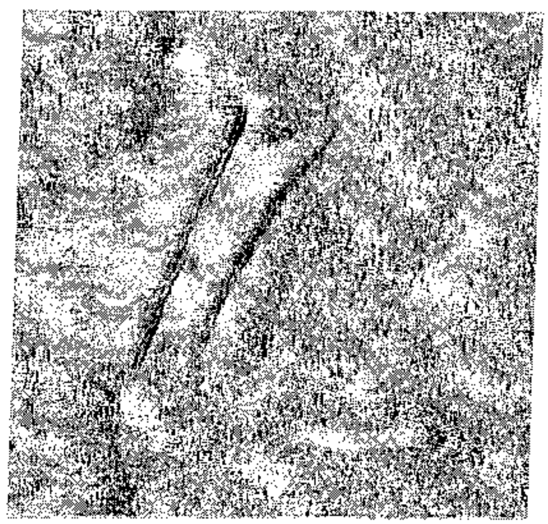
Target # C8-1
SonarWeb V3.13M PRO
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\Channel\SlantRangeCorrected\08chan-BAC.CMN
File Creation Time: 11/19/02 15:24:27
First Target Ping Num: 50 at 10/22/2002 20:08:03
Target Location: 41° 37.6653' N 070° 54.8564' W

Target # C12-1
Sonar Web V3.13M PRO
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\Channel\SlantRangeCorrected\12chan-BAC.CMN
File Creation Time: 11/19/02 15:26:30
First Target Ping Num: 1060 at 10/22/2002 19:50:27
Target Location: 41° 37.7051' N 070° 54.8291' W

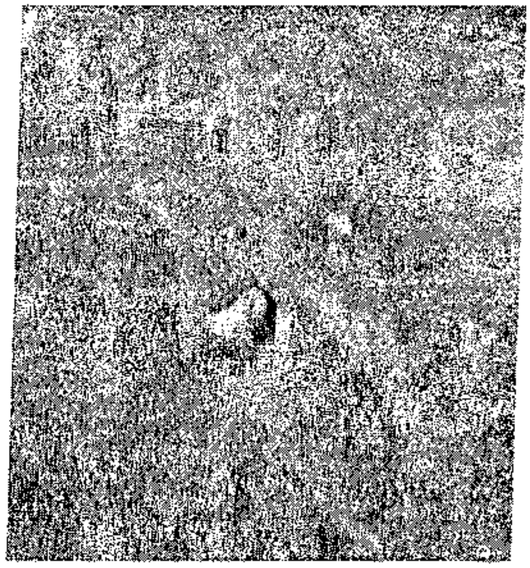


Target # C18-1
Sonar Web V3.13M PRO
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\Channel\SlantRangeCorrected\18chan-BAC.CMN
File Creation Time: 11/19/02 15:27:25
First Target Ping Num: 13340 at 10/22/2002 17:39:49
Target Location: 41° 37.6982' N 070° 54.7568' W

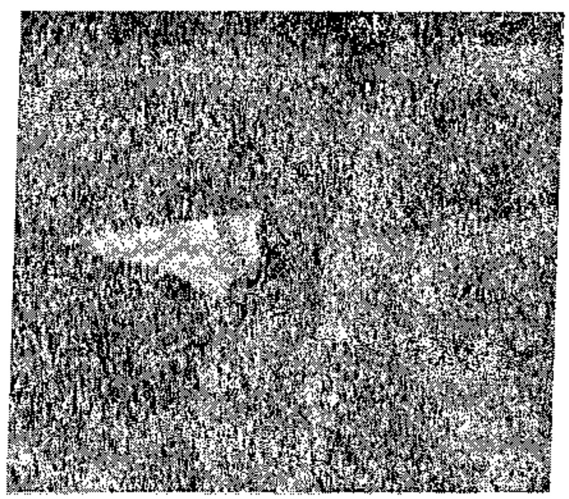




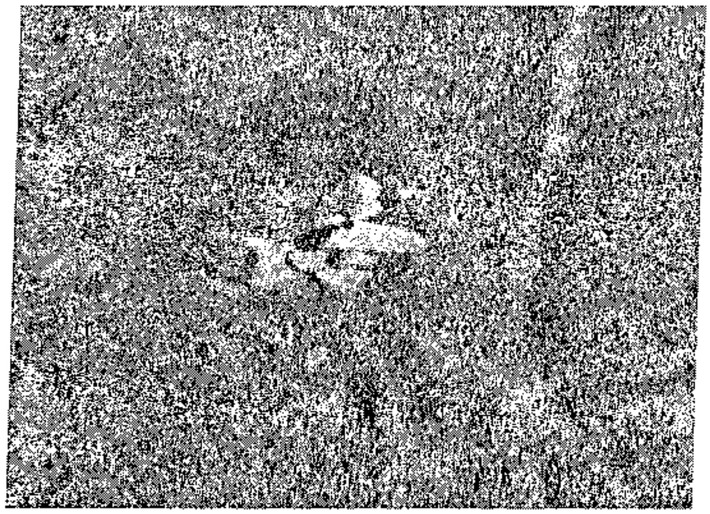
Target # C20-1
SonarWeb V3.13M PRO
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\Channel\SlantRangeCorrected\20chan-BAC.CMN
File Creation Time: 11/19/02 15:29:51
First Target Ping Num: 678 at 10/22/2002 14:26:09
Target Location: 41° 37.7034' N 070° 54.7302' W



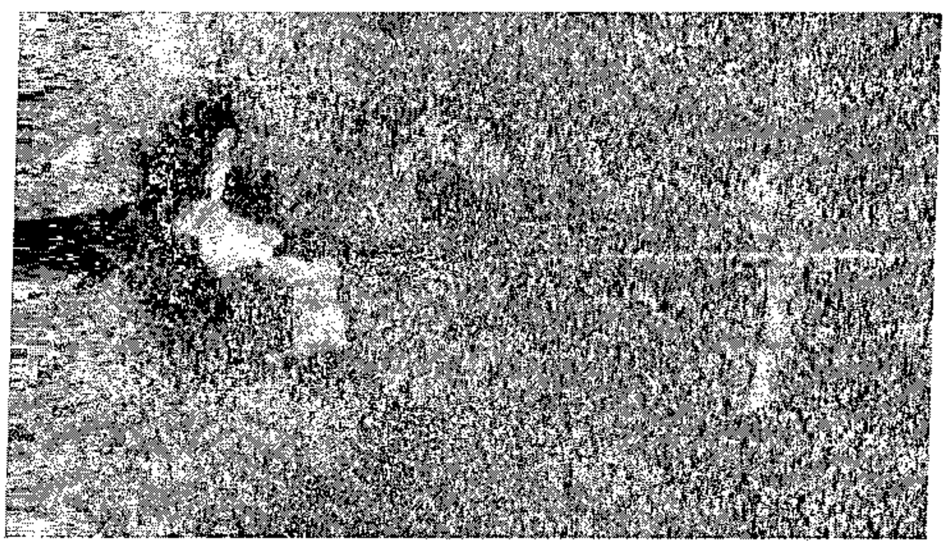
Target # C24-1
SonarWeb V3.13M PRO
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\Channel\SlantRangeCorrected\24chan-BAC.CMN
File Creation Time: 11/19/02 15:31:15
First Target Ping Num: 10626 at 10/22/2002 17:59:10
Target Location: 41° 37.7471' N 070° 54.7098' W



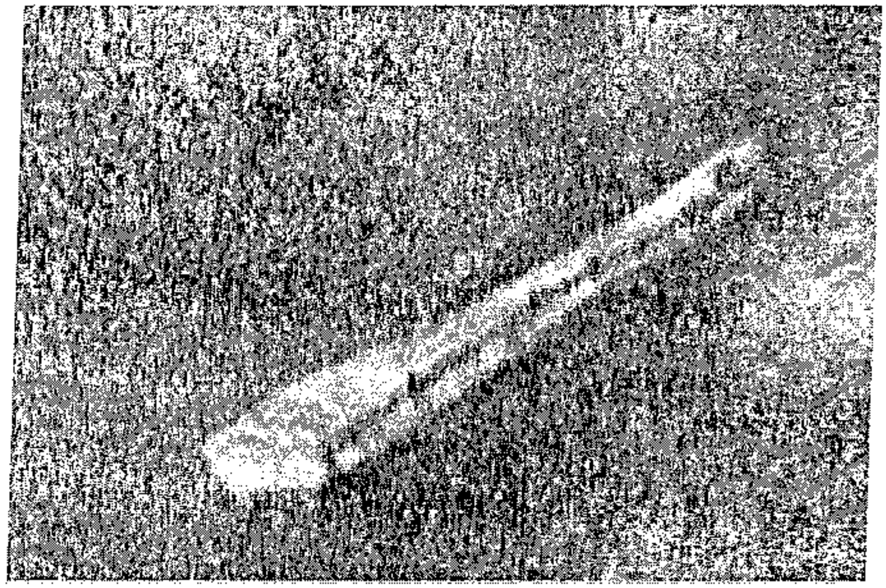
Target # C29-1
Sonar Web V3.13M PRO
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\Channel\SlantRangeCorrected\29chan-BAC.CMN
File Creation Time: 11/19/02 15:32:42
First Target Ping Num: 10276 at 10/21/2002 14:49:02
Target Location: 41° 37.7495' N 070° 54.6542' W

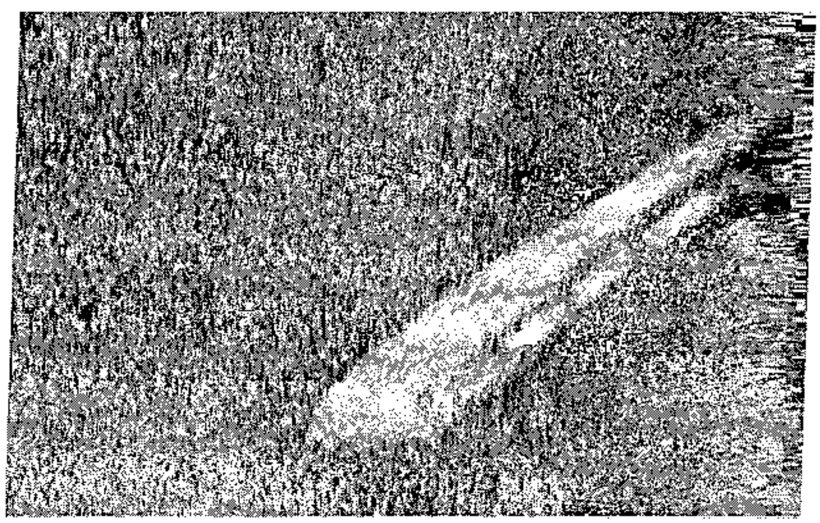


Target # C31-1
SonarWeb V3.13M PRO
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\Channel\SlantRangeCorrected\31chan-BAC.CMN
File Creation Time: 11/19/02 15:33:07
First Target Ping Num: 139 at 10/21/2002 14:51:05
Target Location: 41° 37.7317' N 070° 54.6163' W

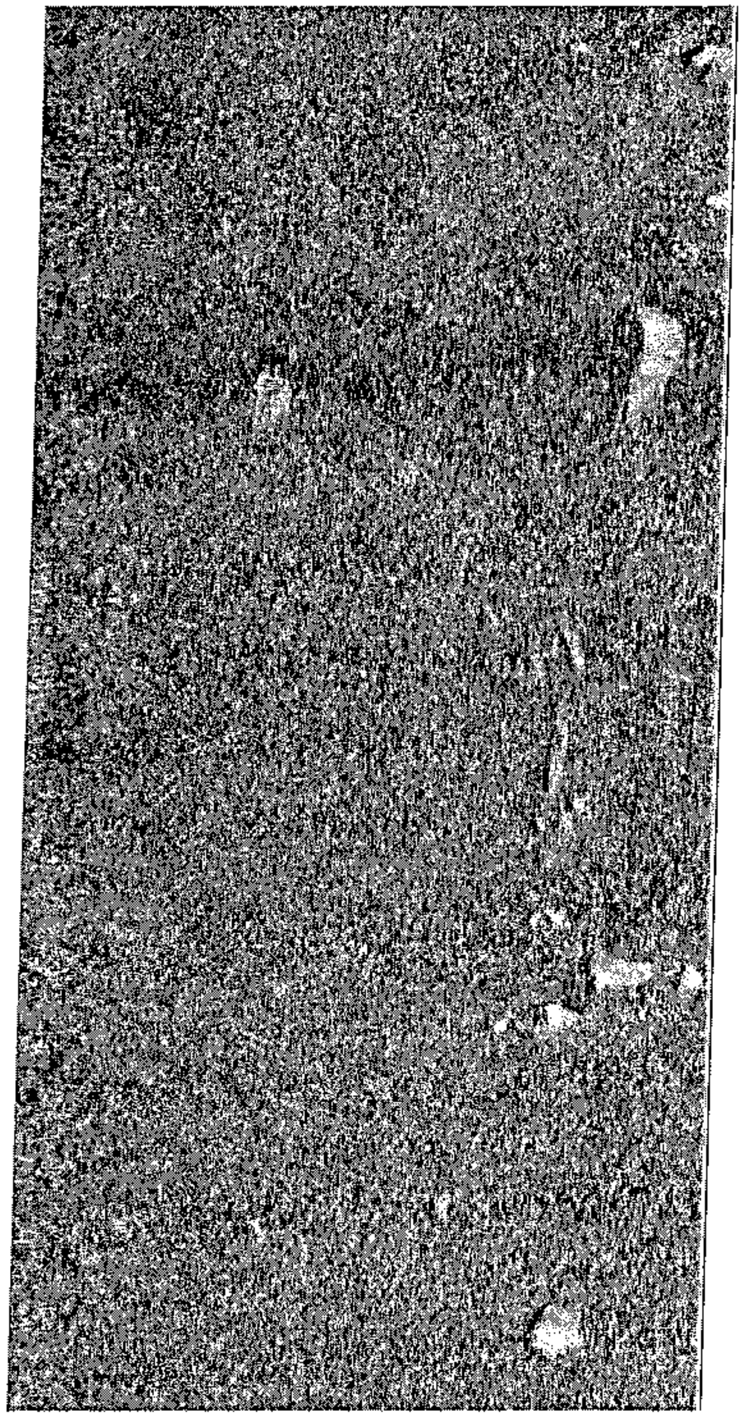


Target # C31-2
SonarWeb V3.13M PRO
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\Channel\SlantRangeCorrected\31chan-BAC.CMN
File Creation Time: 11/19/02 15:33:27
First Target Ping Num: 2399 at 10/21/2002 14:52:29
Target Location: 41° 37.7909' N 070° 54.6584' W

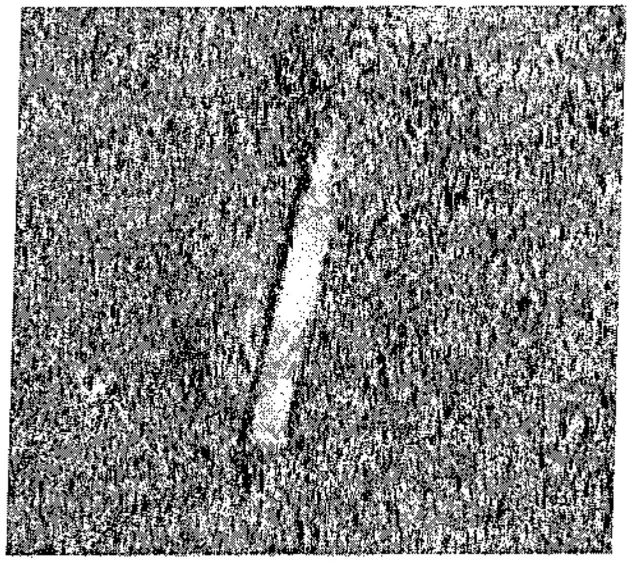


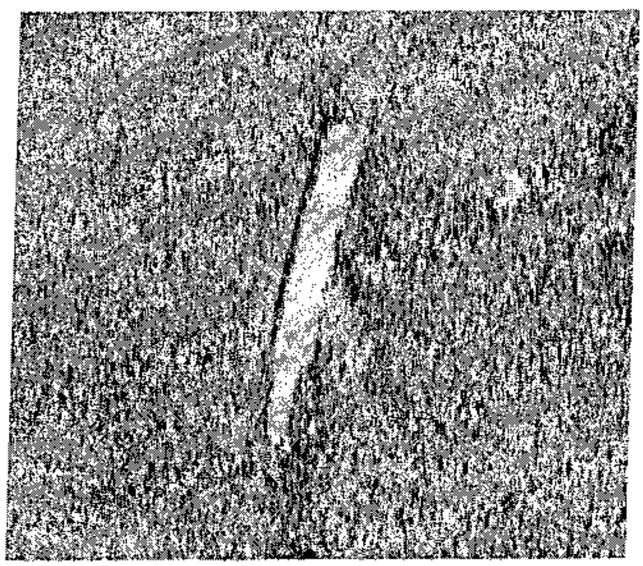


Target # C33-1
SonarWeb V3.13M PRO
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\Channel\SlantRangeCorrected\33chan-BAC.CMN
File Creation Time: 11/19/02 15:34:26
First Target Ping Num: 1246 at 10/21/2002 15:03:06
Target Location: 41° 38.0824' N 070° 54.7976' W

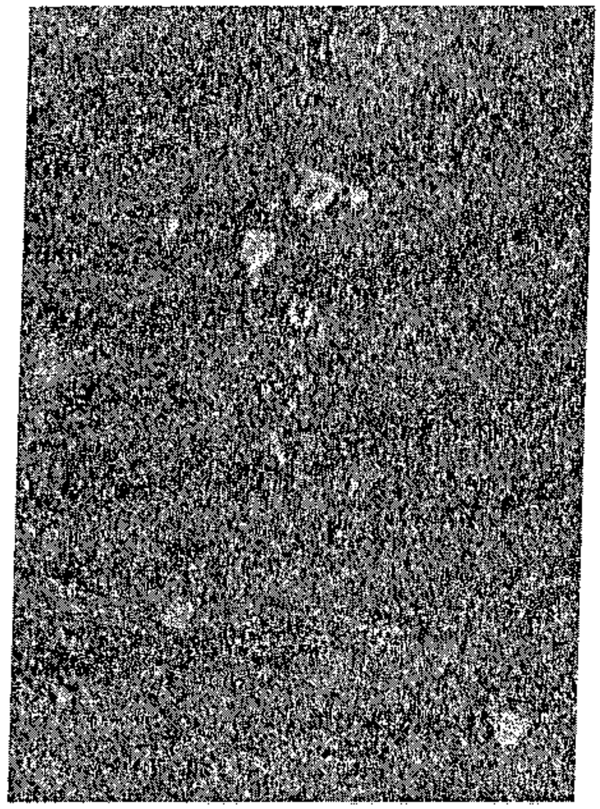


Target # C35-3
SonarWeb V3.13M PRO
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\Channel\SlantRangeCorrected\35chan-BAC.CMN
File Creation Time: 11/19/02 15:37:59
First Target Ping Num: 415 at 10/21/2002 15:11:14
Target Location: 41° 37.7420' N 070° 54.5754' W

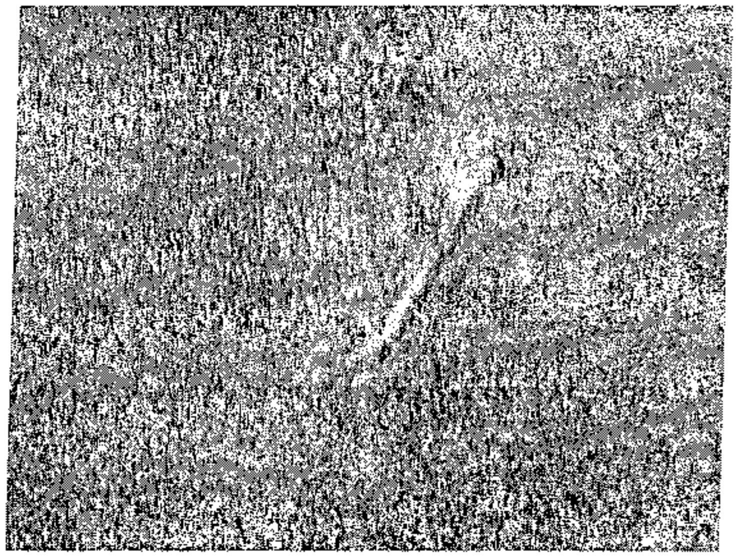


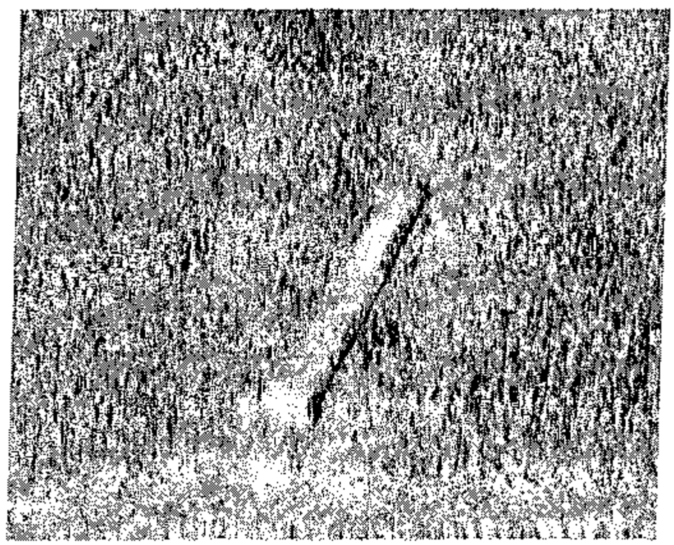


Target # C37-1
SonarWeb V3.13M PRO
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\Channel\SlantRangeCorrected\37chan-BAC.CMN
File Creation Time: 11/19/02 15:38:25
First Target Ping Num: 3337 at 10/21/2002 15:23:07
Target Location: 41° 38.0097' N 070° 54.7183' W

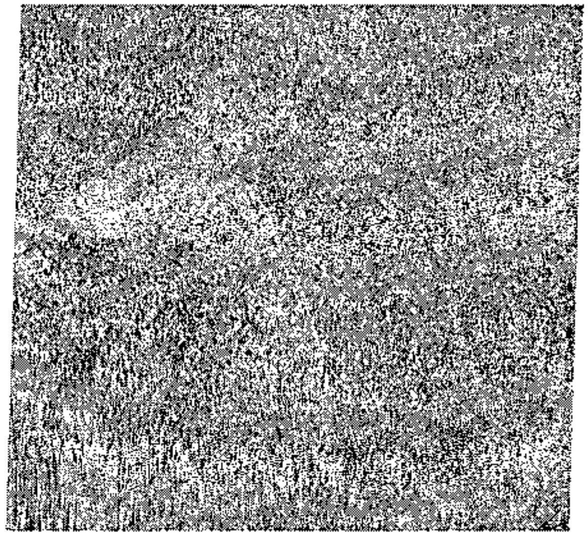


Target # C37-2
SonarWeb V3.13M PRO
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\Channel\SlantRangeCorrected\37chan-BAC.CMN
File Creation Time: 11/19/02 15:40:54
First Target Ping Num: 10851 at 10/21/2002 15:27:49
Target Location: 41° 37.7658' N 070° 54.5651' W

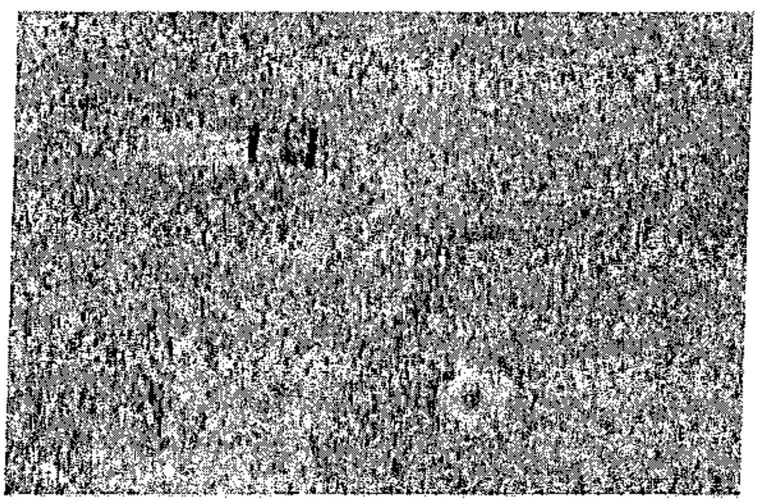




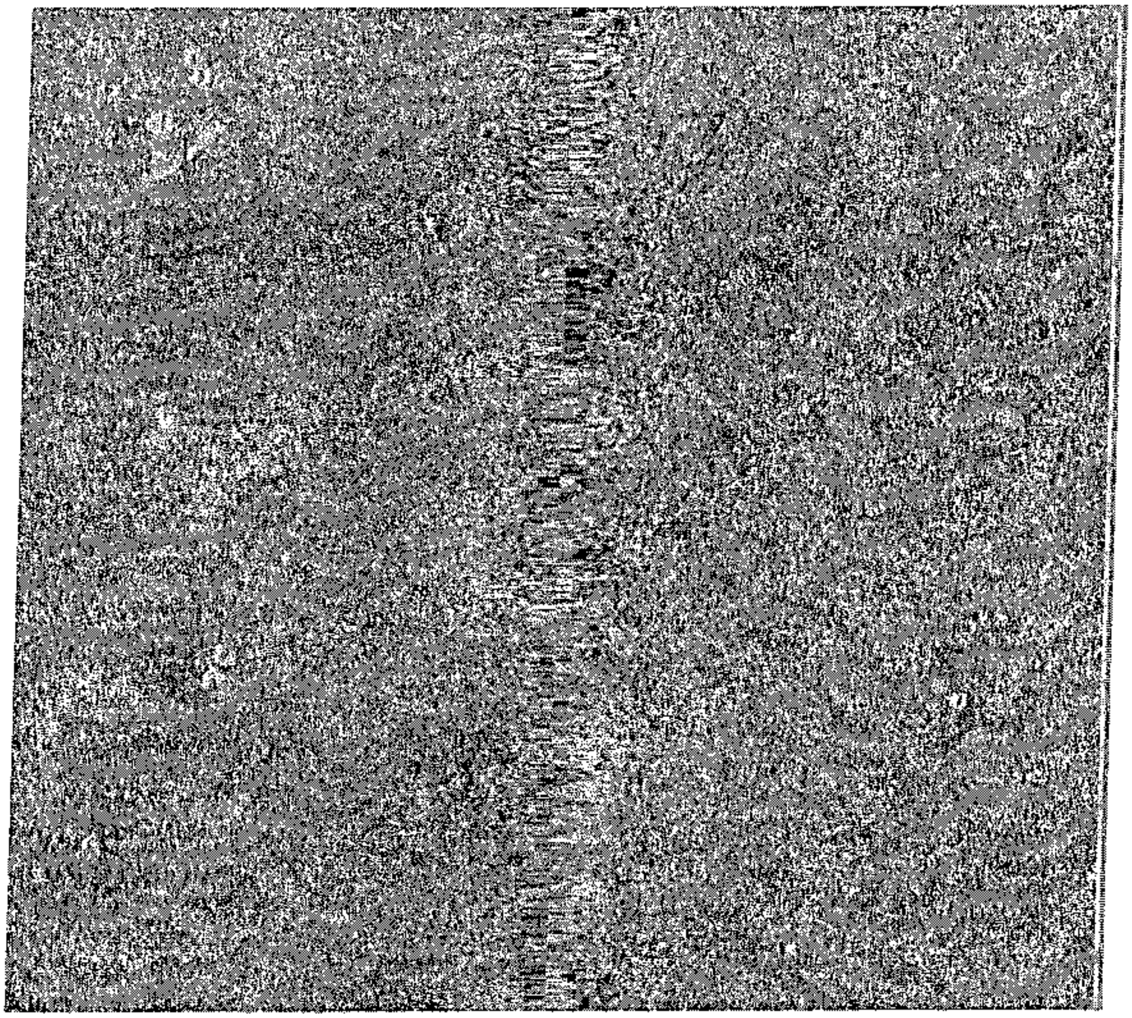
Target # C39-1
SonarWeb V3.13M PRO
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\Channel\SlantRangeCorrected\39chan-BAC.CMN
File Creation Time: 11/19/02 16:38:07
First Target Ping Num: 12674 at 10/21/2002 15:37:14
Target Location: 41° 38.0526' N 070° 54.7209' W



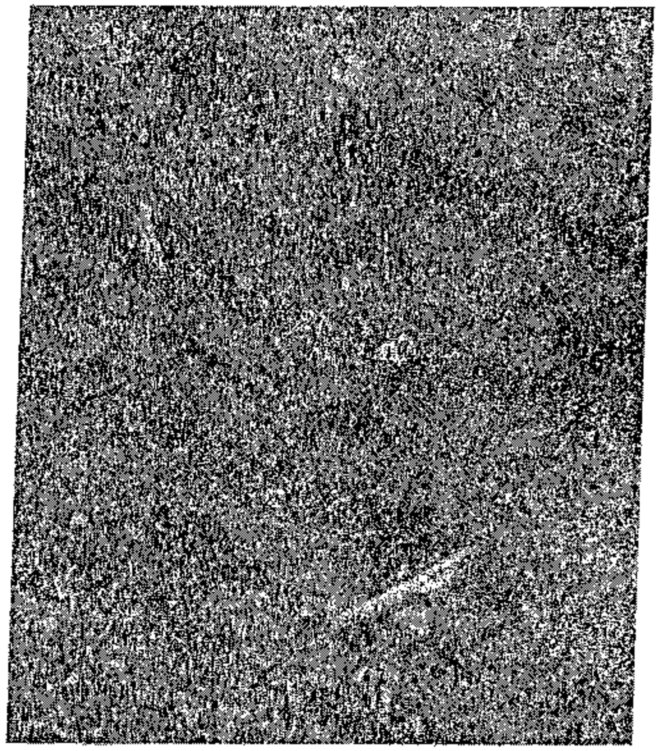
Target # C39-2
SonarWeb V3.13M PRO
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\Channel\SlantRangeCorrected\39chan-BAC.CMN
File Creation Time: 11/19/02 16:38:29
First Target Ping Num: 9321 at 10/21/2002 15:35:08
Target Location: 41° 37.9714' N 070° 54.6694' W



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



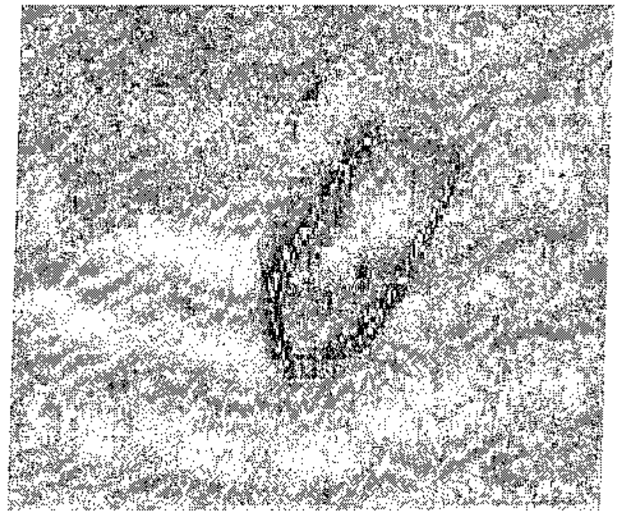
Target # C41-1
SonarWeb V3.13M PRO
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\Channel\SlantRangeCorrected\41rchan-BAC.CMN
File Creation Time: 11/19/02 16:39:44
First Target Ping Num: 5711 at 10/21/2002 17:02:49
Target Location: 41° 37.7838' N 070° 54.5322' W



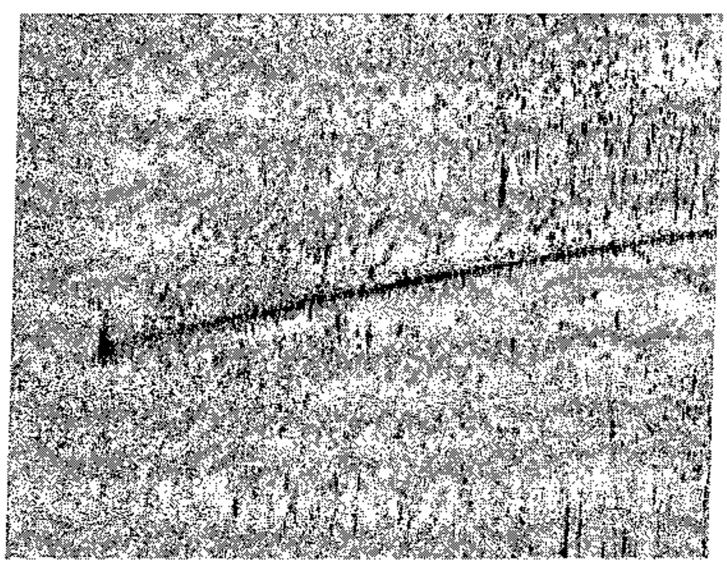
Target # C41-1
SonarWeb V3.13M PRO
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\Channel\SlantRangeCorrected\41rchan-BAC.CMN
File Creation Time: 11/19/02 16:39:44
First Target Ping Num: 5711 at 10/21/2002 17:02:49
Target Location: 41° 37.7838' N 070° 54.5322' W

APPENDIX B

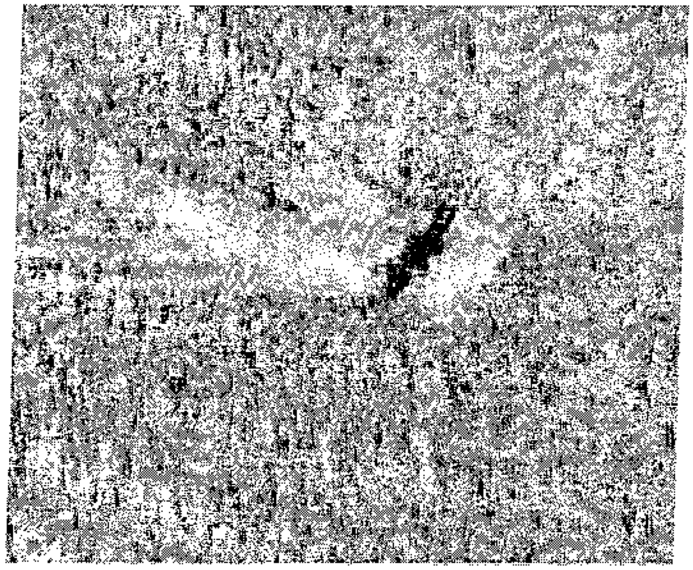
Detail Side Scan Images
Popes Island North Area



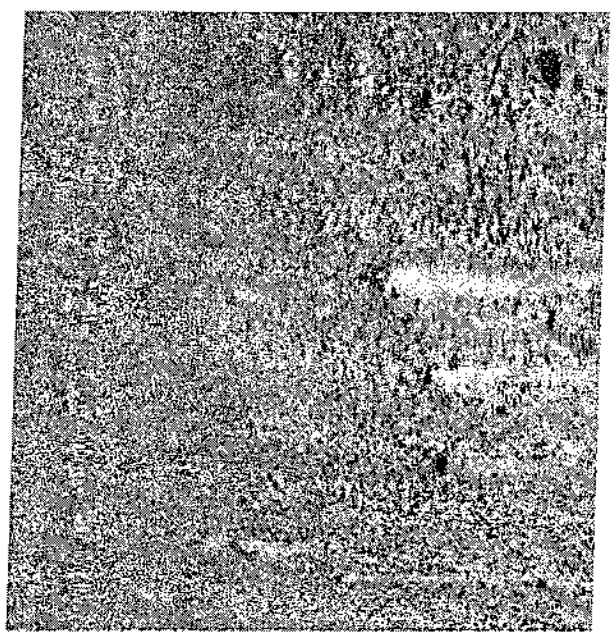
Target # P4-1
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\popes\SlantRangeCorrected\04popes-BAC.CMN
First Target Ping Num: 4117 at 10/23/2002 17:59:56
Target Location: 41° 38.5894' N 070° 54.9566' W



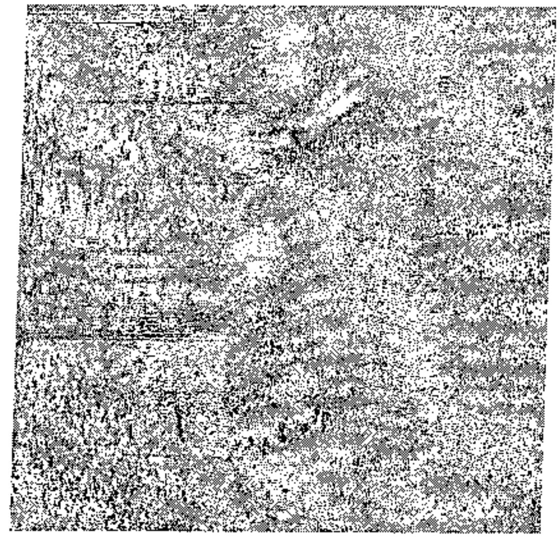
Target # P4-2
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\popes\SlantRangeCorrected\04popes-BAC.CMN
First Target Ping Num: 3520 at 10/23/2002 17:59:33
Target Location: 41° 38.6064' N 070° 54.9768' W



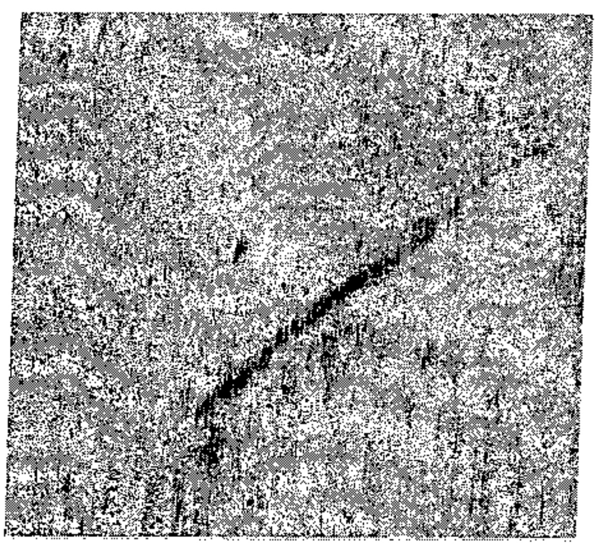
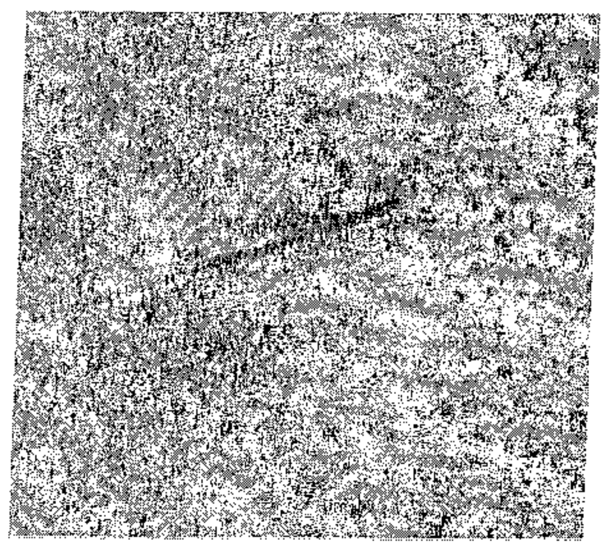
Target # P6-1
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\popes\SlantRangeCorrected\06popes-BAC.CMN
First Target Ping Num: 6434 at 10/23/2002 17:54:43
Target Location: 41° 38.6559' N 070° 54.9933' W



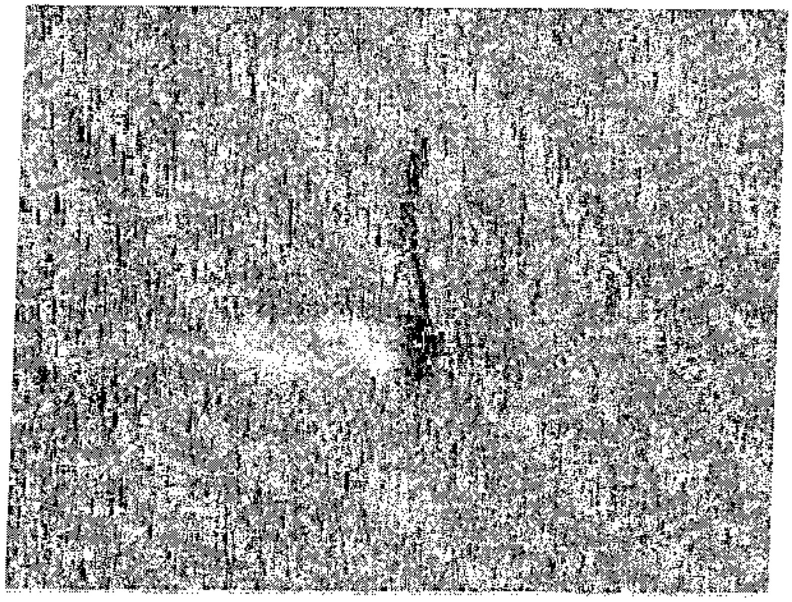
Target # P8-1
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\popes\SlantRangeCorrected\08popes-BAC.CMN
First Target Ping Num: 7346 at 10/23/2002 17:48:25
Target Location: 41° 38.5349' N 070° 54.8380' W

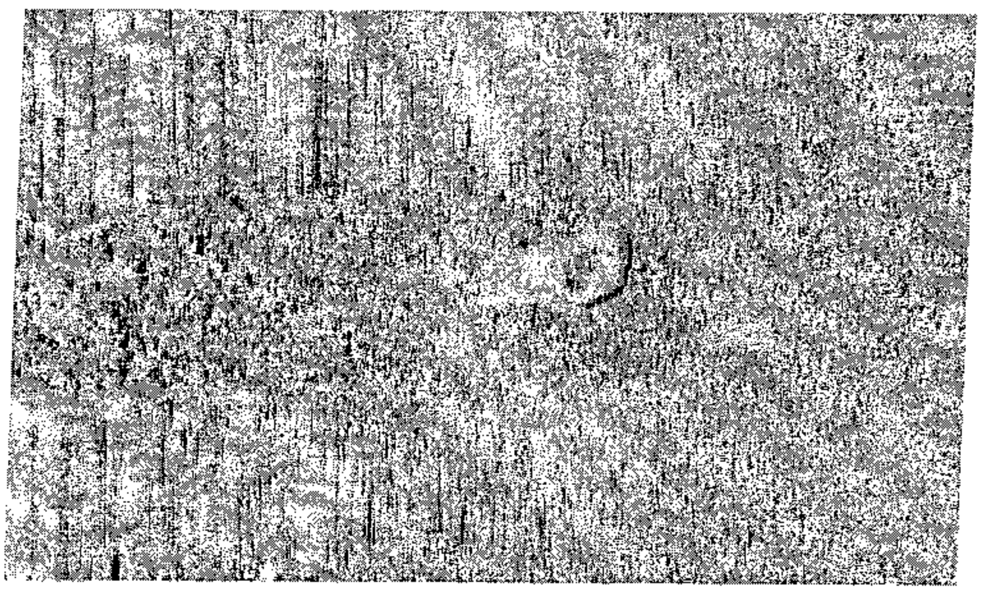
Target # P13-1
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\popes\SlantRangeCorrected\13popes-BAC.CMN
First Target Ping Num: 383 at 10/23/2002 12:45:34
Target Location: 41° 38.7706' N 070° 55.0220' W

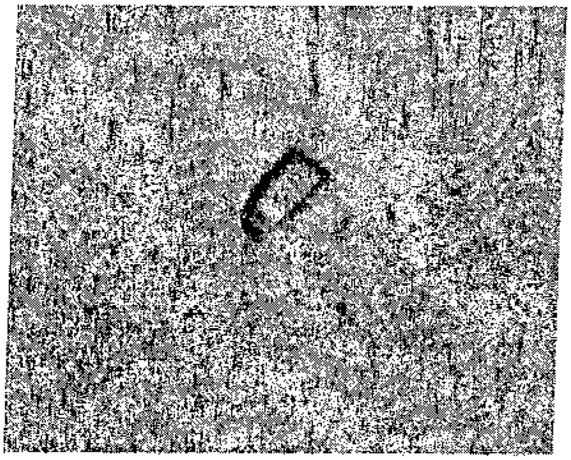
Target # P22-1
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\popes\SlantRangeCorrected\22rpopes-BAC.CMN
First Target Ping Num: 6604 at 10/23/2002 15:26:44
Target Location: 41° 38.7015' N 070° 54.8190' W

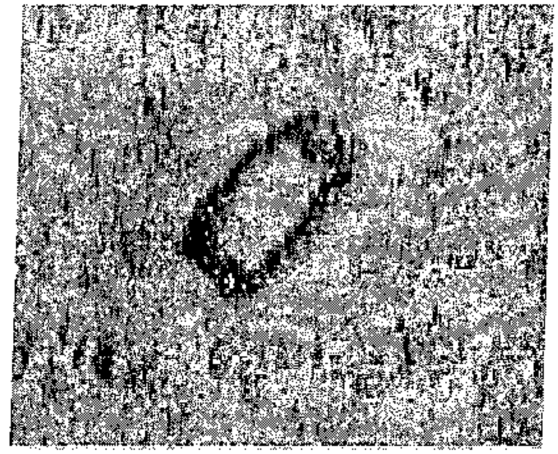


Target # P24-1
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\popes\SlantRangeCorrected\24popes-BAC.CMN
First Target Ping Num: 1716 at 10/23/2002 14:58:10
Target Location: 41° 38.5588' N 070° 54.6286' W

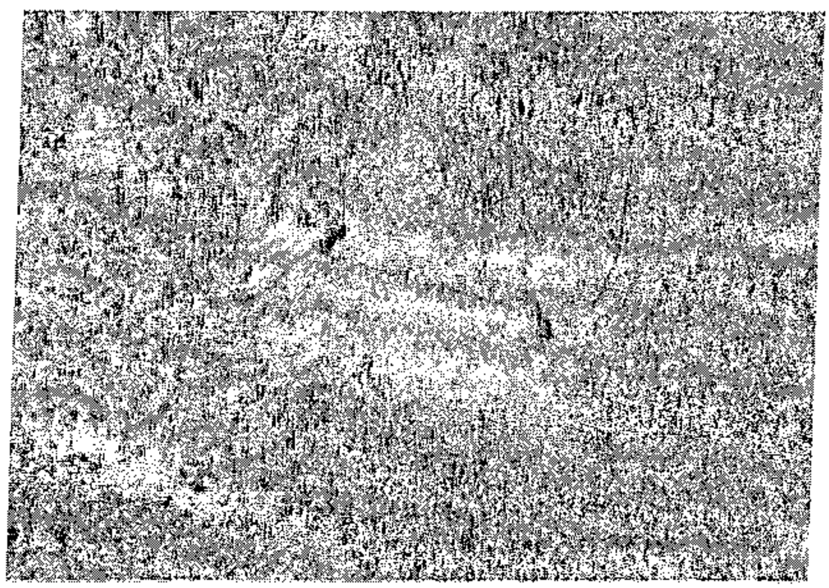


Target # P24-2
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\popes\SlantRangeCorrected\24popes-BAC.CMN
First Target Ping Num: 2188 at 10/23/2002 14:58:27
Target Location: 41° 38.5723' N 070° 54.6404' W

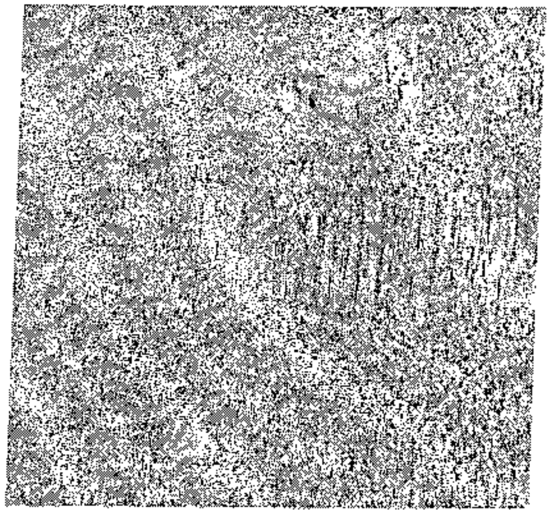


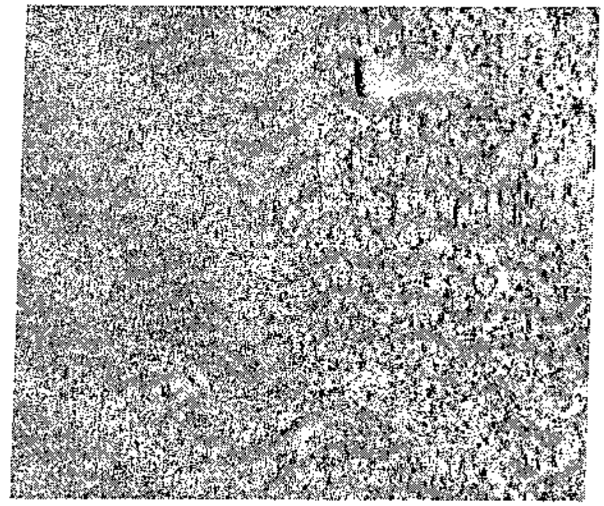


Target # P26-1
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\popes\SlantRangeCorrected\26rpopes-BAC.CMN
First Target Ping Num: 4406 at 10/23/2002 14:49:43
Target Location: 41° 38.7815' N 070° 54.8469' W



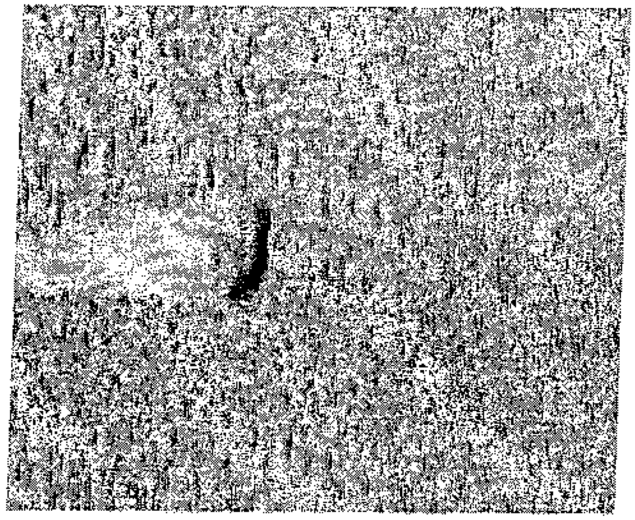
Target # P28-1
Sonar Filename: C:\Program Files\Chesapeake Technology, Inc\SonarWeb\popes\SlantRangeCorrected\28popesd-BAC.CMN
First Target Ping Num: 4679 at 10/23/2002 14:36:39
Target Location: 41° 38.6508' N 070° 54.6768' W





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

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 15th ANNIVERSARY 2002 AMRO ENVIRONMENTAL LABS MERRIMACK, NH

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: [signature] Date: 10-14-02

NA= Not Applicable

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	RCRA(8) Metals	Dioxin/Furan	PCB Congeners	Pest.	PAH	TOC 9060	Water Content	Grain Hydro	% total Sol	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: Tom Hevner, Maguire Group, Inc.
FAX No.: 508.543.5157

Seal Intact? Yes No N/A
P.O. No:
Results Needed By:

GW-1* ___ GW-2 ___ GW-3 ___
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 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 3 OF 3

AMRO Environmental Laboratories Cor[illegible]ion
111 Herrick Street
Merrimack, NH 03054

HA[illegible] F-C[illegible]ODY [illegible]CORD

43450

Office: (603) 424-2022
Fax: (603) 429-8496

Project No.: 16421

Project Name: NB Harbor FEIR

Project State:

Project Manager: TBH

Samplers (Signature): [signature]

AMRO Project No.: 0210114

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	(QA(8) Metals	Dioxin/Furan	PCB Congeners	Pest	PAH	TOC-9060	Water Cont	Grain/Hydro	% total Solids	Remarks
NBH-204-2-SED	10/10/02	Sed	3x8oz	X		X									
NBH-201-3-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~~	~~[illegible]~~	~~3x8oz~~												
~~NBH-206-2-SED~~	~~10/10/02~~	~~[illegible]~~	~~3x8oz~~												
~~NBH-206-3-SED~~	~~10/10/02~~	~~[illegible]~~	~~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: Tom Heavrer
Maguire Group, Inc.

FAX No.: 508-543-5157

Seal Intact? Yes No N/A

P.O. No:

Results Needed By:

GW-1*___ GW-2___ GW-3___

MCP Level Needed: ____________

*= May require additional cost

Relinquished By	Date/ Time	Received By
[signature]	13:[illegible] 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 2

8

qc/qcmemos/forms/amrococ/Rev 2 04/01/02

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
ANTIMONY	EPA 200.7
ANTIMONY	EPA 204.2
ARSENIC	EPA 200.7
ARSENIC	EPA 206.2
ARSENIC	ASTM D2972-93(C)
BERYLLIUM	EPA 200.7
CADMIUM	EPA 200.7
CHROMIUM	EPA 200.7
COBALT	EPA 200.7
COPPER	EPA 200.7
IRON	EPA 200.7
LEAD	EPA 200.7
LEAD	EPA 239.2
MANGANESE	EPA 200.7
MERCURY	EPA 245.1
MOLYBDENUM	EPA 200.7
NICKEL	EPA 200.7
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
ORTHOPHOSPHATE	EPA 300.0
TOTAL PHOSPHORUS	EPA 365.2
CHEMICAL OXYGEN DEMAND	EPA 410.4
BIOCHEMICAL OXYGEN DEMAND	EPA 405.1
TOTAL CYANIDE	EPA 335.2
NON-FILTERABLE RESIDUE	EPA 160.2
OIL AND GREASE	EPA 413.1
TOTAL PHENOLICS	EPA 420.1
VOLATILE HALOCARBONS	EPA 624
VOLATILE AROMATICS	EPA 624
CHLORDANE	EPA 608
ALDRIN	EPA 608
DIELDRIN	EPA 608
DDD	EPA 608
DDT	EPA 608
HEPTACHLOR	EPA 608
HEPTACHLOR EPOXIDE	EPA 608
POLYCHLORINATED BIPHENYLS (WATER)	EPA 608

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. **Lab Order:** 0210114
Project: 16421 NB Harbor FEIR

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. **Lab Order:** 0210114
Project: 16421 NB Harbor FEIR

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. **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
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.	**Lab Order:**	0210114
Project:	16421 NB Harbor FEIR		

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.	**Lab Order:**	0210114
Project:	16421 NB Harbor FEIR		

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. **Lab Order:** 0210114
Project: 16421 NB Harbor FEIR

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
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.	**Lab Order:**	0210114
Project:	16421 NB Harbor FEIR		

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.	**Lab Order:**	0210114
Project:	16421 NB Harbor FEIR		
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.	**Lab Order:**	0210114
Project:	16421 NB Harbor FEIR		

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
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.	**Lab Order:**	0210114
Project:	16421 NB Harbor FEIR		

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.	**Lab Order:**	0210114
Project:	16421 NB Harbor FEIR		

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
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. **Lab Order:** 0210114
Project: 16421 NB Harbor FEIR

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
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. **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
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.	**Lab Order:**	0210114
Project:	16421 NB Harbor FEIR		

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
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.	**Lab Order:**	0210114
Project:	16421 NB Harbor FEIR		

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
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.	**Lab Order:**	0210114
Project:	16421 NB Harbor FEIR		

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.	**Lab Order:**	0210114
Project:	16421 NB Harbor FEIR		

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.	**Lab Order:**	0210114
Project:	16421 NB Harbor FEIR		

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.	**Lab Order:**	0210114
Project:	16421 NB Harbor FEIR		

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
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. **Lab Order:** 0210114
Project: 16421 NB Harbor FEIR

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.	**Lab Order:**	0210114
Project:	16421 NB Harbor FEIR		

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.	**Lab Order:**	0210114
Project:	16421 NB Harbor FEIR		

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
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: **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
RL - Reporting Limit; defined as the lowest concentration the laboratory can accurately quantitate.
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: **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
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 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

1987 15th ANNIVERSARY 2002 AMRO ENVIRONMENTAL LABS MERRIMACK, NH

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

Office: (603) 424-2022
Fax: (603) 429-8496

CHAIN-OF-CUSTODY RECORD

42957

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: Tom Hevner, Maguire Group, Inc. Foxboro, MA

FAX No.: 508-543-5157

Seal Intact? Yes No N/A

P.O. No:

Results Needed By:

GW-1*___ GW-2___ GW-3___

MCP Level Needed:

*= May require additional cost

Relinquished By	Date/Time	Received By
TBH	10/22/02 1430	W. H. Lavoie
W. H. Lavoie	10/23/02 1030	[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

4

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: 0210204.
Date Rec.: 10-22-02
Date Due: 11-07-02

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?		✓		4x1LGAU for Dioxin-None for PCB-cong using 2x1L for PCB
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: GG 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

qc/qcmemos/forms/samplerec Rev.18 06/00

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	Pest 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
ANTIMONY	EPA 200.7
ANTIMONY	EPA 204.2
ARSENIC	EPA 200.7
ARSENIC	EPA 206.2
ARSENIC	ASTM D2972-93(C)
BERYLLIUM	EPA 200.7
CADMIUM	EPA 200.7
CHROMIUM	EPA 200.7
COBALT	EPA 200.7
COPPER	EPA 200.7
IRON	EPA 200.7
LEAD	EPA 200.7
LEAD	EPA 239.2
MANGANESE	EPA 200.7
MERCURY	EPA 245.1
MOLYBDENUM	EPA 200.7
NICKEL	EPA 200.7
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
ORTHOPHOSPHATE	EPA 300.0
TOTAL PHOSPHORUS	EPA 365.2
CHEMICAL OXYGEN DEMAND	EPA 410.4
BIOCHEMICAL OXYGEN DEMAND	EPA 405.1
TOTAL CYANIDE	EPA 335.2
NON-FILTERABLE RESIDUE	EPA 160.2
OIL AND GREASE	EPA 413.1
TOTAL PHENOLICS	EPA 420.1
VOLATILE HALOCARBONS	EPA 624
VOLATILE AROMATICS	EPA 624
CHLORDANE	EPA 608
ALDRIN	EPA 608
DIELDRIN	EPA 608
DDD	EPA 608
DDT	EPA 608
HEPTACHLOR	EPA 608
HEPTACHLOR EPOXIDE	EPA 608
POLYCHLORINATED BIPHENYLS (WATER)	EPA 608

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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
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 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
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: *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	2.7
ENDRIN	3.1	2.5

Initial CCV: T22 Term. CCV: T23

INDA

	Initial Front	Initial Back	Term. Front	Term. 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

	Initial Front	Initial Back	Term. Front	Term. 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
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-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	50	130	0			
Heptachlor	0.0605	0.0064	µg/L	0.08	0	75.6	44	152	0			
Aldrin	0.08308	0.0064	µg/L	0.08	0	104	41	113	0			
Heptachlor epoxide	0.08113	0.0064	µg/L	0.08	0	101	33	126	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.	**Lab Order:**	0210204
Project:	16421 NBH FEIR DMMP		

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	S - Spike Recovery outside accepted recovery limits
J - Analyte detected below quantitation limits	R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank	E - Value above quantitation range
* - Value exceeds Maximum Contaminant Level	

AMRO Environmental Laboratories Corp.

Date: *21-Nov-02*

CLIENT: Maguire Group, Inc.
Lab Order: 0210204
Project: 16421 NBH FEIR DMMP

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
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-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.

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 PEIR 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
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-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
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 Sacramento
880 Riverside Parkway
West Sacramento, CA 95605-1500

Tel: 916 373 5600
Fax: 916 371 8420
www.stl-inc.com

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

Project No.: 16421
Project Name: NBH FEIR DMMP
Project State: MA
Project Manager:
Samplers (Signature): Graciela Ghiraldi
AMRO Project No.: 0210204.

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 2 ? 2002
INI: [illegible]

Send Results To: AMRO Environmental, 111 Herrick St, Merrimack, NH 03054
FAX No.: 603-429-8496
Seal Intact? Yes No N/A
P.O. No:
Results Needed By: STD
GW-1* ___ GW-2 ___ GW-3 ___
MCP Level Needed: ___
*= May require additional cost

Relinquished By	Date/ Time	Received By
Graciela Ghiraldi	15:30 10/23/02.	Bob Hawkes
Bob Hawkes	16:10 10-23-02	[illegible] 10/23/02

Ice

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'd to Burlington (RL)

qc/qcmemos/forms/amrococ/Rev.2 04/01/02

G2J240176
REC'D @ STL-SAC [signature] 10-24-02 0930

STL - Sacramento (916) 373 - 5600

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.

SEVERN TRENT SERVICES

STL Burlington

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.

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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

Michael F. Wheeler, Ph.D.
Laboratory Director

Enclosure

SEVERN TRENT SERVICES

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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.

NBH-208-WATER

Lab Name: STL BURLINGTON

Contract:

SDG No.: 90550

Lab Code: STLVT

Case No.:

Lab Sample ID: 507125

Matrix: WATER

Client: AMRO

Date Received: 10/24/02

% Solids:

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

Lab Name: STL BURLINGTON   Contract: SDG No.: 90550

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.*

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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 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 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
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 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

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

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 Herrick Street
Merrimack, NH 03054

Fax: (603) 429-8496

69

Project No.: 16421

Project Name: NBH FEIR DMYP

Project State: MA

Project Manager:

Samplers (Signature): Gracia Ghiraldi

AMRO Project No.: 0210204.

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	GW	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	

Send Results To:
AMRO Environmental
111 Herrick St
Merrimack, NH 03054

FAX No.: 603-429-8496

Seal Intact? Yes No N/A

P.O. No:

Results Needed By: STD

GW-1* GW-2 GW-3

MCP Level Needed:

*= May require additional cost

ICE

Relinquished By	Date/ Time	Received By
Gracia 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.

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Fedx Dioxins to Sacramento / TOC & PCB Fedex'd to Burlington (RL)

qc/qcmemos/forms/amrococ/Rev.2 04/01/02

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	BCV(AB) Metals	Dioxin/Furans	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	SED	✓	X												
NBH-201-2-SED	10/10/02	Sed	3x8oz		✓										X	X	X	
NBH-201-3-SED	10/10/02	Sed	3x8oz		✓										X			
NBH-202-1-SED	10/10/02	Sed	3x8oz		✓													FAST TURN
NBH-202-2-SED	10/10/02	Sed	3x8oz		✓													FOR
NBH-202-3-SED	10/10/02	Sed	3x8oz		✓		X	X	X	X	X	X	X	X				Metals,
NBH-203-1-SED	10/10/02	Sed	3x8oz		✓													Results will
NBH-203-2-SED	10/10/02	Sed	3x8oz		✓													dictate of
NBH-203-3-SED	10/10/02	Sed	3x8oz		✓													analysis.
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:
Results Needed By:
GW-1* ___ GW-2 ___ GW-3 ___
MCP Level Needed:
*= 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 ___ OF 3

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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 State:
Project Manager: TBH
Samplers (Signature): [signature]
AMRO Project No.: 0210114

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/Furans	PCB Congeners	Pest	PAH	TOC-9060	Water Content	Grain/Hydro	% Total Sol.	Nickel	Zinc	Copper		Remarks
NBH-204-4-SED	10/10/02	Sed	3x8oz	X		X									X	X	X		
NBH-204-3-SED	10/10/02	Sed	3x8oz	↓		X									X	X	↓		
NBH-205-1-SED	10/10/02	Sed	3x8oz	↓		X									X	X	↓		
NBH-205-2-SED	10/10/02	Sed	3x8oz	↓		X									X	X	↓		
NBH-205-3-SED	10/10/02	Sed	3x8oz	↓		X									X	X	↓		
NBH-205-4-SED	10/10/02	Sed	3x8oz	↓		X									X	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: Tom Heuver, Maguire Group, Inc.
FAX No.: 508-543-5157
Seal Intact? Yes No N/A
P.O. No:
Results Needed By:
GW-1* ___ GW-2 ___ GW-3 ___
MCP Level Needed: ___
*= May require additional cost.

Relinquished By	Date/Time	Received By
[signature]	10-11-02 13:30	[signature]

PRIORITY TURNAROUND TIME AUTHORIZATION
Before submitting samples for expedited TAT, you must have requested in advance and received a coded **AUTHORIZATION NUMBER.**
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AUTHORIZATION No. ___ BY: ___

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White: Lab Copy Yellow: Accompanies Report Pink: Client Copy SHEET 2 OF 3

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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 State:
Project Manager: TBH
Samplers (Signature): [signature]
AMRO Project No.: 0210114

Matrix: A= Air, S= Soil, GW= Ground W., WW= Waste W., DW= Drinking W., O= Oil, Other= Specify

Analysis Required:

Sample ID	Date/Time Sampled	Matrix	Total # of Cont. & Size	Comp	Grab	RCRA(8) Metals	Dioxin/Furan	PCB Congeners	Pest.	PAH	TOC 9060	Water Content	Grain Hydro	% 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	10/11/02	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: Tom Hevner, Maguire Group, Inc.
FAX No.: 508.543.5157
Seal Intact? Yes No N/A
P.O. No:
Results Needed By:
GW-1* GW-2 GW-3
MCP Level Needed:
*= May require additional cost

Relinquished By	Date/Time	Received By
[signature]	13:30 10-11-02	[signature]

PRIORITY TURNAROUND TIME AUTHORIZATION
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AUTHORIZATION No. BY:

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White: Lab Copy Yellow: Accompanies Report Pink: Client Copy

SHEET 3 OF 3

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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
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

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
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: *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	S - Spike Recovery outside accepted recovery limits
J - Analyte detected below quantitation limits	R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank	E - Value above quantitation range
H - Method prescribed holding time exceeded	# - 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	3.1
ENDRIN	4.0	3.7

Initial CCV: T15 Term. CCV: T16

INDA

	Initial CCV Front	Initial CCV Back	Term. CCV Front	Term. CCV 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

	Initial CCV Front	Initial CCV Back	Term. CCV Front	Term. CCV 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.[	2nd INDA:	C:\HPCHEM\1\DATA\02OCT22\T22OCT22.D
1st INDB:	C:\HPCHEM\1\DATA\02OCT22\T22OCT02.[	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.

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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.

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 0046.

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 [signature]

Michael F. Wheeler, Ph.D.
Laboratory Director

Enclosure

Wet Chemistry

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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

Contract:

SDG No.: 90425

Lab Code: STLVT

Case No.:

Lab Sample ID: 506124

Matrix: SEDIMENT

Client: AMRO

Date Received: 10/18/02

% Solids: 63.3

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

Contract:

SDG No.: 90425

Lab Code: STLVT

Case No.:

Lab Sample ID: 506125

Matrix: SEDIMENT

Client: AMRO

Date Received: 10/18/02

% Solids: 52.6

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

Contract:

SDG No.: 90425

Lab Code: STLVT

Case No.:

Lab Sample ID: 506124

Matrix: SEDIMENT

Client: AMRO

Date Received: 10/18/02

% Solids: 63.3

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

Contract:

SDG No.: 90425

Lab Code: STLVT

Case No.:

Lab Sample ID: 506125

Matrix: SEDIMENT

Client: AMRO

Date Received: 10/18/02

% Solids: 52.6

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

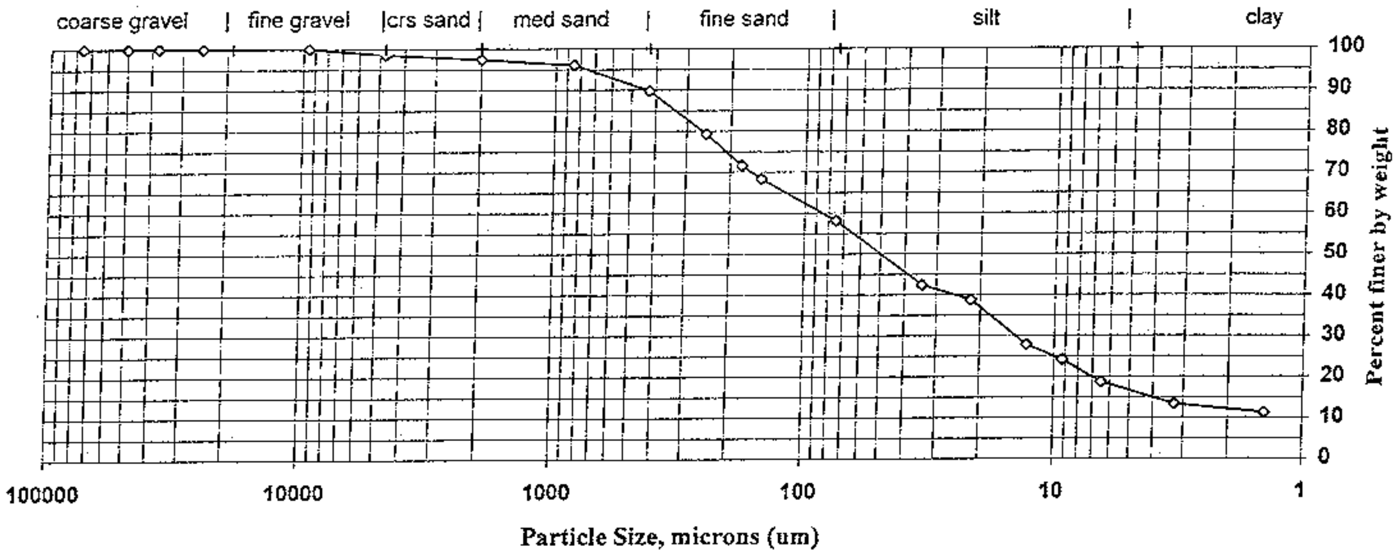
Particle Size of Soils by ASTM D422

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%		Maximum Particle Size:	9.5 mm
Specific Gravity:	2.65	(assumed)	Shape (> #10):	rounded
Non-soil mass:	NA		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

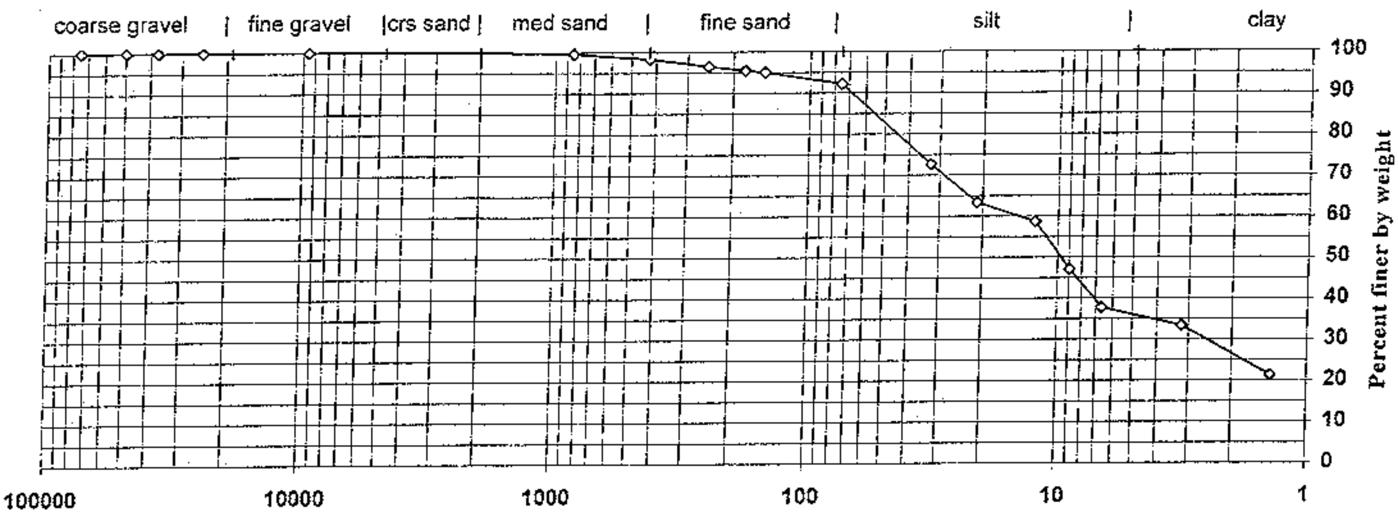
Sample preparation method: D2217

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

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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 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
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 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
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 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
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 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) 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 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

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	(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 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				
21				
22				
23				
24				

COMMENTS: *-Sample extracts received additional sulfur clean-up. The associated clean-up blank is PIBLK_SCU.

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

…540

Office: (603) 4…22
Fax: (603) 429-8496

Project No.: 16421
Project Name: NB HARBOR FEIR
Project State: MA
Project Manager:
Samplers (Signature): CC
AMRO Project No.: 0210141

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		✓	✓	✓	✓	✓	✓	

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: AMRO ENVIRONMENTAL 111 HERRICK ST MERRIMACK NH 03054
FAX No.: 603 429 8496

Seal Intact? Yes No N/A
P.O. No:
Results Needed By: STD

GW-1* ____ GW-2 ____ GW-3 ____
MCP Level Needed: ____
*= 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	[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. Miller 10/17/02 received: PDZ Bon 10/18/02 0930

CCe

0040

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,

for

Jill Kellmann
Project Manager

TABLE OF CONTENTS

STL SACRAMENTO PROJECT NUMBER G2J180250

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

<u>WO#</u>	<u>Sample #</u>	<u>Client Sample ID</u>	<u>Sampling Date</u>	<u>Received Date</u>
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.: 16421
Project Name: NB HARBOR FEIR
Project State: MA
Project Manager:
Samplers (Signature): CC
AMRO Project No.: 0210141

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 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

RECEIVED IN GOOD CONDITION UNDER COC
OCT 18 2002
INI. ar

Send Results To: AMRO ENVIRONMENTAL, 111 HERRICK ST, MERRIMACK NH 03054
FAX No.: 603 429 8496
Seal Intact? Yes No N/A
P.O. No:
Results Needed By: STD
GW-1* ___ GW-2 ___ GW-3 ___
MCP Level Needed:
*= May require additional cost

Relinquished By	Date/ Time	Received By
C Cearley	10/17/02 9:30	Bob Hawkins
Bob Hawkins	10/17/02 1545	[illegible 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 ___ OF ___

~~Relinquished~~ RELINQUISHED D. [signature] 10/17/02 16:50 rec'd By: [signature] 10-18-02 1115

[initials]

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
MS Lot-Sample #: C2J170335-007
Date Sampled...: 10/15/02
Prep Date......: 10/25/02
Prep Batch #...: 2298333
Dilution Factor: 1

Work Order #...: E98VC1AC-MS
E98VC1AD-MSD
Date Received..: 10/17/02
Analysis Date..: 11/02/02
% Moisture.....: 0.0

Matrix.........: SOLID

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
MS Lot-Sample #: C2J170335-007
Date Sampled...: 10/15/02
Prep Date......: 10/25/02
Prep Batch #...: 2298333
Dilution Factor: 1

Work Order #...: E98VC1AC-MS
E98VC1AD-MSD
Date Received..: 10/17/02
Analysis Date..: 11/02/02
% Moisture.....: 0.0

Matrix.........: SOLID

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		
			MARINE: SANDY SILT; organic Silt, 10-15% fine Sand, dark gray, saturated.			
	3.3-5			S-3		
5.0						
			GRAVELLY SAND; 10-15% fine sub-rounded Gravel, coarse to fine Sand, brown, saturated.			
10.0						
			Bottom of Vibracore - 10.5'			
15.0						
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			S-2		
			MARINE: SILTY CLAY; non-plastic Clay, organic Silt, gray, saturated.			
	4-5.3		**MISCELLANEOUS FILL: SILTY SAND;** medium to fine Sand, 10-15% organic non-plastic fines, shell and metal fragments.	S-3		
5.0						
			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 ELEVATIOI	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 ELEVATIOI	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		
	4-6		**MARINE: SILT;** SAME AS ABOVE.	S-3		
5.0						
	6-8		**MARINE: SILT;** SAME AS ABOVE.	S-4		
10.0						
			Bottom of Vibracore - 12.5'			
15.0						
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 ELEVATION	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						
			Bottom of Vibracore - 12'			
15.0						
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

CZM

Submitted by:

Maguire Group Inc.

MAGUIRE GROUP

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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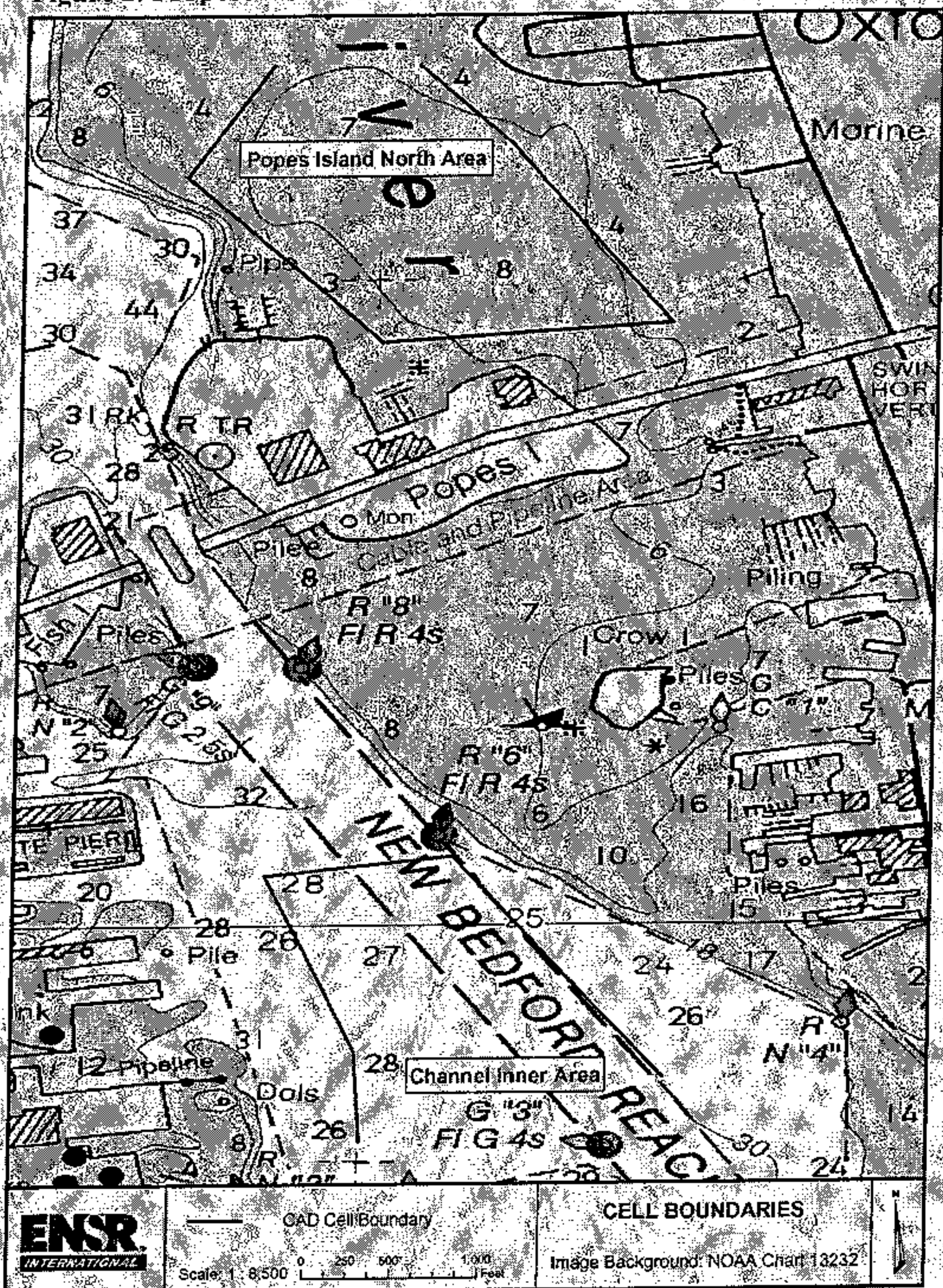
INTRODUCTION

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.

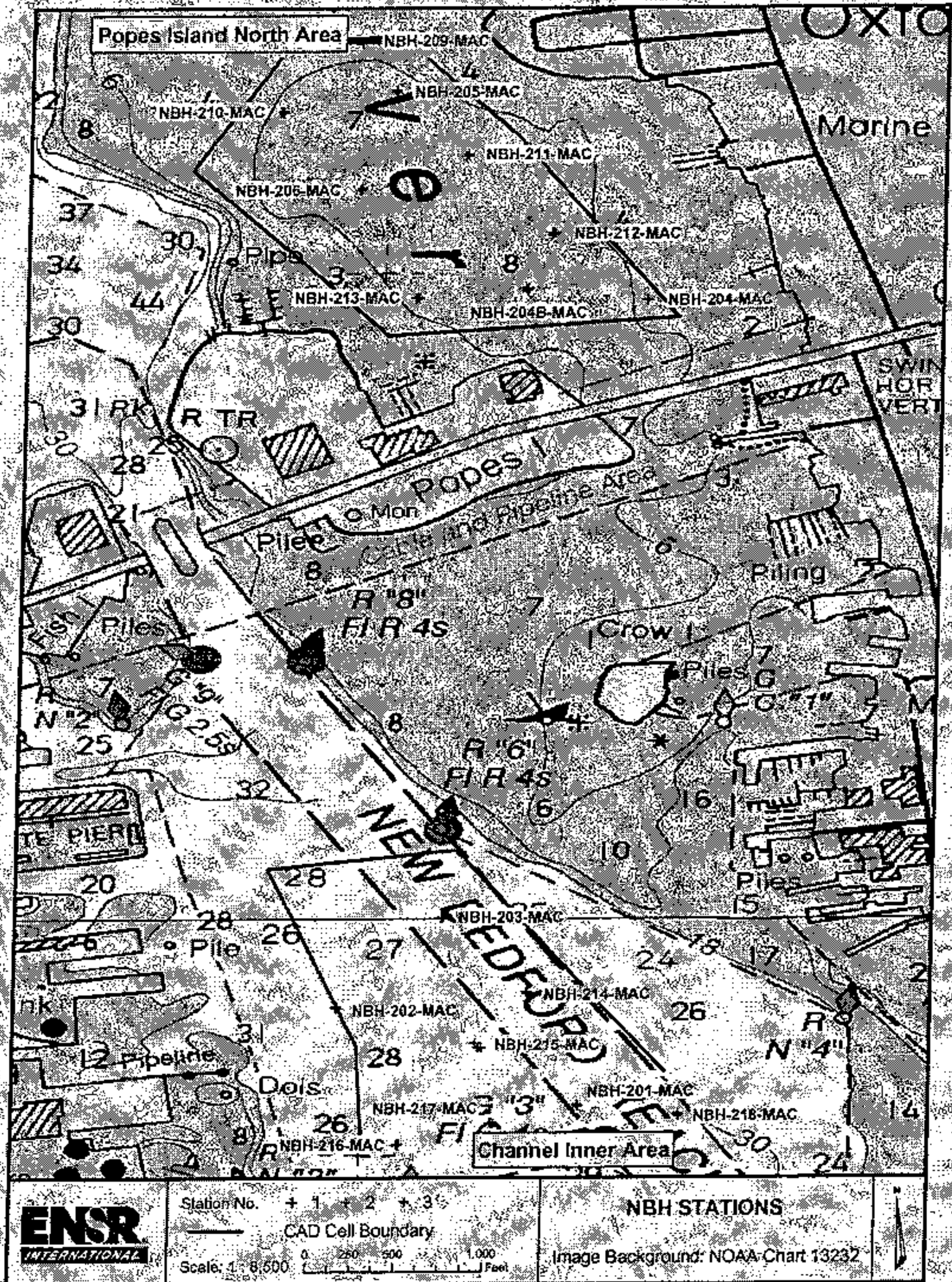
Table 1. Coordinates for stations sampled in the proposed CAD Cell sites. Bold face type=Popes Island North; regular type=Channel Inner.				
Station Name	Easting	Northing	Latitude (°N)	Longitude (°W)
NBH-201-MAC	817092.48	2690922.85	41.63046564	-70.91136496
NBH-202-MAC	816051.96	2691482.56	41.63202124	-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.



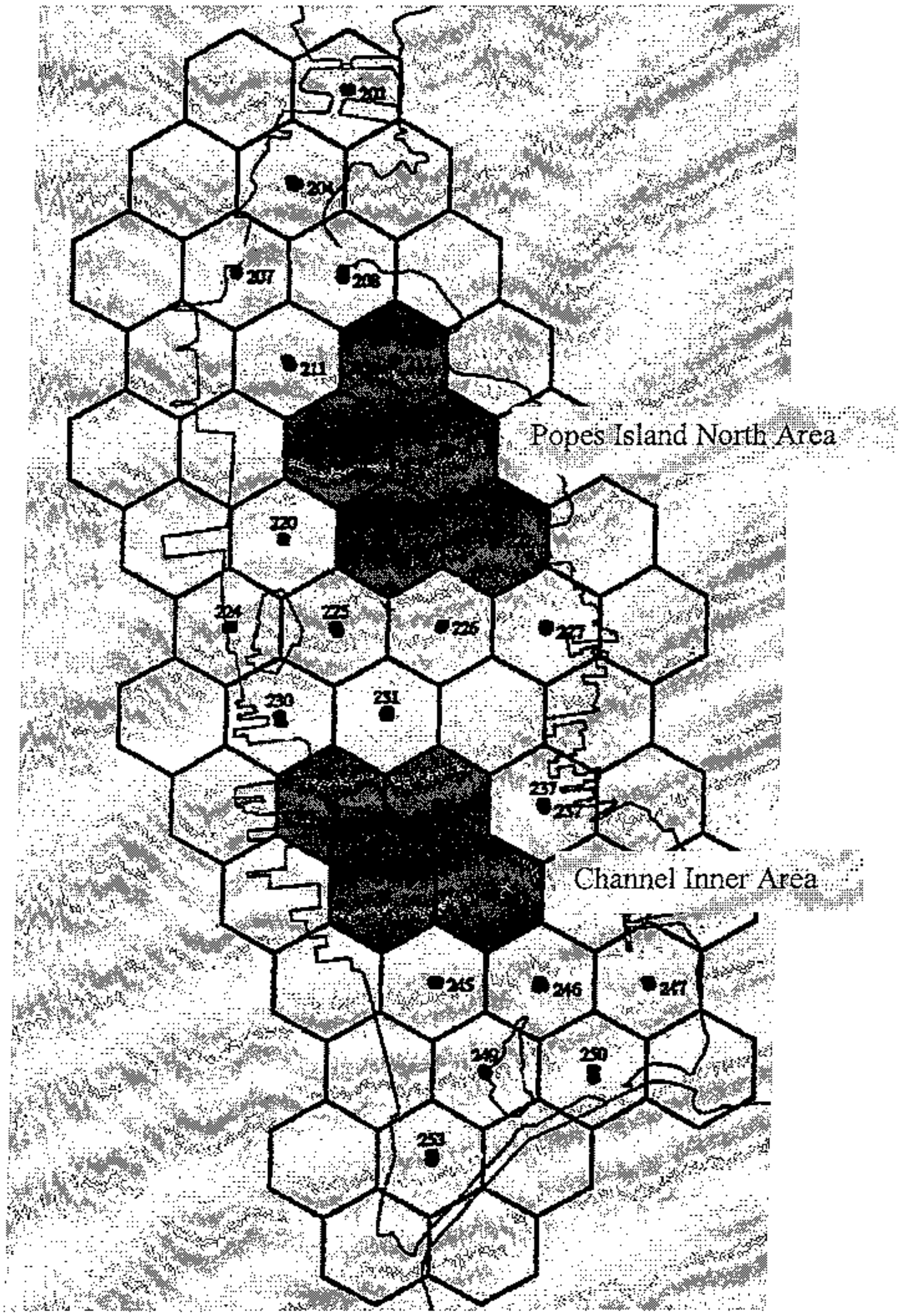


Figure 3. Map showing station numbering system for New Bedford Harbor Long Term Benthic Monitoring (USACE), Section 2. Areas highlighted in red are those previously sampled by the USACE in the vicinity of the proposed CAD cell locations.

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.

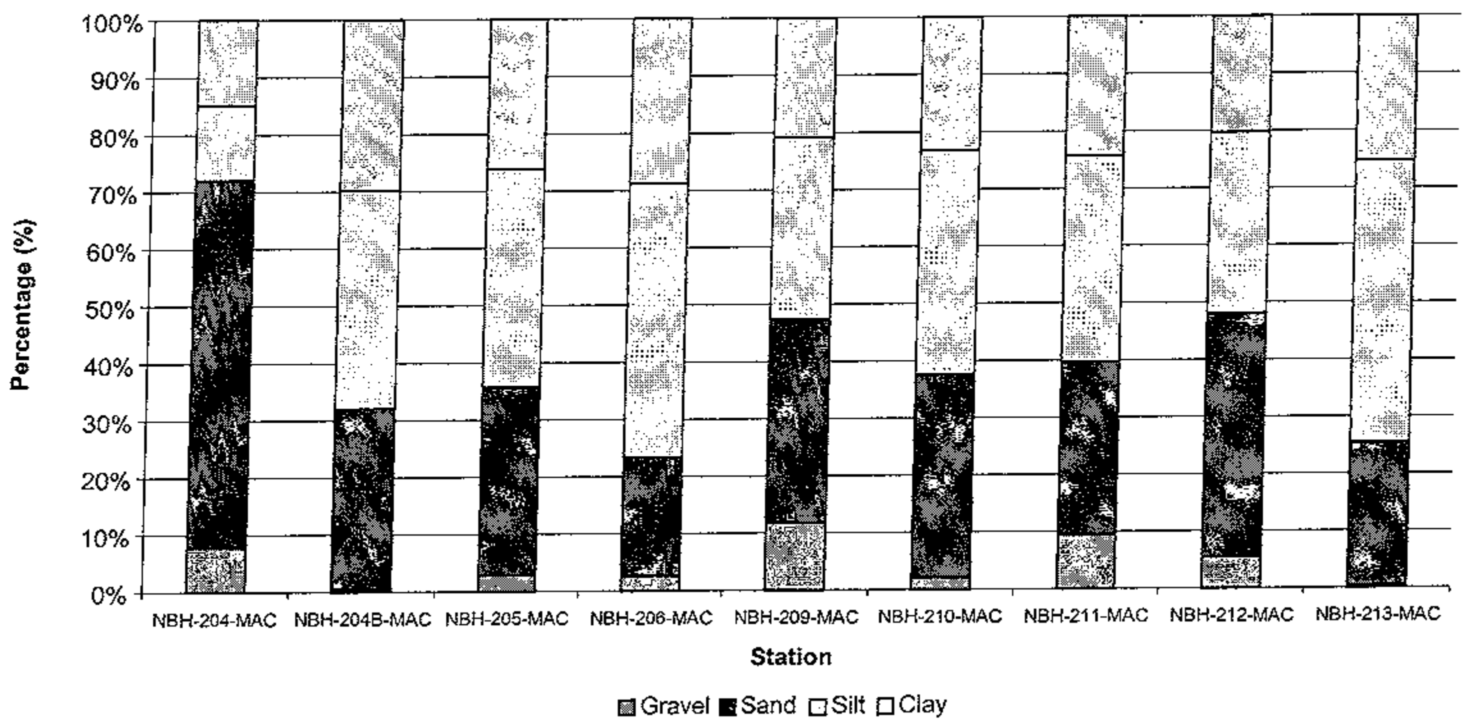


Figure 5. Sediment Composition at proposed Channel Inner CAD site.

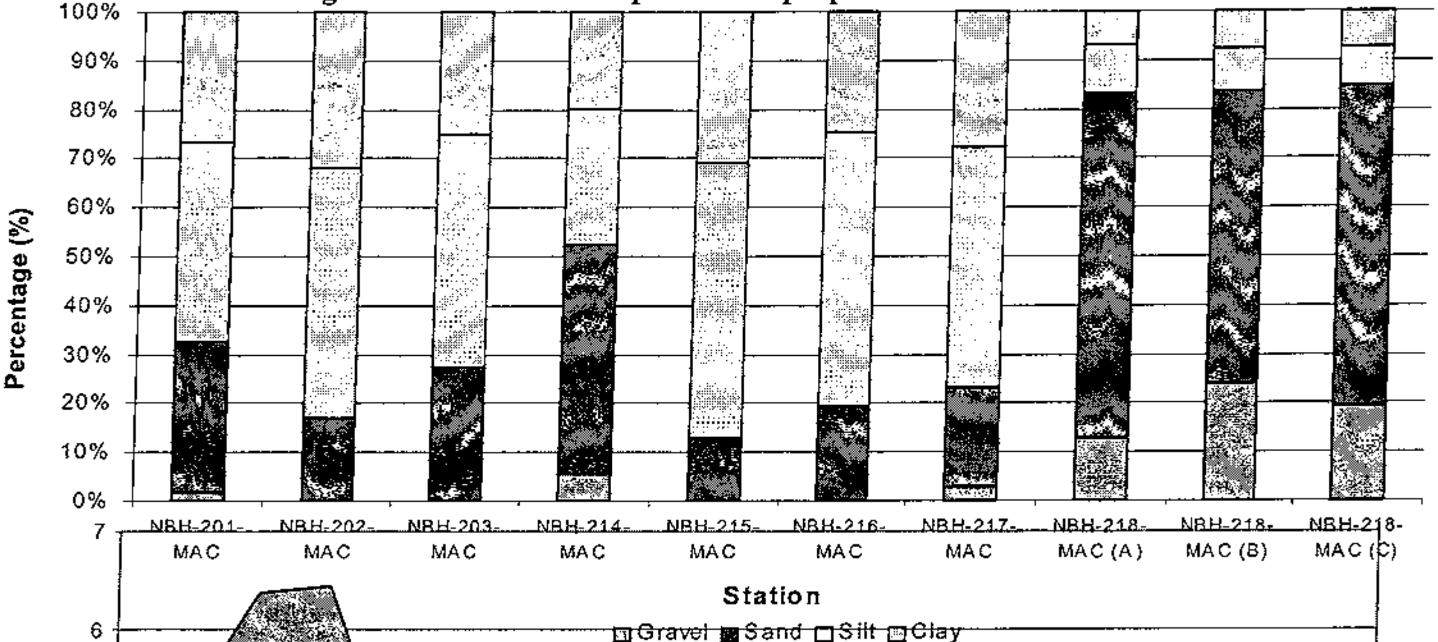


Figure 6. Total organic carbon from Popes Island North and Channel Inner proposed CAD

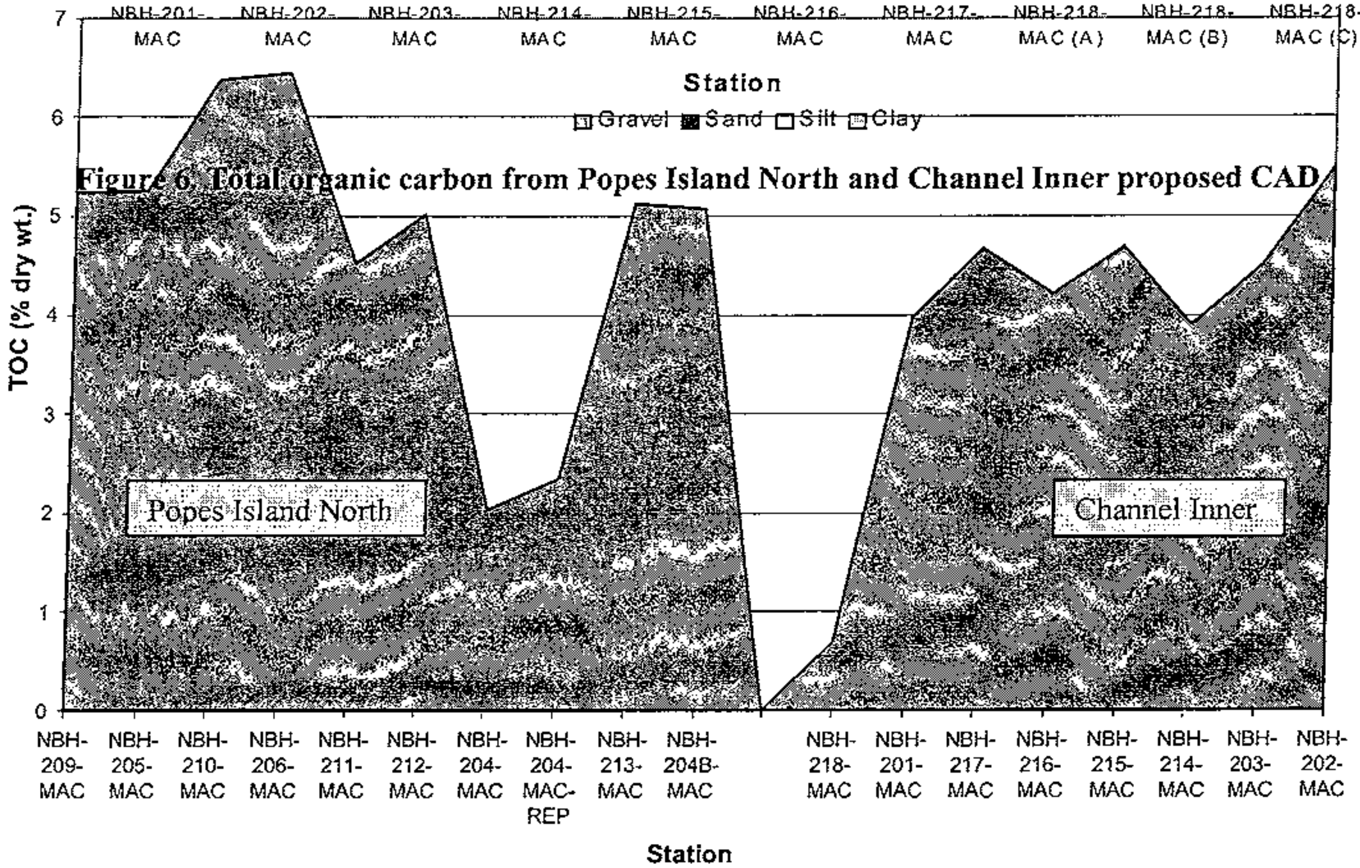


Table 2 . Sediment grain-size data from the two proposed CAD cell site stations.																		
	%	%	%	%	PHI PERCENT										Total Sample			Coarse Only
Station Name	Gravel	Sand	Silt	Clay	>-5	-4	-3	-2	-1	0	1	2	3	4	Mean	Std Dev.	Mean	Std Dev.
NBH-201-MAC	1.7	31.0	40.4	26.9	0.00	0.00	0.00	0.00	1.68	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	9.63	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

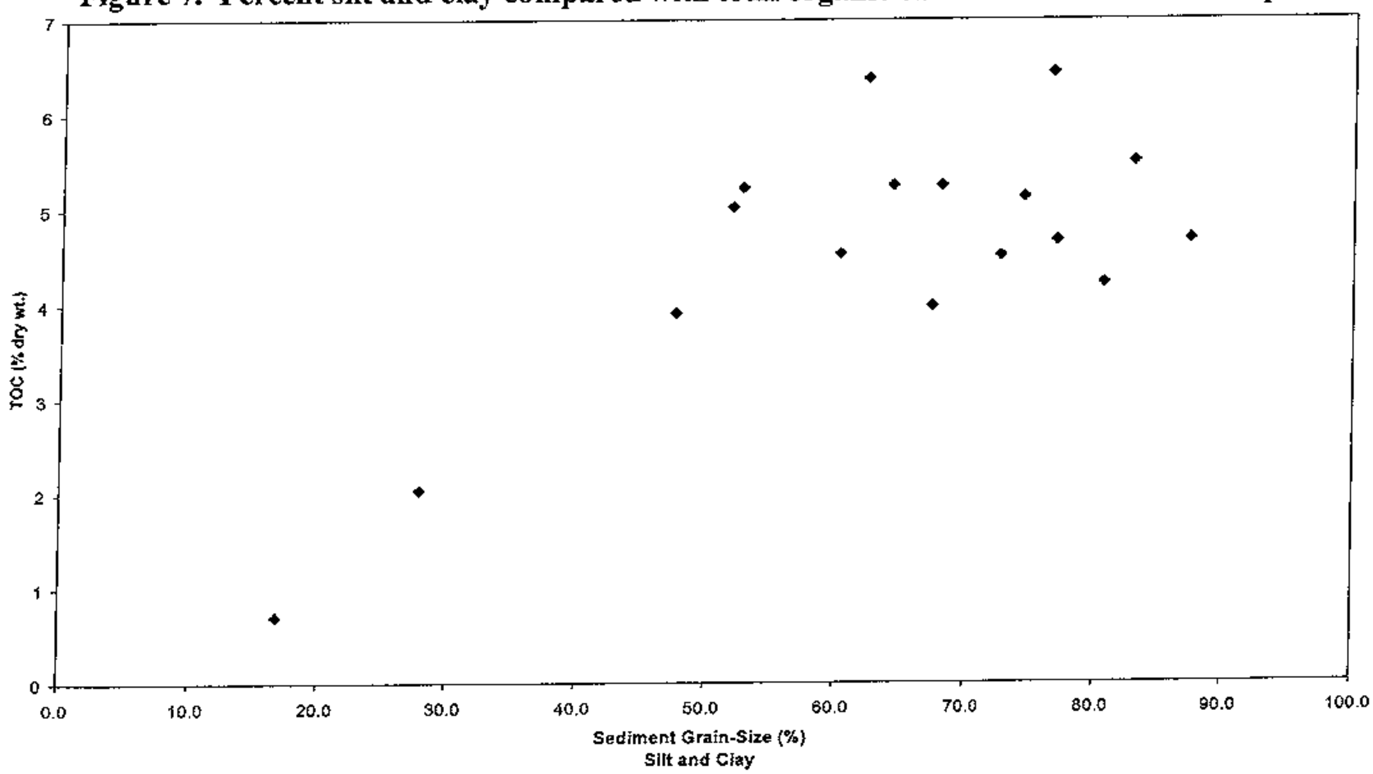
Table 3. Total Organic Carbon (TOC) data from each station taken at the two proposed CAD cell sites.			
Popes Island North	**TOC (% dry weight)**	**Channel Inner**	**TOC (% dry weight)**
NBH-204-MAC	2.04	NBH-218-MAC	0.70
NBH-204-MAC-REP	2.35	NBH-201-MAC	3.98
NBH-211-MAC	4.53	NBH-214-MAC	3.91
NBH-212-MAC	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
Tubificidac 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

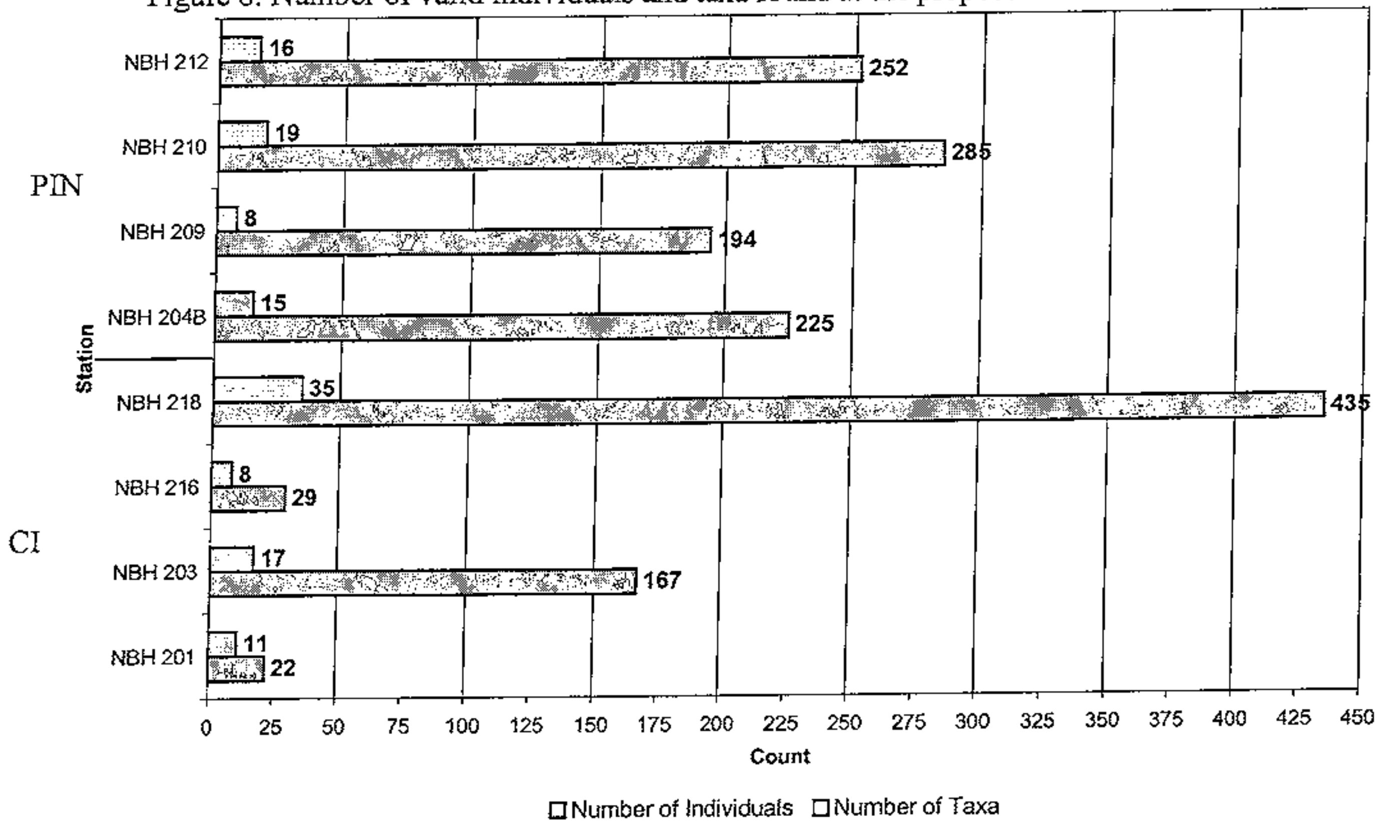
P=polychaete; O=oligochaete; N=nemertean; G=gastropod; B=bivalve

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.

Taxon	NODC Code	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
		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

REFERENCES CITED

ENSR. 2001. New Bedford Harbor Long Term Monitoring Survey III: Summary Report. Contract number DACW33-96-D-0004. 35 pp. + Appendices.

ENSR, 2001. Boston Harbor Navigational Improvement Project (BHNIP). Prepared for Massachusetts Coastal Zone Management. 56 pp. + Appendices.

Environmental Protection Agency (EPA). 1991. EMAP. Near-Coastal Laboratory Procedures Macrobenthic Community Assessment. Prepared by Versar, Inc.

Lloyd, H., Zar, J.H., and Karr, J.R. 1968. On the calculation of information-theoretical measures of diversity. American Midland Naturlaist. 79: 257-272.

Magurran, A.E. 1988. Ecological Diversity and Measurement. Princeton University Press, Princeton. 179 pp.

Maguire Group, Inc. 2002. Draft Environmental Impact Report for the Dredged Material Management Plan (#EOEA 11669). Prepared for Massachusetts Coastal Zone Management, City of New Bedford and Town of Fairhaven. 393 pp. + Appendices.

Nelson, W.G., B.J. Bergen, S.J. Benyi, G. Morrison, R.A. Voyer, C.J. Strobel, S. Rego, G. Thursby and C.E. Pesch. 1996. New Bedford Harbor Long Term Monitoring Assessment Report: Baseline Sampling. U.S. Environmental Protection Agency, National Health and Environmental Effects Research Laboratory, Atlantic Ecology Division, Narragansett, RI. EPA/600/R-966/097.

Pielou, E.C. (1966). The measurement of diversity in different types of biological collections. Journal of Theoretical Biology. 13: 131-144.

Rhoads, D.C. and J.D. Germano. 1982. Characterization of organism-sediment relations using sediment profile imaging: An efficient method of Remote Ecological Monitoring of the Seafloor (REMOTS® system). Marine Ecology Progress Series 8: 115-128.

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

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MAGUIRE GROUP

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

Submitted to:

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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.

REFERENCES CITED

Valente, R.M., Swanson, M.C. and C.L. Seidel. 1999. Habitat characterization of the DMMP candidate aquatic disposal sites. SAIC Report No. 463.

ENSR. 2003. Draft benthic infaunal analysis for the New Bedford/Fairhaven Harbor Dredged Material Disposal Plan #11669, Confined Aquatic Disposal (CAD). ENSR #04391010.

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

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MAGUIRE GROUP

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:

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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 ± 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.

References

Nelson, W.G., R.J.Pruell (SAIC) and D.J. Hansen (EPA). 1991. Monitoring plan for remediation of the first operable unit ("hot spot") at the New Bedford Harbor Superfund Site. Document prepared for EPA Region 1 and the US Army Corp. of Engineers, New England Division.

Applied Science Associates. 2001. Preliminary dredged material transport modeling in New Bedford Harbor. ASA Report 01-100.

Applied Science Associates. 2002. Memorandum from Craig Swanson, Hyun-Sook Kim (ASA) to Hank Merrill (Maguire Group Inc.). Description of Field Data Requirements for Modeling the Dispersion of Sediment and Contaminants During Dredged Disposal Operations in New Bedford Harbor. 25 September 2002.

Ho. K.T., R.A. McKinney, A. Kuhn, M.C. Pelletier, R.M. Burgess. Identification of acute toxicants in New Bedford Harbor Sediments. Environmental Toxicology and Chemistry. 16: 551-557.

Lecco, Steven. 1998. Summary Tables for New Bedford/Fairhaven Sediment Chemistry Results. Massachusetts Dredged Material Management Plan MGI # 14912. October, 1998.

Miller, D.C., S. Poucher, J.A. Cardin and D. Hansen. 1990. The acute and chronic toxicity of ammonia to marine fish and a mysid. Arch. Environ. Contam. Toxicol. 19: 40-48.

National Biological Service. 1996. Sediment porewater toxicity survey and Phase I Sediment Toxicity Identification Evaluation studies in Lavaca Bay, Texas. Corpus Christi, TX.

Nelson, W.G., R.J.Pruell (SAIC) and D.J. Hansen (EPA). 1991. Monitoring plan for remediation of the first operable unit ("hot spot") at the New Bedford Harbor Superfund Site. Document prepared for EPA Region 1 and the US Army Corp. of Engineers, New England Division.

NOAA, 1993. Sampling and Analytical Methods of the National Status and Trends Program National Benthic Surveillance and Mussel Watch Projects, 1984-1992. NOAA Tech Memo NOS ORCA 71. July.

NOAA, 1998. National Oceanic and Atmospheric Administration, 1998. Sampling and Analytical Methods of the National Status and Trends Program Mussel Watch Project: 1993-1996 Update, NOAA Technical Memorandum NOS ORCA 130

U.S. EPA. 1997. United States Environmental Protection Agency. June 1997. Test Methods for Evaluating Solid Waste. Physical/Chemical Methods. EPA SWL~846, 3rd edition, including Final Update III. U.S. EPA, Washington, D.C.

Office of Coastal Zone Management. 2002. Dredged Material Management Plan (DMMP) Draft Environmental Impact Report (DEIR) for New Bedford and Fairhaven, MA. Prepared under EOEA No. 11669 to Maguire Group. April.

SAIC 1993. Toxicity testing to support the New York/New Jersey Harbor Site specific criteria study. Science Applications Intl. Corp. Final Report to EPA. Contract No. 68-C8-0066. Work Assignment C-4-94. Internal Report # 1037.

SAIC. 1993. Draft data report on comparative sensitivity of four amphipod species to aqueous ammonia. Submitted to USEPA. EPA contract No. 68-CO-0044. Prepared by Science Applications International Corporation, Narragansett, RI. 30 pp.

US EPA. 1991. Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms. EPA/600/4-90/027.

U. S. Environmental Protection Agency and United States Army Corps of Engineers. 1998. "Evaluation of dredged material proposed for inland disposal: Testing manual," Washington, DC.

U. S. Environmental Protection Agency and United States Army Corps of Engineers. 1991. "Evaluation of dredged material proposed for ocean disposal: Testing manual," EPA/503R 91/001 Washington, DC.

EPA-823-B-94-001 ..."Interim Guidance on Determination and Use of Water-Effect Ratios for Metals," February 1994.

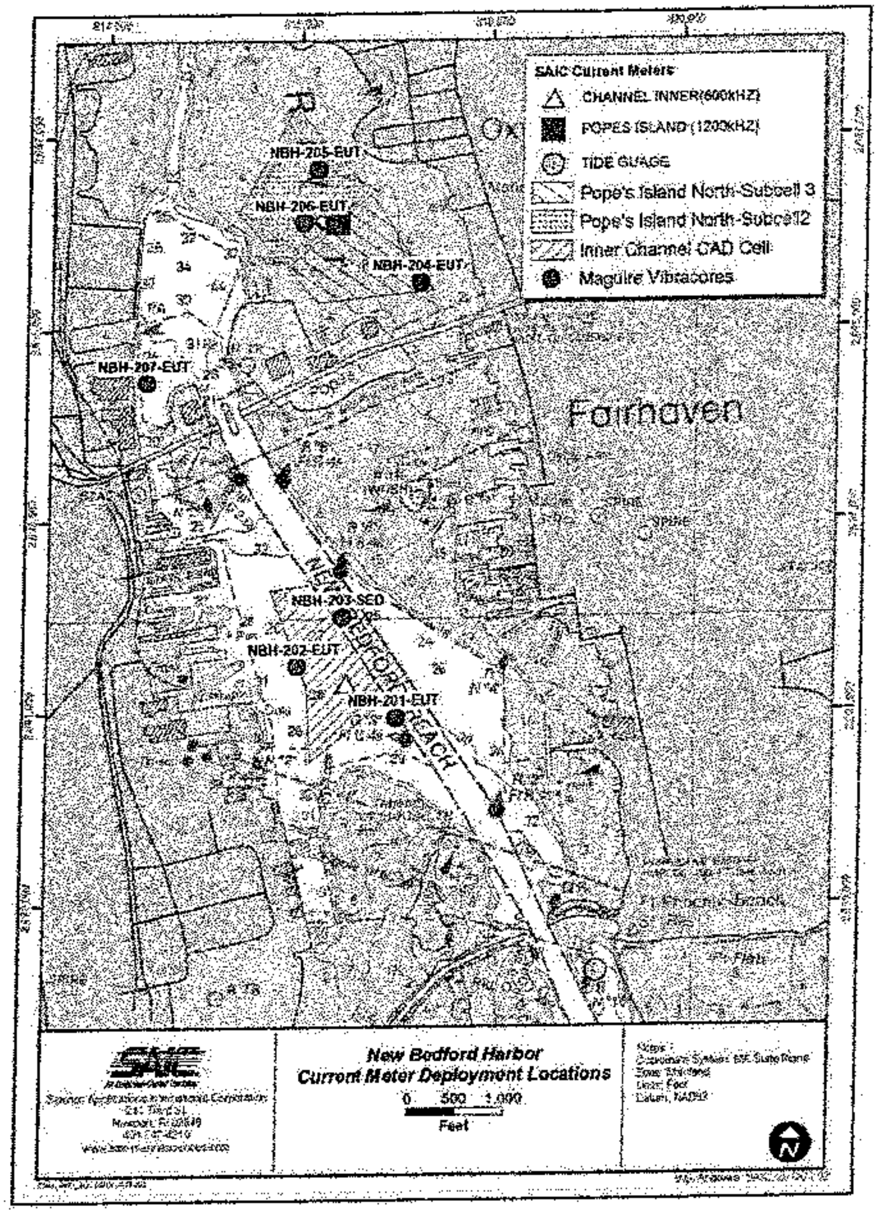


Figure 1. New Bedford Harbor stations selected for the Site Specific Water Quality Criteria Assessment Study (denoted as stations sampled synoptically for sediment core characterization- 'Maguire Vibracores').

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

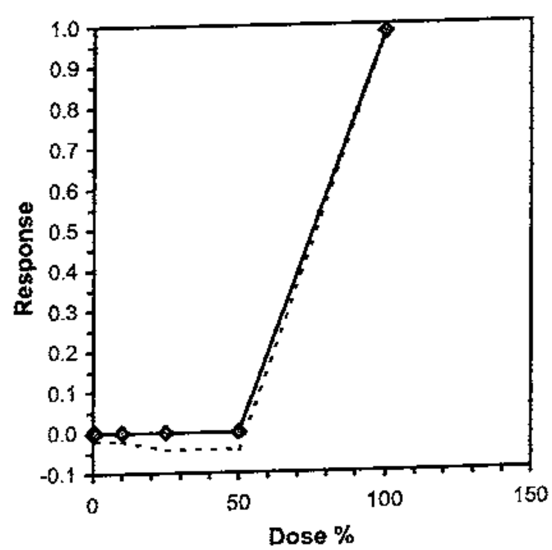
Conc-%	1	2	3	4	5
S-Control	10.000	10.000	9.000	9.000	10.000
I-Control	10.000	10.000	10.000	10.000	10.000
1	9.000	10.000	10.000	10.000	10.000
10	10.000	10.000	10.000	10.000	9.000
25	10.000	10.000	10.000	10.000	10.000
50	10.000	10.000	10.000	10.000	10.000
100	0.000	0.000	1.000	0.000	0.000

			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				



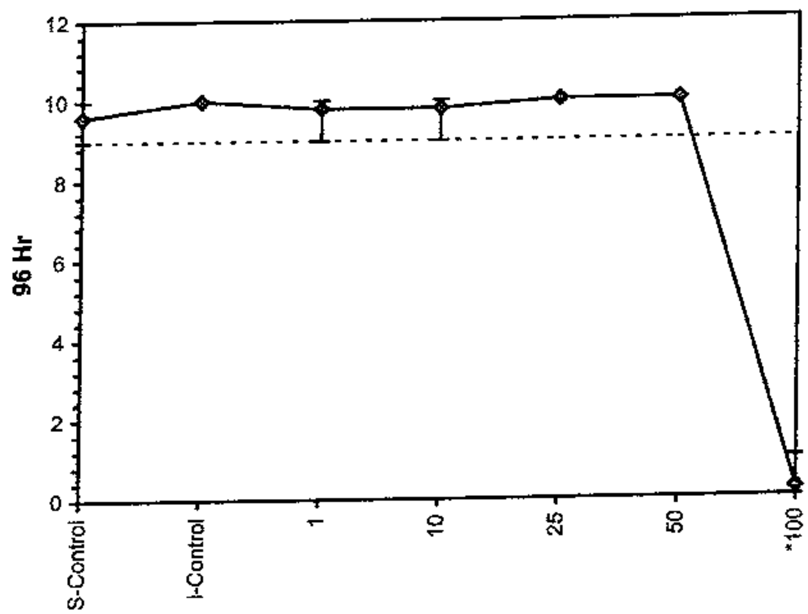
ToxCalc v5.0.23

Reviewed by:_____

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
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CZM

Submitted by:

Maguire Group Inc.

MAGUIRE GROUP

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
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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 ($4 \pm 2^{\circ}$ 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.

Sequential Treatments

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., Al^{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.
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> 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.

<u>Results for the Spiked Sample</u>

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.

References

Adams and Slaughter-Williams. 1988. The effect of PCBs (Aroclors 1254 and 1016) on fertilization and morphology in *Arbacia punctulata.* Water, Soil and Air Pollution.38:299-310.

Bay, S. R. Burgess and D. Nacci. Status and Applications of echinoid (phylum Echinodermata) toxicity test methods. ASTM Standard Tech. Publication 1179. 1993. pp 281-286.

Ho. K.T., R.A. McKinney, A. Kuhn, M.C. Pelletier, R.M. Burgess. 1997. Identification of acute toxicants in New Bedford Harbor Sediments. Environmental Toxicology and Chemistry. 16: 551-557.

Ho, K.T., Kuhn, A., Pelletier, MC. Hendricks,TL and Helmstetter, A. 1999. pH dependent toxicity of five metals to three marine organisms. 14: 235-240.

Leckie, J.O. and J.A. Davis. 1979. Aqueous Environmental Chemistry of Copper. In: Copper in the Environment. Part 1: Ecological Cycling. Jerome Nriagu (Ed.). pp 89-121. John Wiley and Sons.

Lussier, S.M., W.S. Bootman, S. Poucher, D. Champlin and A. Helmstetter. 1999. Comparison of dissolved and total metals concentrations from acute tests with saltwater organisms. Environmental Toxicology and Chemistry, 18: 889-898.

Miller, D.C., S. Poucher, J.A. Cardin and D. Hansen. 1990. The acute and chronic toxicity of ammonia to marine fish and a mysid. Arch. Environ. Contam. Toxicol. 19: 40-48.

Nacci, D., U. Jackim and R. Walsh. 1986. Comparative evaluation of three rapid marine toxicity tests: sea urchin early embryo growth tests, sea urchin sperm cell toxicity test and Microtox. Environmental Toxicology and Chemistry. 5: 521-525.

National Biological Service. 1996. Sediment SPP toxicity survey and Phase I Sediment Toxicity Identification Evaluation studies in Lavaca Bay, Texas. Corpus Christi, TX.

Nelson, W.G., R.J.Pruell (SAIC) and D.J. Hansen (EPA). 1991. Monitoring plan for remediation of the first operable unit ("hot spot") at the New Bedford Harbor Superfund Site. Document prepared for EPA Region 1 and the US Army Corp. of Engineers, New England Division.

SAIC. 1993. Toxicity testing to support the New York/New Jersey Harbor Site specific criteria study. Science Applications Intl. Corp. Final Report to EPA. Contract No. 68-C8-0066. Work Assignment C-4-94. Internal Report # 1037.

U.S. EPA. 1991. Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms. EPA/600/4-90/027.

U. S. Environmental Protection Agency and United States Army Corps of Engineers. 1991. "Evaluation of dredged material proposed for ocean disposal: Testing manual," EPA/503R 91/001 Washington, DC.

US EPA. 1996. Marine Toxicity Identification Evaluation (TIE), Phase I Guidance Document. EPA/600/R-096/054. US EPA Office of Research and Development.

U. S. Environmental Protection Agency and United States Army Corps of Engineers. 1998. Evaluation of dredged material proposed for inland disposal: Testing manual, Washington, DC.

Figure 1. Simplified Flow Diagram for Sequential TIE: Fractionation, Testing and Interpretation

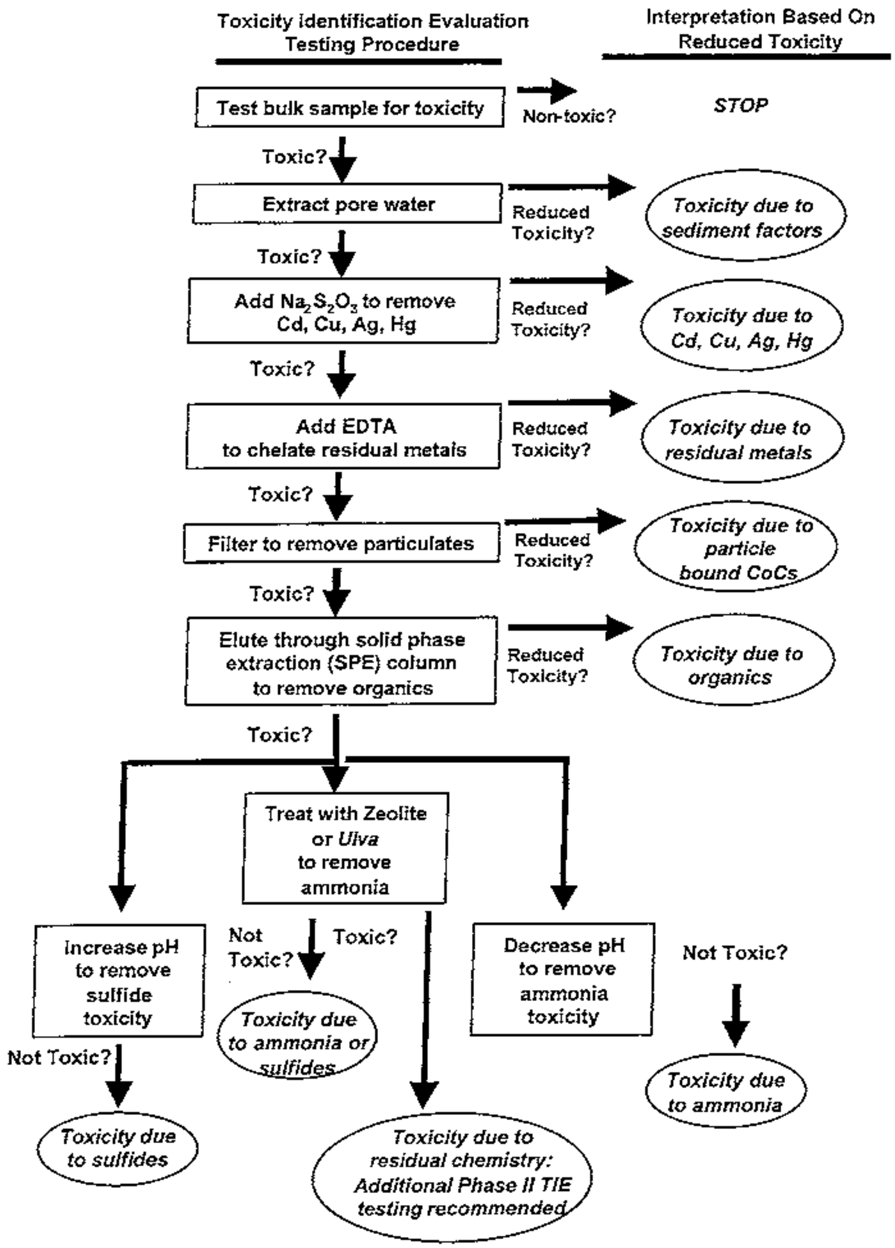

Table 1. Species-specific elutriate Hazard Quotients for chemical exposures to *Americamysis bahia* and *Arbacia punctulata* exposed to New Bedford Harbor Suspended Particulate Phase samples.

	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).

Aquatec Biological Sciences

Ecology · Environmental Toxicology · Natural Resource Assessments · Microbiology

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

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 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 / 25	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

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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: 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:

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

Science Applications International Corporation

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 Poucher	Project Name: New Bedford	Carrier: Fed Ex	obtained / 500 mL
Address: 221 Third street		Airbill Number: 8383 0250 4326	1 gal / hype
City/State/Zip: Newport RI 02840	Project Number:	Date Shipped: 10/29/02	
Telephone: (401) 847-4210	Sampler Name(s): John Williams (SPP Prep)		
Facsimile:			
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	10/24/02	14:00			SPP Clear	TIE Manipulations		2 (1 full 1 partial)				

Relinquished by: (signature)	DATE	TIME	Received by: (signature)
[signature]	10/29/02	13:13	Packed 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

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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	UIVA	
NBH_SPP_202	1	150mL			UIVA	
Spike	1	185mL			UIVA	
Control	1	185mL			UIVA	
NBH_SPP_Cent	1	60mL			lo PH	
NBH_SPP_202	1	150mL			lo PH	
Spike	1	185mL			lo PH	
Control	1	185mL			lo PH	
Seawater	1	1 Gal	11/30/02		~~Se~~ EPA AED SeaWater	Use for Dilutions
Total:	14					

Packed/Released By	Date	Time	Received By	Date	Time	Remarks:
Signature: Kate A. Montgomery	10/30/02	16:00	Signature:			
Printed Name: Kate A. Montgomery			Printed Name:			
Released By	Date	Time	**Received By**	Date	Time	
Signature: Kate A. Montgomery	10/30/02	16:00	Signature: [signature]	10/31/02	09:30	
Printed Name: Kate A. Montgomery			Printed Name: John Williams			

Final Destination: Aquatec Williston, VT

Contact Name and Phone Number: John Williams 802 860 1638

Shipping Method: Fed-Ex

Page 2 of 2

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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: [signature] Printed Name: Kate A. Montgomery	10/30/02	16:00	Signature: Printed Name:			Rec. Temp 1.3°C
Released By Signature: [signature] Printed Name: Kate A. Montgomery	10/30/02	16:00	**Received By** Signature: [signature] Printed Name: John Williams	10/31/02	09:30	
Final Destination: Aquatec Williston, VT			Contact Name and Phone Number: John Williams 8028601638			Shipping Method: Fed-Ex

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

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 / WATER CHEMISTRY DATA

Sample		# Normal	# Abnormal	# in 1-mL (2)		Day 0	Day 1	Day 2	Day 3
23136	A	1	49	10	pH	7.9			
Cent SPP	B	3	97	29	DO	6.9			
C-18	C	0	100	24	Temp	19.2			20.3
					Salinity	30			
23138	A	96	3	89	pH	7.6			
SPIKE	B	99	1	91	DO	8.6			
C-18	C	99	1	83	Temp	20.3			20.4
	D				Salinity	30			
23139	A	96	4	101	pH	7.8			
Control	B	98	2	85	DO	7.7			
C-18	C	99	1	91	Temp	20.9	19.9		20.3
					Salinity	30			
I/D		T 11/6/02				10/31/02	11/1	11/2	11/3 JW

72-h BIOLOGICAL DATA / WATER CHEMISTRY DATA

Sample		# Normal	# Abnormal	# in 1-mL		Day 0	Day 1	Day 2	Day 3
23140	A	0	100	73	pH	7.3			
Cent SPP	B	0	100	70	DO	4.1			
ULVA	C	0	100	51	Temp	21.6			20.5
					Salinity	30			
23142	A	0	100	35	pH	7.5			
SPIKE		0	100	53	DO	5.1			
ULVA	C	1	99	36	Temp	20.2			20.4
					Salinity	30			
23143	A	99	1	88	pH	7.3			
Control		100	0	79	DO	5.2			
ULVA	C	97	3	82	Temp	20.4			20.5
					Salinity	30			
I/D		T 11/6/02				10/31/02	11/1	11/2 JG	11/3 JW

72-h BIOLOGICAL DATA / WATER CHEMISTRY DATA

Sample		# Normal	# Abnormal	# in 1-mL		Day 0	Day 1	Day 2	Day 3
23144	A	0	100	38	pH	7.2			
Cent SPP	B	0	100	24	DO	5.7			
LO PH	C	0	100	19	Temp	21.0			20.6
					Salinity	30			
23146	A	96	4	90	pH	8.6			
SPIKE		97	3	76	DO	8.8			
LO PH	C	97	3	86	Temp	19.8			20.6
					Salinity	30			
23147	A	(1) 99	1	97	pH	7.1			
Control		100	0	98	DO	8.0			
LO PH	C	99	1	85	Temp	20.4		20.3	20.3
	D				Salinity	30			
I/D		T 11/6/02				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
Reviewed by: T Date: 11/6/02

Abnormals are spherical multicellular/granular masses.

ApTIEToxForms

Embryo count X 23 = estimated # of embryos

(1) Considered marginally normal. Pluteus larvae, small, slightly

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 / WATER CHEMISTRY DATA

Sample	# Normal	# Abnormal	# in 1-mL		Day 0	Day 1	Day 2	Day 3
23148 A	0	50	11	pH	7.9			
Cent SPP B	0	50	8	DO	8.4			
UNT C	0	50	5	Temp	20.3			20.2
				Salinity	30			
I/D		11/8/02			10/31/02	11/1	11/2	11/3

72-h BIOLOGICAL DATA / WATER CHEMISTRY DATA

Sample	# Normal	# Abnormal	# in 1-mL		Day 0	Day 1	Day 2	Day 3
23150 A	1	99	70	pH				
SPIKE B	1	99	89	DO				
UNT C	0	100	87	Temp				20.3
10%				Salinity				
23150 A	0 ①	100	18 ①	pH				
SPIKE B	0	100	30	DO				
UNT C	0	100	80	Temp				20.5
25%				Salinity				
23150 A	0 ①	100	68 ①	pH				
SPIKE B	0	100	57	DO				
UNT C	0	100	39	Temp				20.5
50%				Salinity				
23150 A	0 ①	100	69 ①	pH	7.6			
SPIKE B	0	100	75	DO	8.7			
UNT C	0	100	99	Temp	19.9	20.5	20.5	20.5
100%				Salinity	30			
I/D		11/8/02			10/31/02	11/1	11/2	11/3

72-h BIOLOGICAL DATA / WATER CHEMISTRY DATA

Sample	# Normal	# Abnormal	# embryos in 1mL		Day 0	Day 1	Day 2	Day 3
23151 A	100	0	Not counted	pH	8.0			
Control	100	0	93	DO	8.2			
UNT C	99	1	87	Temp	20.5			20.5
				Salinity	30			
I/D		11/4/02			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)

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	J	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 J	11/1	11/2	11/3 JW

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	J	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 J	11/1 J	11/2 JG	11/3 JW

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	J	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 J	11/1	11/2	11/3 JW

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	G	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 G	11/1	11/2	11/3 JW

Aerated before testing.

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	G	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 G	11/1	11/2	11/3 JW

Aerated before testing.

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	G	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 G	11/1 J	11/2 JG	11/3 JW

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) 3.67×10^8

Number of eggs in egg stock X 500 = —

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: [initials] Date: 10/31/02.

Test preserved 11/3/02 JW 15:00

Reviewed by: [initials] Date 11/11/02

Laboratory: Aquatec Biological Sciences, Inc. Williston, Vermont

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	637459	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	Ammonia:
52	1	CCB	U	1	1	-1146	-0.009300	LO
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	610643	36.263691	
56	5	CCV	U	1	1	850516	5.051842	
57	1	CCB	U	1	1	-2047	-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
					+ mysid	4°C
23030 202-W-ELUT 23024 202-ELUT	4800 mL H_2O, 1200mL Sed = 6L	11:35 – 12:05	12:05 – 13:05	~1200	baseline.	13:50 – 14:00
	JW 11/29/02					

Aquatec Biological Sciences, Inc.
Reviewed by: [signature] Date: 12/2/02

TIEForms

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	T			
I/D/T		10/31/02	11/1 15:00	11/2 JG	11/3 JW	11/4 20:00

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	~~20.0~~ 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

NUMBER SURVIVING

① One stuck on petri dish top

Sample		Day 0	Day 1	Day 2	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~~ ①		
I/D/T		10/31/02	11/1 15:15	11/2 JG	11/3 JW	11/4 20:20

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 20:20
			14:30		10:00	
				Fed ✓	Fed ✓	

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

Reviewed by: ________ Date: 11/5/02

12/21/02 22.10 - all replicates

12/1/02 All reps fed during monitoring

① Written in wrong spare 11/1 + 11/2

11/4/02 Final chems measured w/in test container 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 15:39	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

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	11/2 JG	11/3 JW	11/4

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	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
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%		15:57			
I/D/T	10/31/02	11/1	11/2 JG	11/3 JW	11/4 20:30

Insufficient sample to run 10% or 25%. One rep only 25 50% & 100%

SPIKE STS – only enough for 50% – one rep; 100% – one rep.

21:20

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	11/1	11/2 JG	11/3 JW	11/4

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	11/2 JG	11/3 JW	11/4

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
DO	8.7				~~7.4~~ 7.0
Temp	20.3			24.1	25.1
Salinity	30				31
	10/31/02	11/1	11/2 JG	11/3 JW	11/4

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 16:30	11/2 JG	11/3 JW	11/4

21:28 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	~~31~~
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	20.6			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				~~30~~ 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

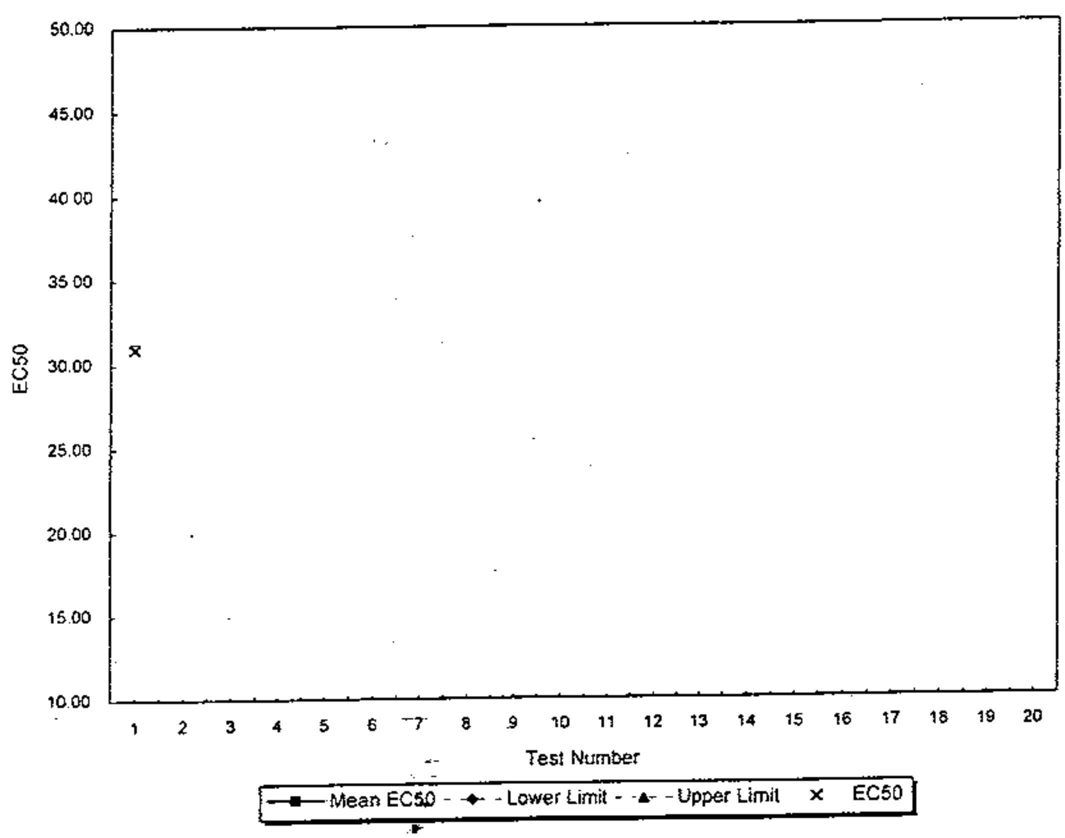
	Day 0	Day 1	Day 2	Day 3	Day 4
pH	8.0				8.0
DO	8.6				6.9
Temp	20.4			24.1	25.0
Salinity	33				31
	10/31/02	11/1	11/2	11/3 JW	11/4

Standard Reference Toxicant Control Charts

Science Applications International Corporation

Reference Toxicant Control Chart
Arbacia punctulata Embryo Development
in Copper sulfate (ug/L)

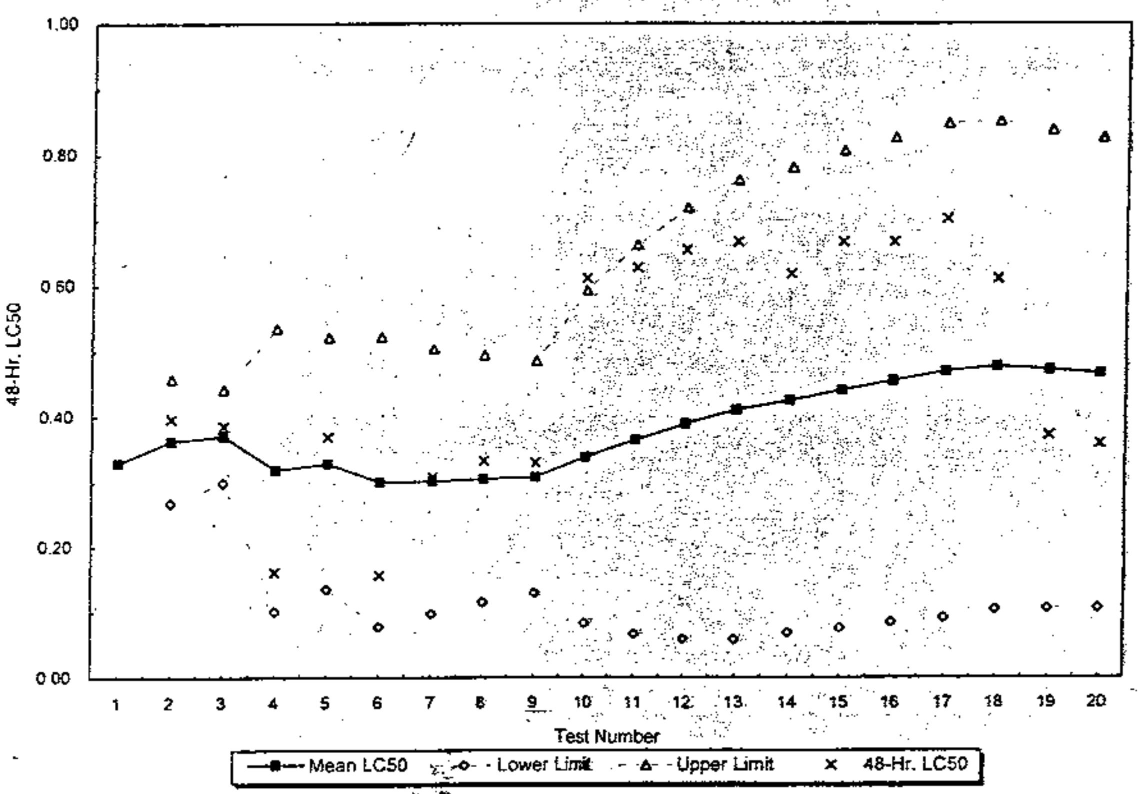
Test Number	Test Date	48-h EC50	Mean EC50	Lower Limit	Upper Limit	Organism Source
1	10/31/02	30.935	30.94			Aquatec Biological Sciences
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						



\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

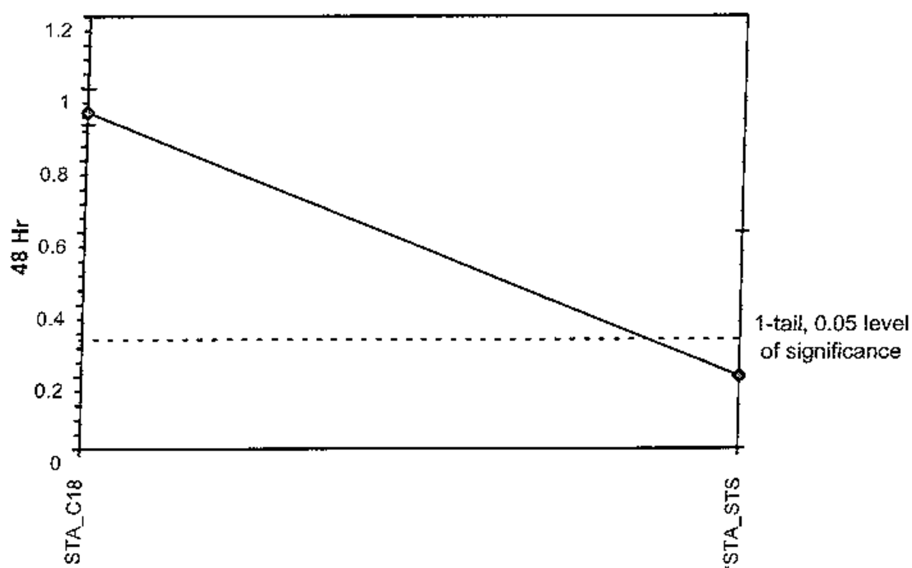
Mysid Survival, Growth and Fecundity Test-48 Hr			
Start Date:	Test ID: NBHMYS48	Sample ID:	NBH MYS 48
End Date:	Lab ID:	Sample Type:	AMB1-Ambient water
Sample Date:	Protocol: EPAA 91-EPA Acute	Test Species:	AB-Americamysis bahia
Comments:	New Bedford Harbor, 48hr Americamysis bahia		

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

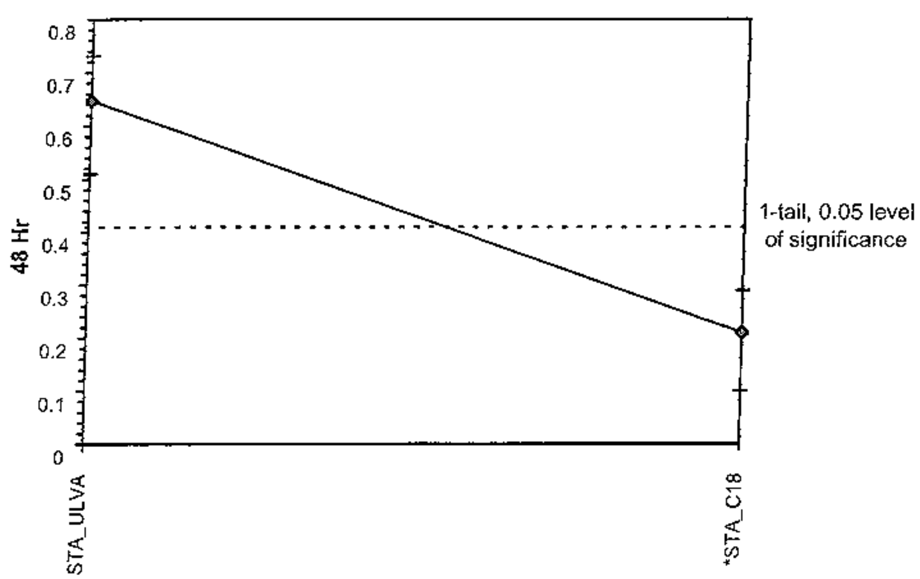
Mysid Survival, Growth and Fecundity Test-48 Hr					
Start Date:		Test ID:	NBHURC72	Sample ID:	NBH URC 72hr
End Date:		Lab ID:		Sample Type:	AMB1-Ambient water
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	AP-Arbacia punctulata
Comments:	New Bedford Harbor, 72hr Urchin Survival				

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

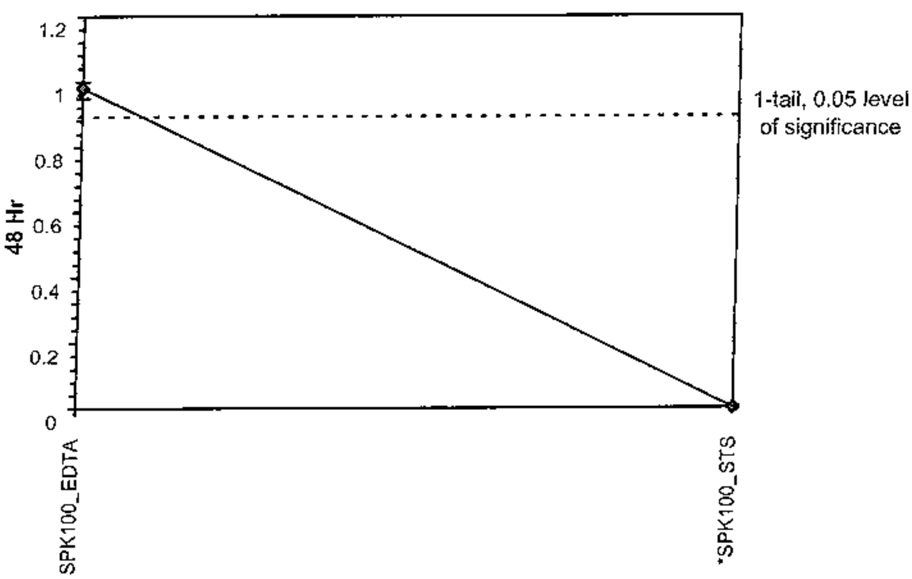
Mysid Survival, Growth and Fecundity Test-48 Hr			
Start Date:	Test ID: NBHURC	Sample ID:	NBH URC
End Date:	Lab ID:	Sample Type:	AMB1-Ambient water
Sample Date:	Protocol: EPAA 91-EPA Acute	Test Species:	AP-Arbacia punctulata
Comments:	New Bedford Harbor, Arbacia punctulata, Normal Development		

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

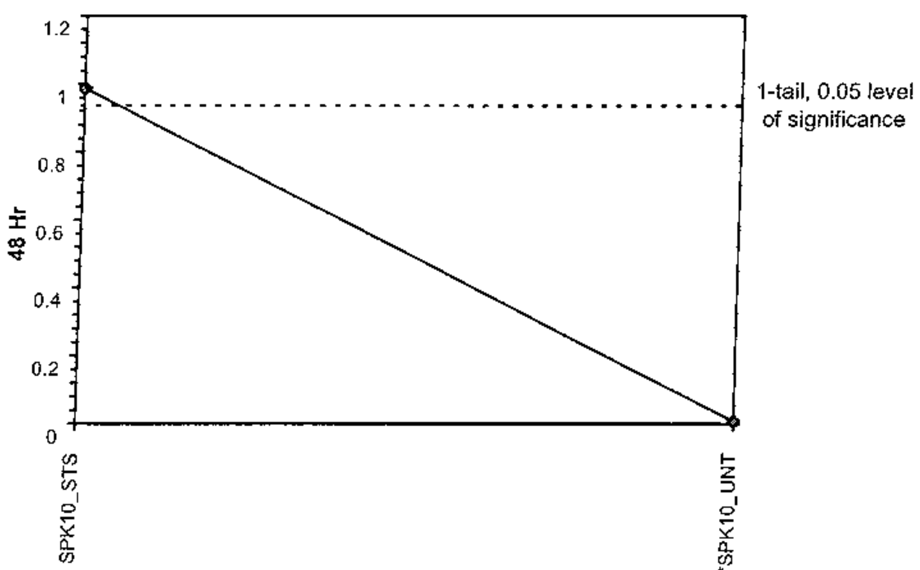
Mysid Survival, Growth and Fecundity Test-48 Hr					
Start Date:		Test ID:	NBHURCS48	Sample ID:	NBH URC 48
End Date:		Lab ID:		Sample Type:	AMB1-Ambient water
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	AP-Arbacia punctulata
Comments:	New Bedford Harbor, Arbacia punctulata, Normal Development				

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

CZM

Submitted by:

Maguire Group Inc.

MAGUIRE GROUP

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

<u>*Sample Collection and Testing.*</u> 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

Di Toro, D., Allen, H., Bergman, H., Meyer, J., Paquin, P., Santore, R. 2001. Biotic ligand model of the acute toxicity of metals. I. Technical Basis. Environ. Toxocol. Chem. 20: 2383-2396.

SAIC. 1993. Toxicity testing to support the New York/New Jersey Harbor Site specific criteria study. Science Applications Intl. Corp. Final Report to EPA. Contract No. 68-C8-0066. Work Assignment C-4-94. Internal Report # 1037.

US EPA. 2002. Short Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms. Third Edition. October, 2002. EPA-821-R-02-014.

US EPA. 2001. Streamlined Water Effect Ratio Procedure for Discharges of Copper. EPA-822-R-01-005. EPA Office of Water. March, 2001.

U.S. EPA. 2000. Method Guidance and Recommendations for Whole Effluent Toxicity Testing (40 CFR Part 136). EPA 821-B-00-004.

U.S. EPA. 1997. United States Environmental Protection Agency. June 1997. Test Methods for Evaluating Solid Waste. Physical/Chemical Methods. EPA SWII1846, 3rd edition, including Final Update III. U.S. EPA, Washington, D.C.

U.S. EPA. 1995. Ambient Water Quality Criteria Saltwater Copper Addendum. Draft, April 14, 1995, promulgated in the Interim final National Toxics Rule (60FR22228-222237, May 4, 1995).

U.S. EPA. 1994. Interim Guidance on Determination and Use of Water-Effect Ratios for Metals. EPA-823-B-94-001, February 1994

U.S. EPA. 1991. Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms. EPA/600/4-90/027.

U.S. EPA and U.S. ACE. 1991. "Evaluation of dredged material proposed for ocean disposal: Testing manual," EPA/503R 191/001 Washington, DC.

U.S. EPA and U.S. ACE. 2002. Regional Implementation Manual for the Evaluation of Dredged Material Proposed for Disposal in New England Waters. Draft. U.S. EPA Region 1 and U.S. Army Corps of Engineers, New England District. September, 2002.

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
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CZM

Submitted by:

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MAGUIRE GROUP

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:

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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

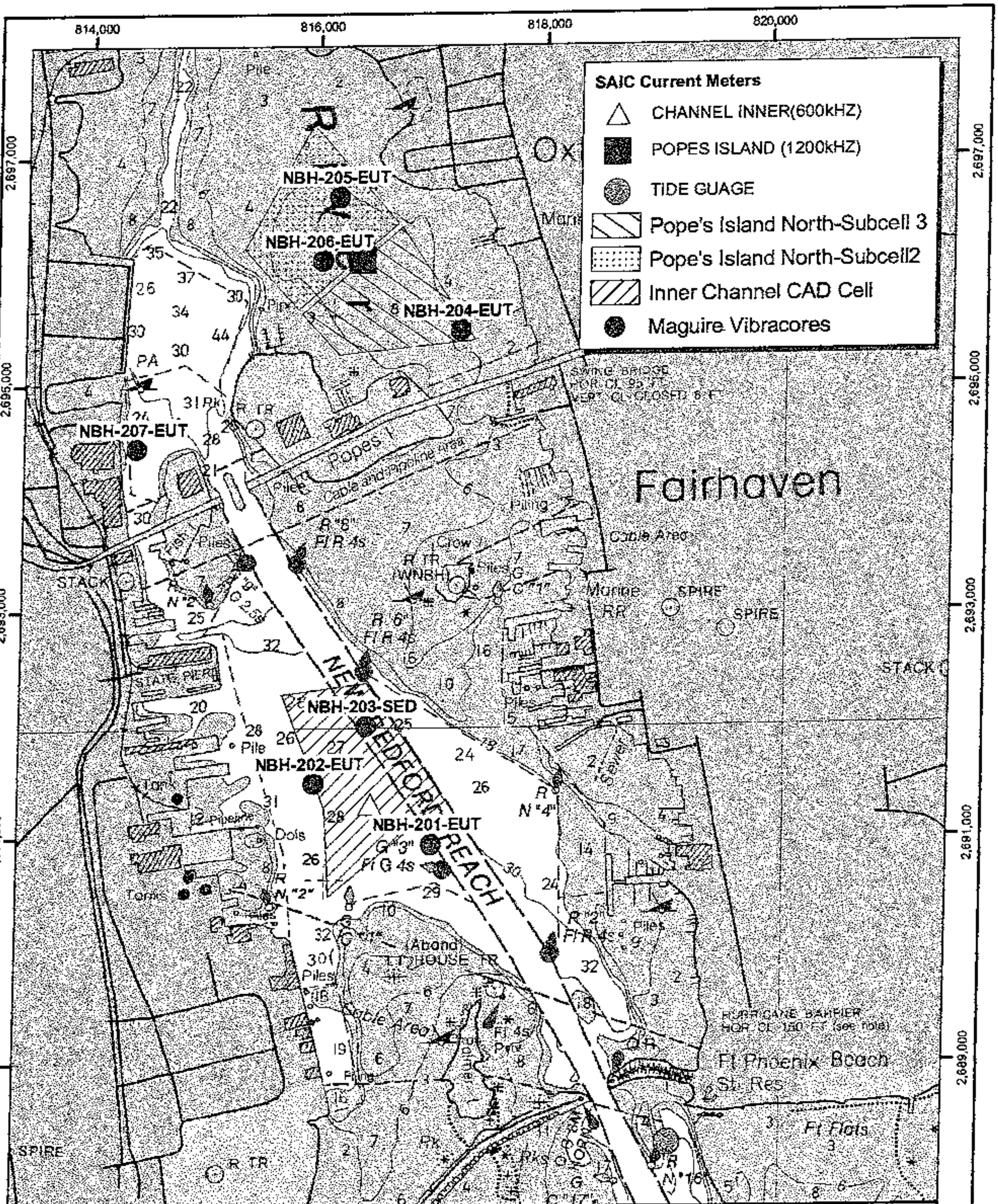
This CD contains data collected at two locations within New Bedford Harbor and one just outside of the hurricane barrier during the fall of 2002. Water column currents were collected within the harbor utilizing a 600 kHz RD Instruments Acoustic Doppler Current Profiler (ADCP) at the Channel Inner site, 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".



New Bedford Harbor Current Meter Deployment Locations

0 500 1,000
Feet

SAIC
An Employee-Owned Company

Science Applications International Corporation
211 Third St.
Newport, RI 02840
401-847-4210
www.saic-marinesciences.com

Notes:
Coordinate System: MA State Plane
Zone: Mainland
Units: Feet
Datum: NAD83

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:

Massachusetts Coastal Zone Management Agency
251 Causeway Street, Suite 900
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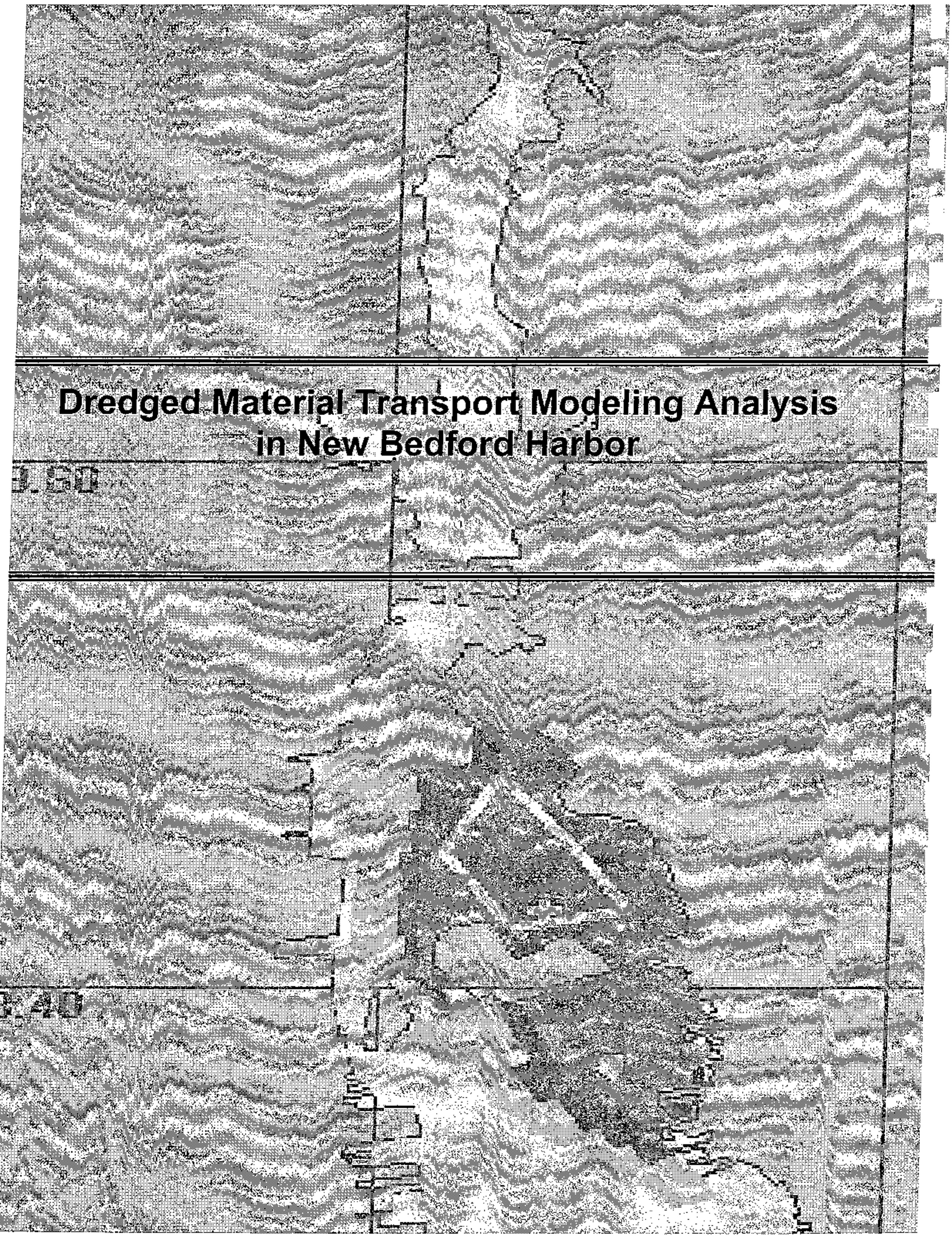
Submitted by:

Maguire Group Inc.

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.

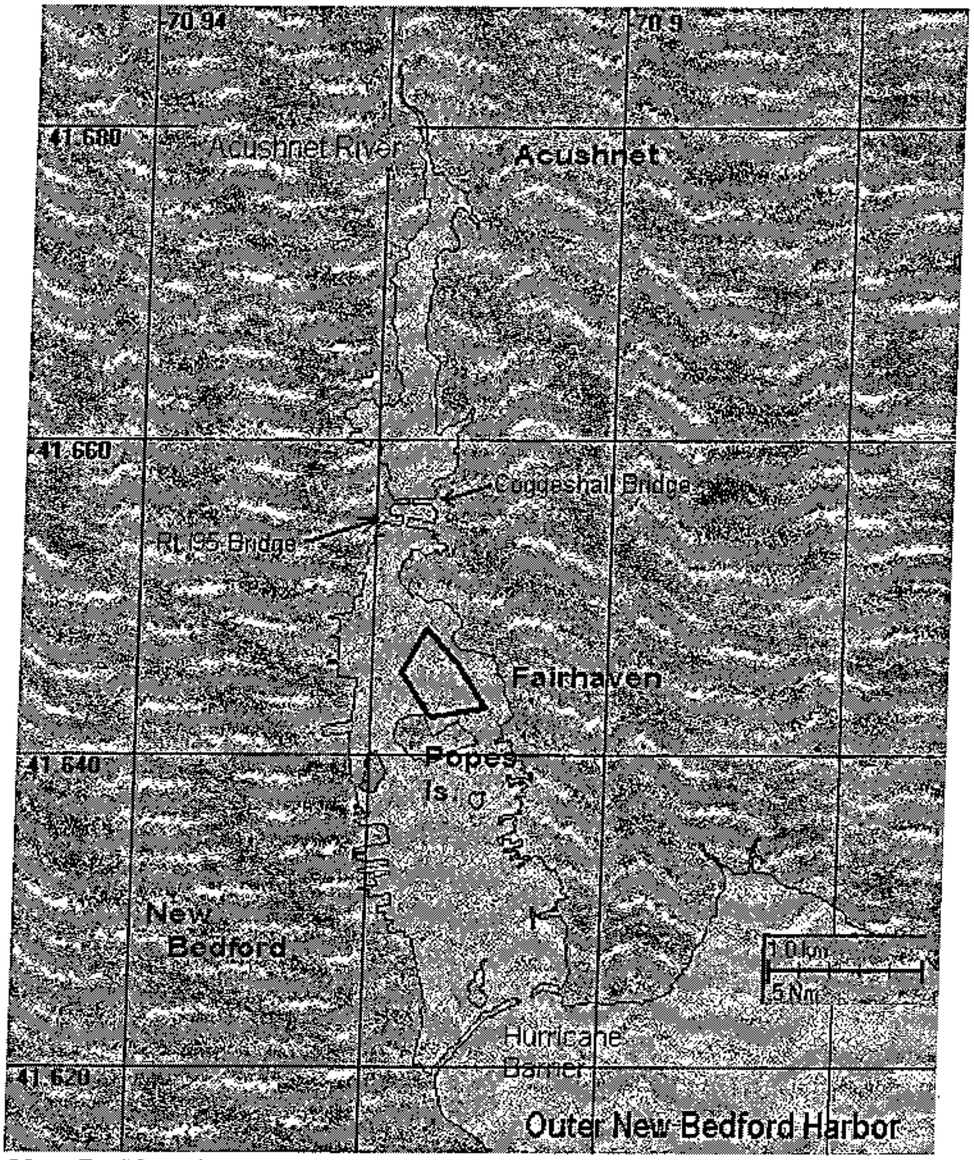


Figure 1-1. New Bedford Inner Harbor.

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

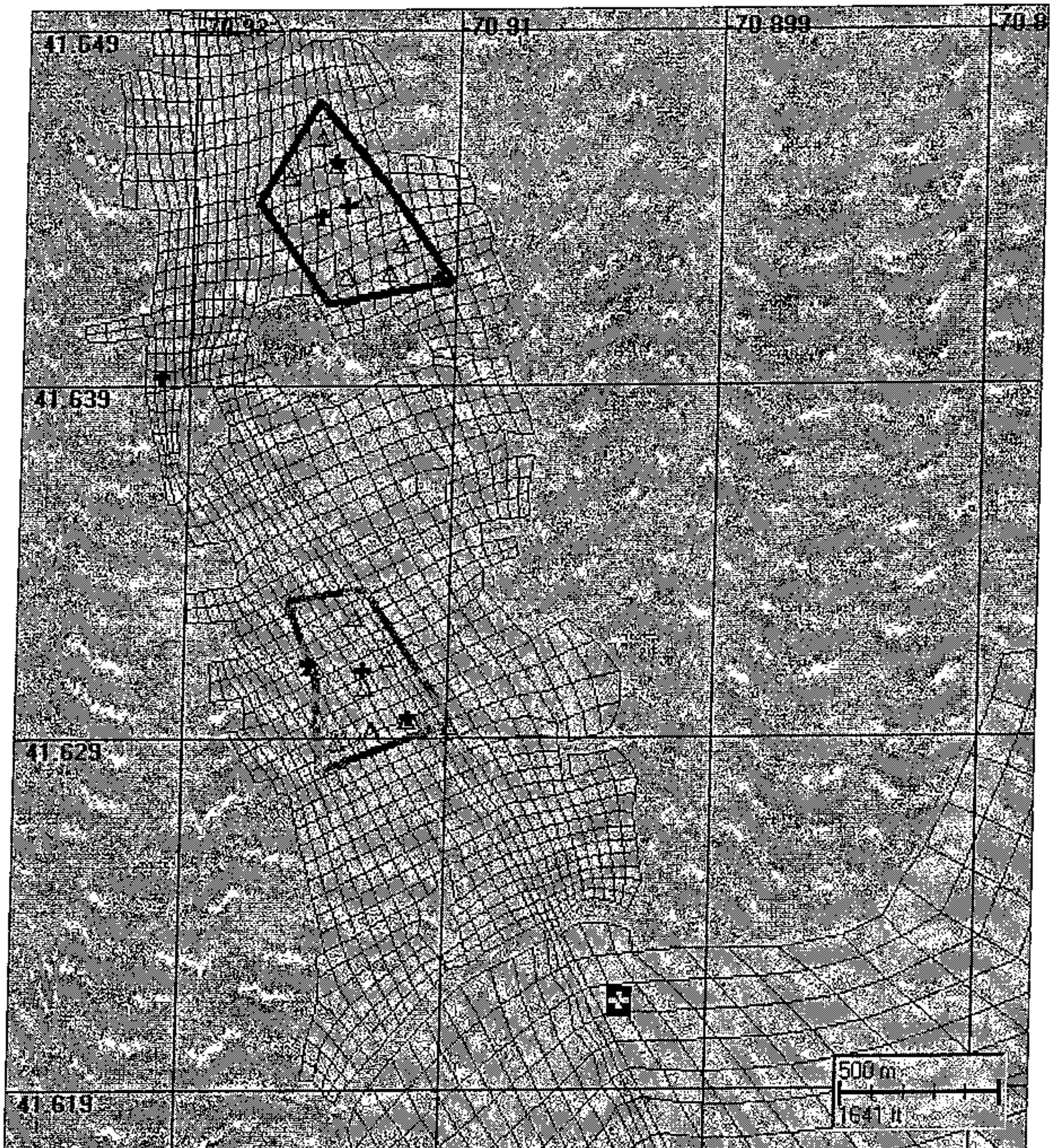


Figure 2-1. Distribution of two long term deployment stations (black crosses), eleven sediment sampling sites (blue triangles), and six elutriate analyses locations (red crosses). Popes Island (blue polygon) and Channel Inner (green polygon) CAD sites are also shown. Grid of model cells shown is explained 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.

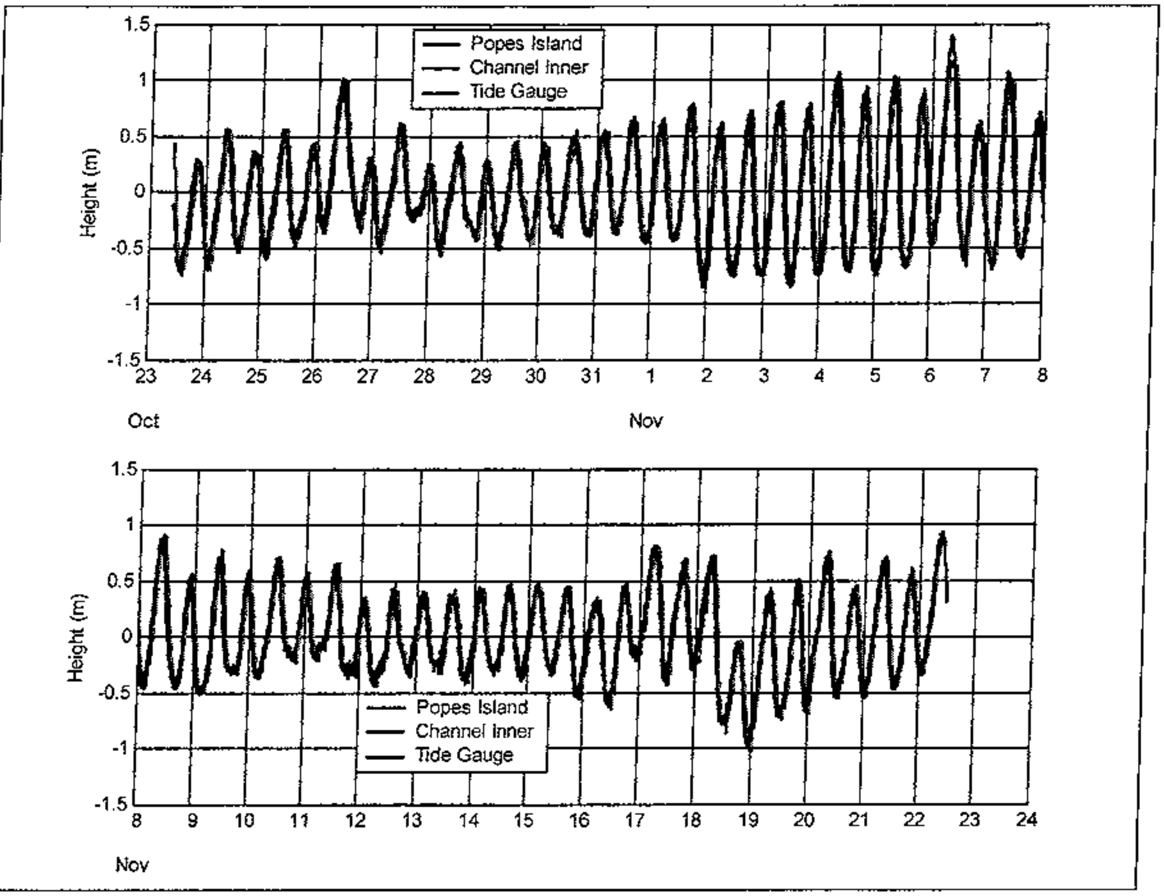


Figure 2-2. Sea surface height relative to mean sea level measured at the Popes Island (blue), Channel Inner (red) and Tide Gauge (black) stations during the study period.

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.

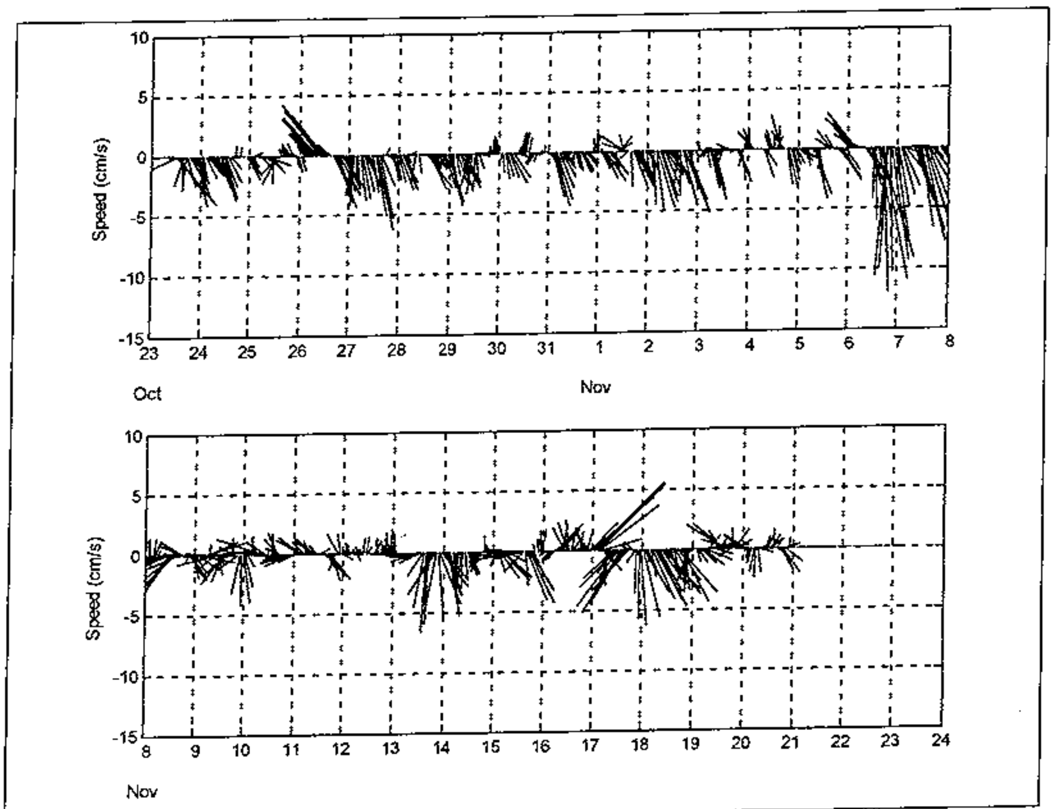


Figure 2-3. Depth averaged current velocities at the Popes Island station. Individual vectors point in the direction the current is moving to (e.g., a vertical line pointing upwards indicates flow from south to north). The length of each vector is proportional to the current speed. The data have been 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.

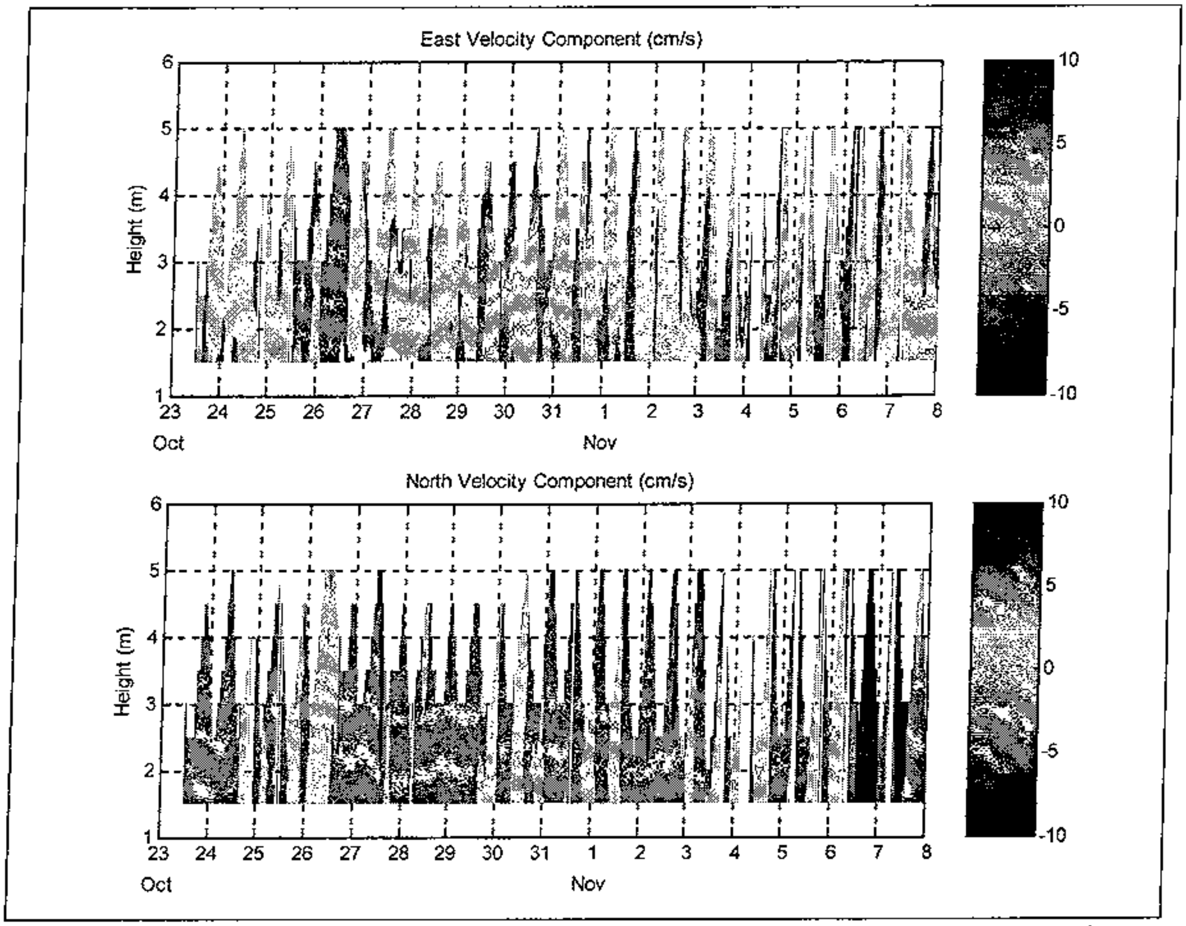


Figure 2-4. Vertical structure of east (top) and north (bottom) components of current velocity at the Popes Island station for the period from 23 October through 8 November 2002.

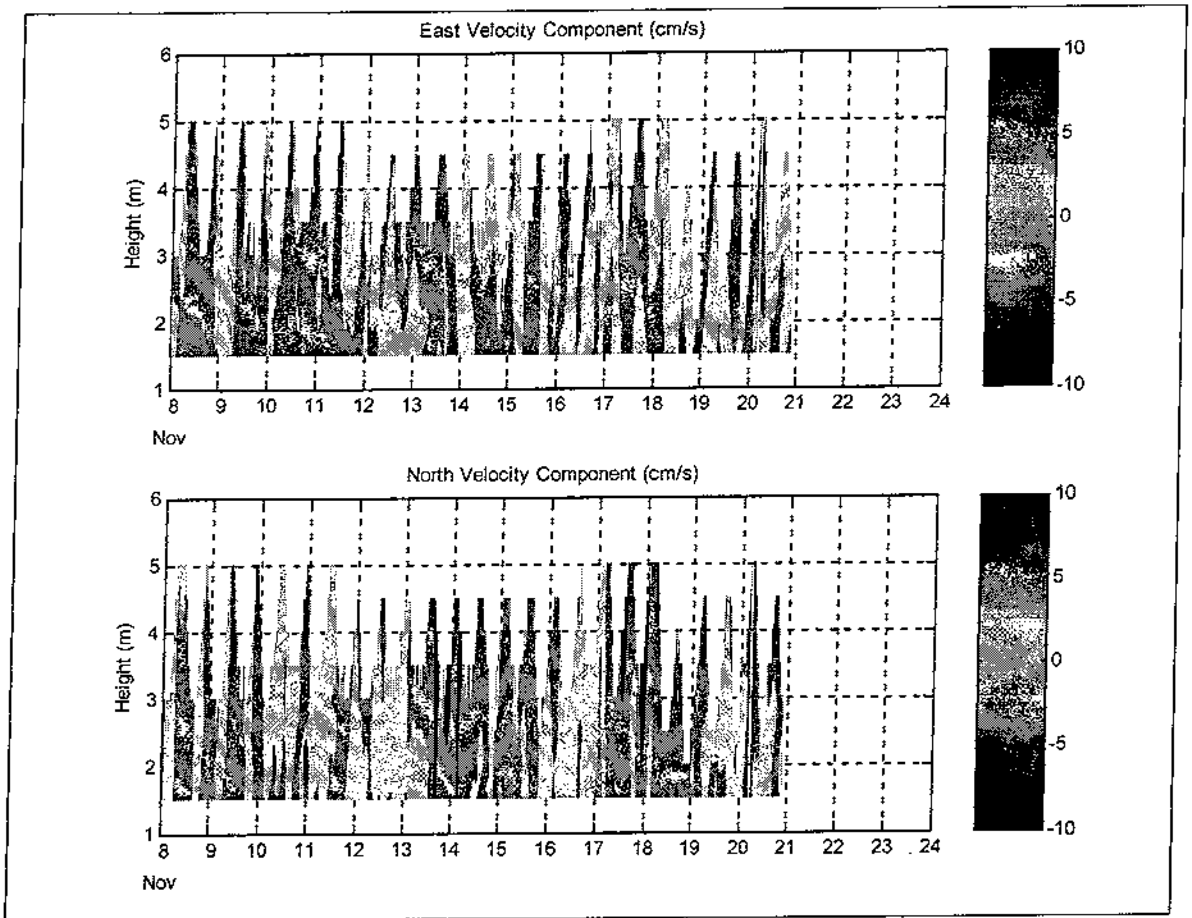


Figure 2-5. Vertical structure of east (top) and north (bottom) components of current velocity at the Popes Island station for the period from 8–24 November 2002.

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).

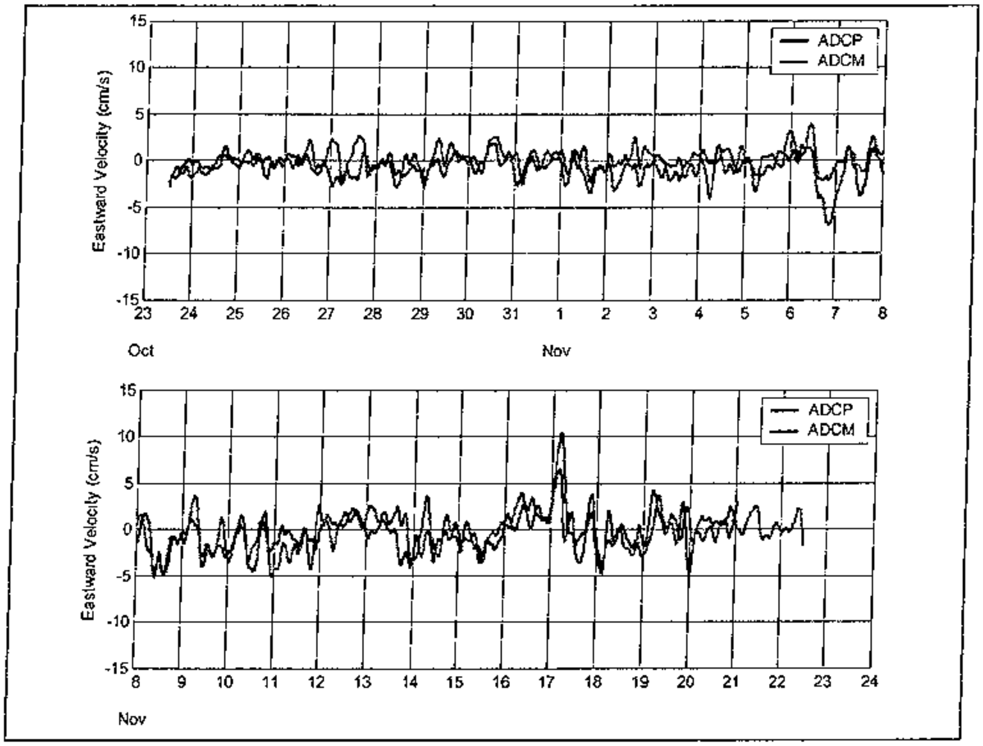


Figure 2-6. A comparison of the eastward component of near bottom current velocity as measured by the ADCP (blue) and the ADCM (red) at the Popes Island station.

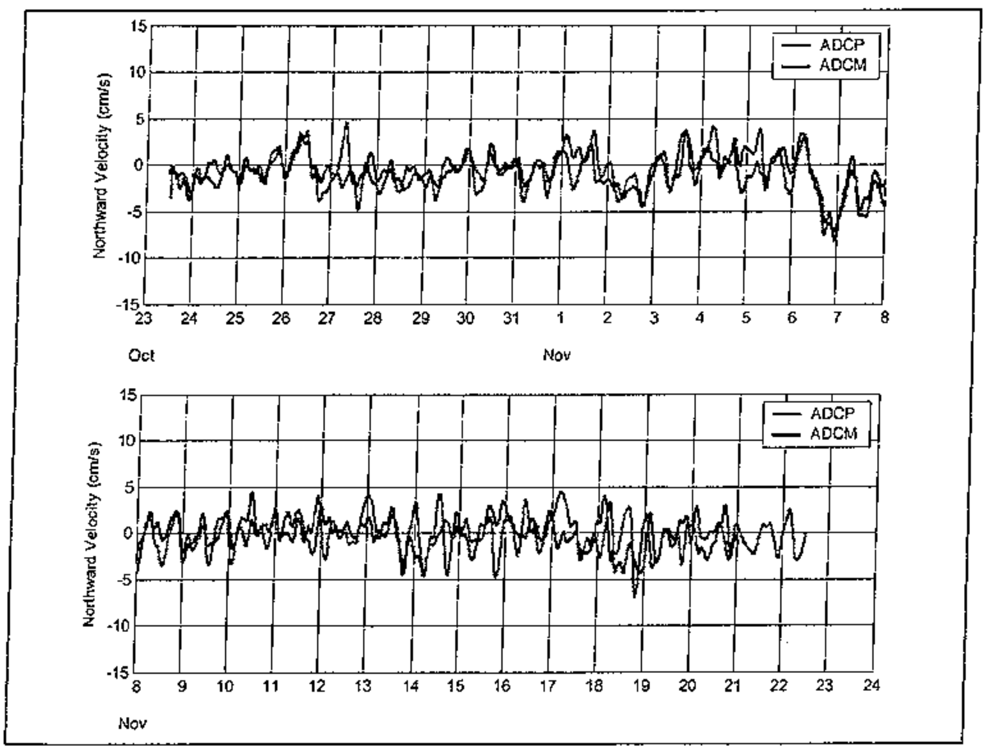


Figure 2-7. A comparison of the northward component of near bottom current velocity as measured by the ADCP (blue) and the ADCM (red) at the Popes Island station.

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.

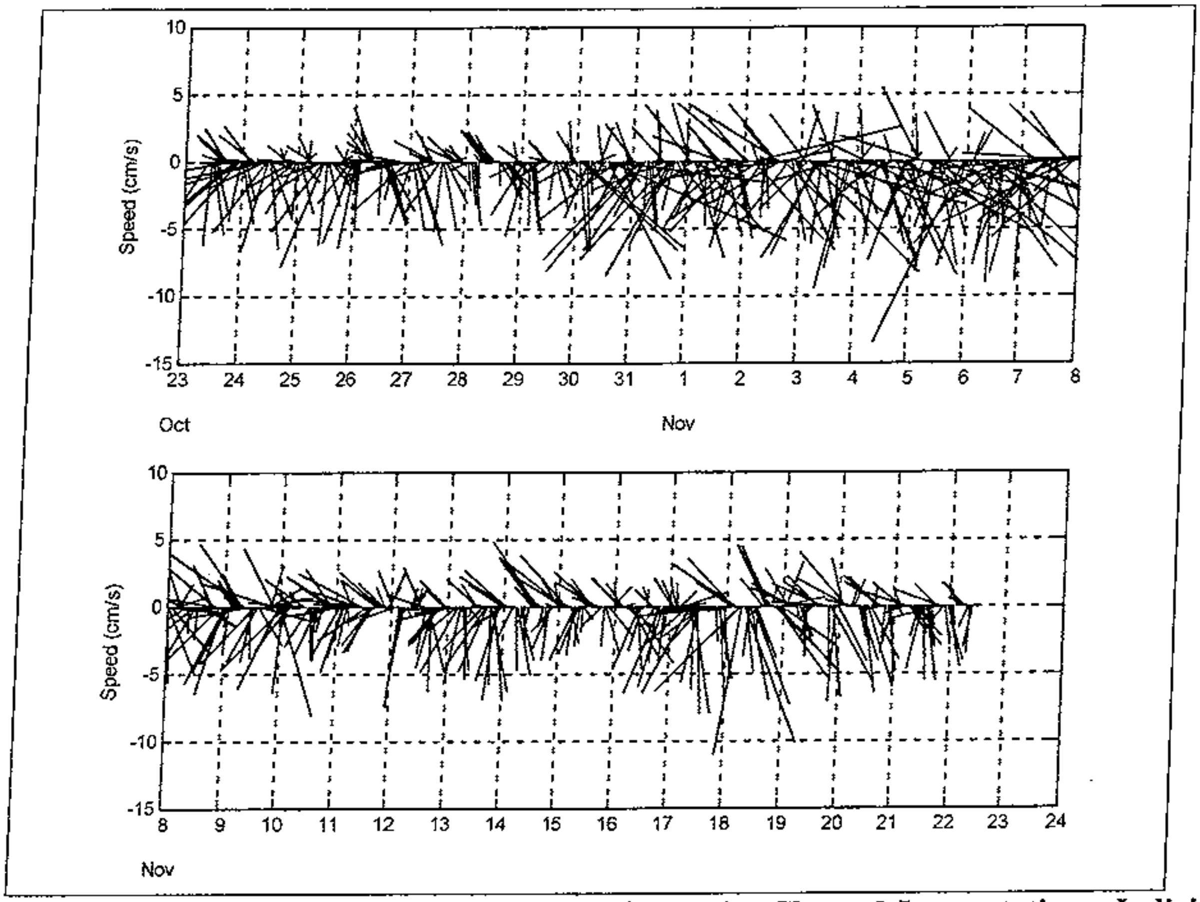


Figure 2-8. Depth averaged current velocities at the Channel Inner station. Individual vectors point in the direction the current is moving to (e.g., a vertical line pointing upwards indicates flow from south to north). The length of each vector is proportional to the current speed. The data have been 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.

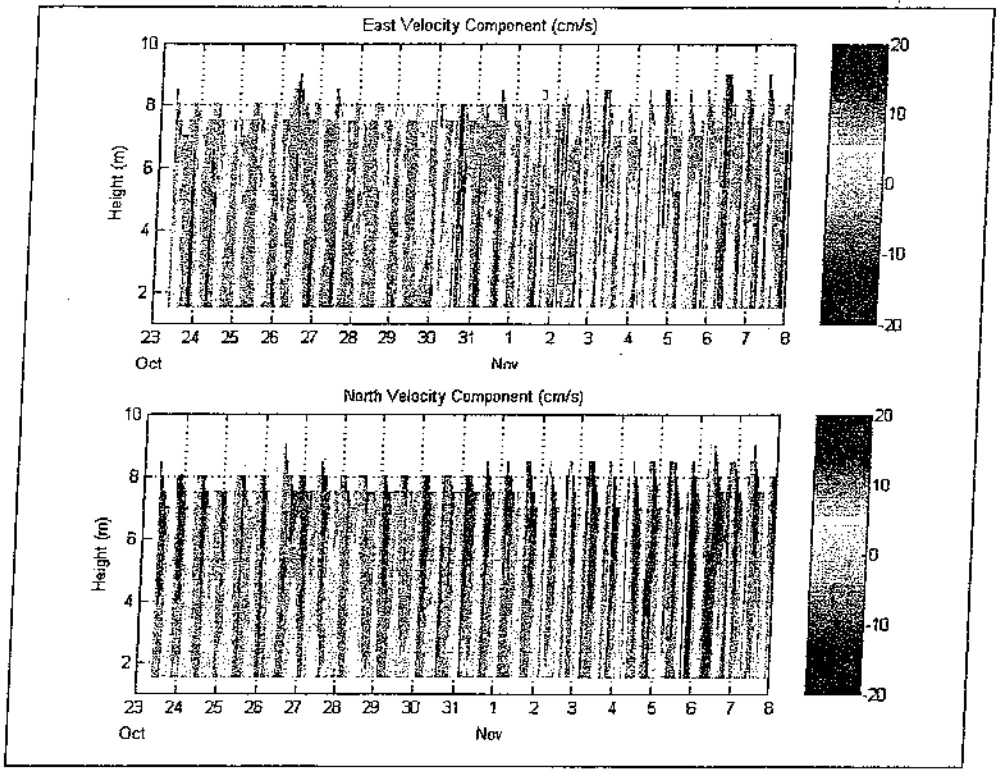


Figure 2-9. Vertical structure of east (top) and north (bottom) components of current velocity at the Channel Inner station for the period from 23 October through 8 November 2002

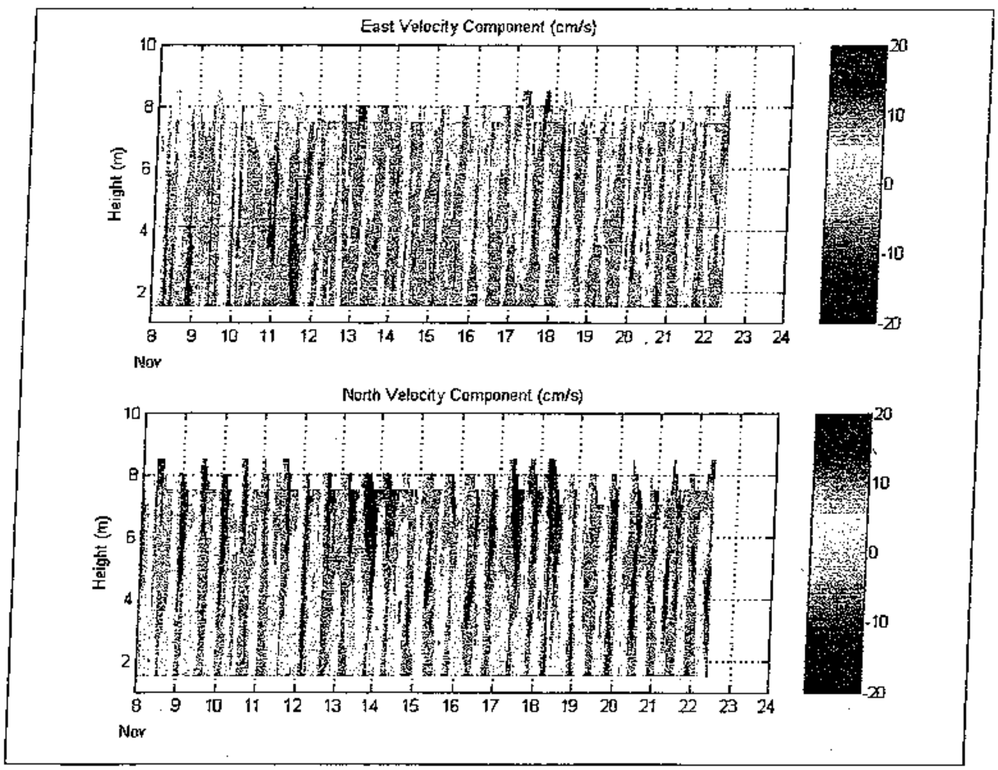


Figure 2-10. Vertical structure of east (top) and north (bottom) components of current velocity at the Channel Inner station for the period from 8–24 November 2002.

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)

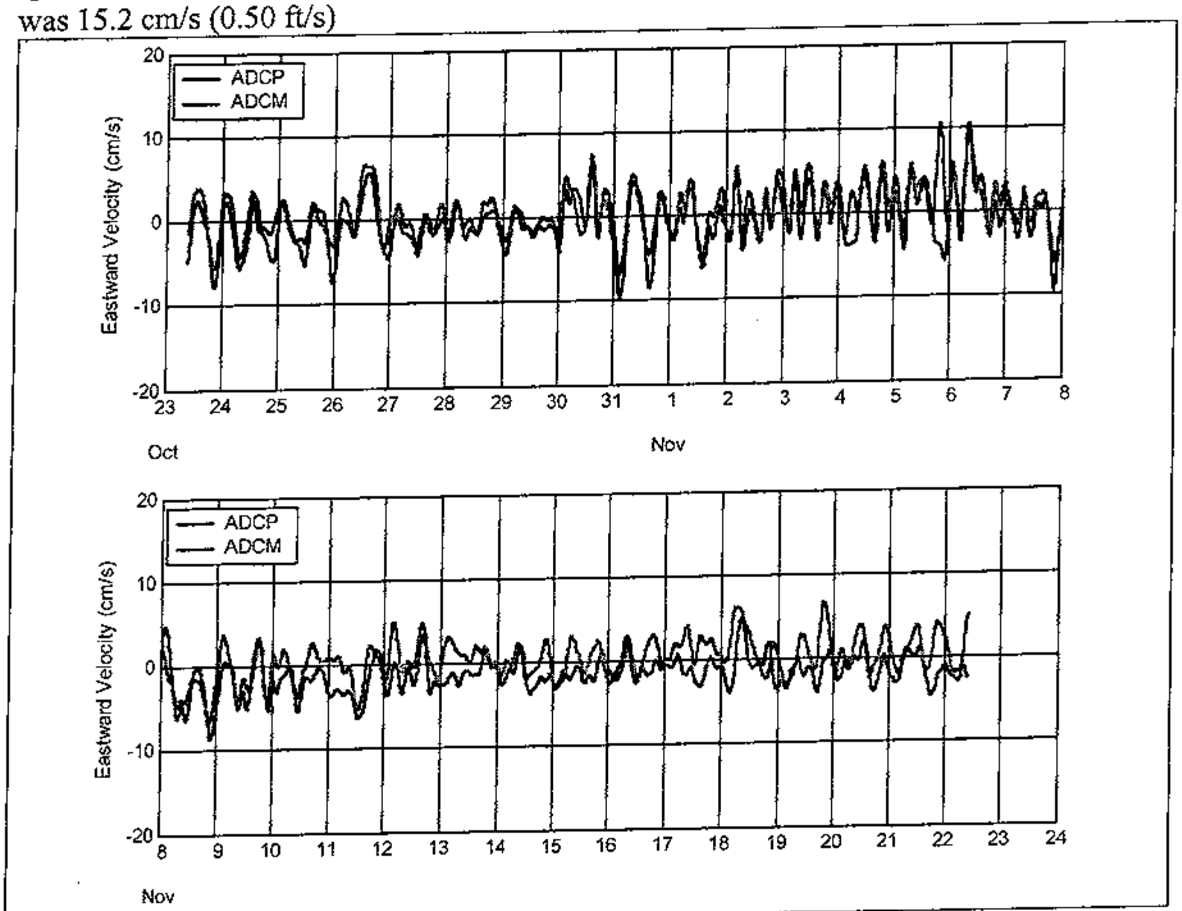


Figure 2-11. A comparison of the eastward component of near bottom current velocity as measured by the ADCP (blue) and the ADCM (red) at the Channel Inner station.

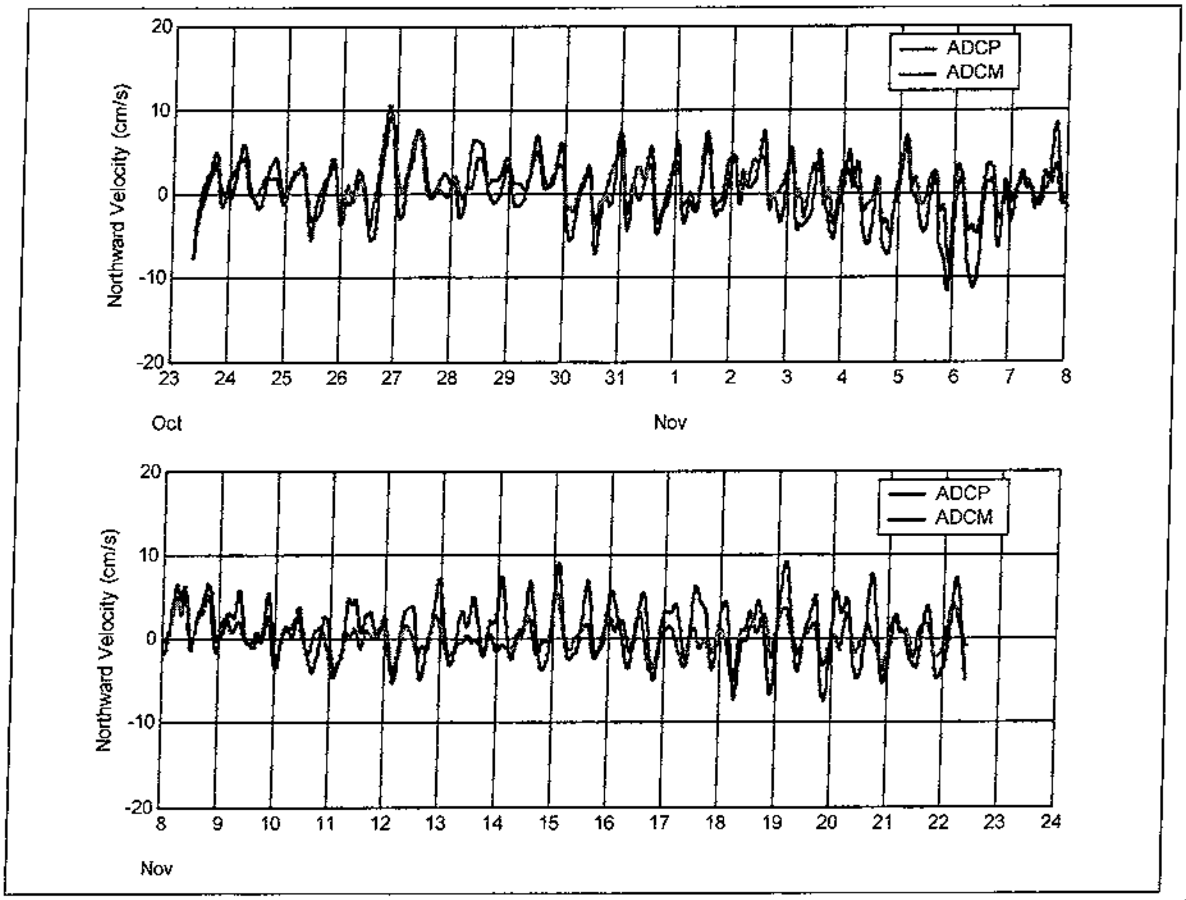


Figure 2-12. A comparison of the northward component of near bottom current velocity as measured by the ADCP (blue) and the ADCM (red) at the Channel Inner station.

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.

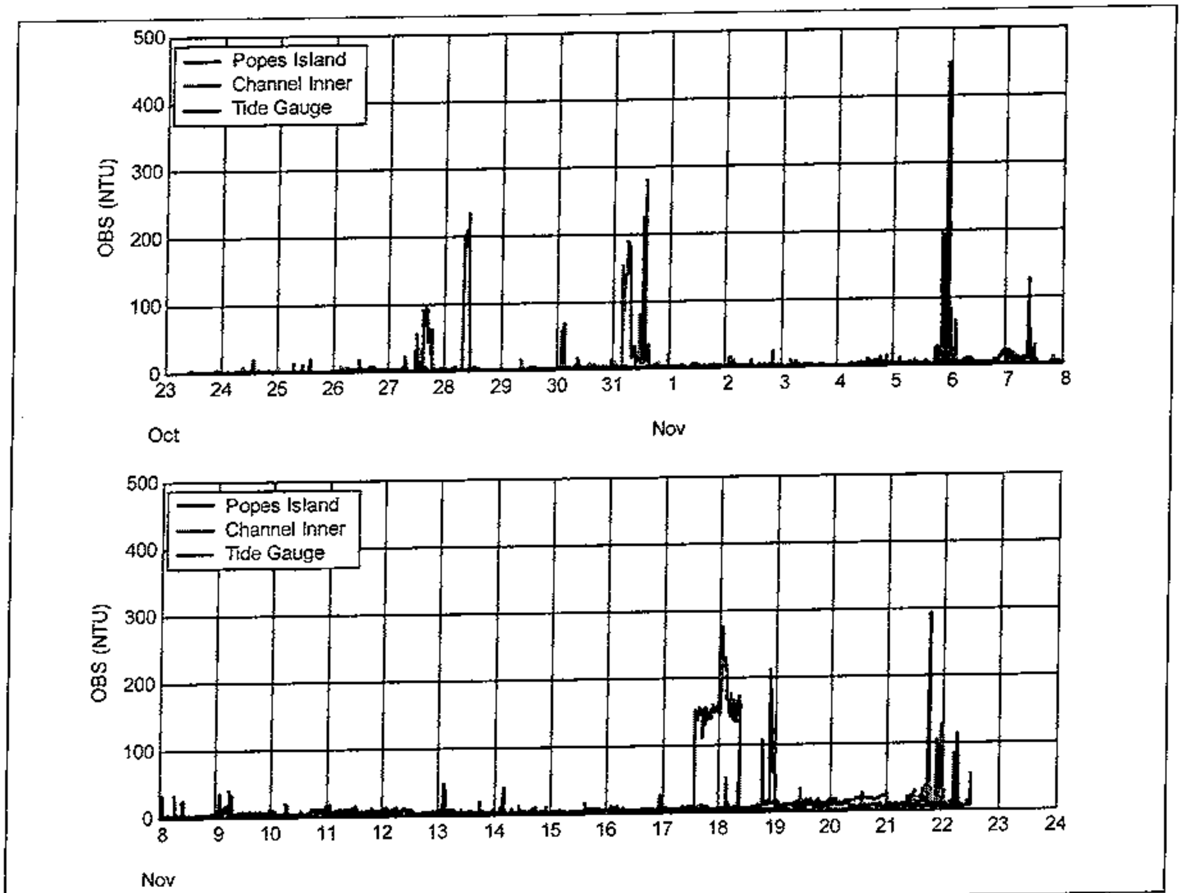


Figure 2-13. Optical backscatter measured at the Popes Island (blue), Channel Inner (red) and Tide Gauge (black) stations during the study period.

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

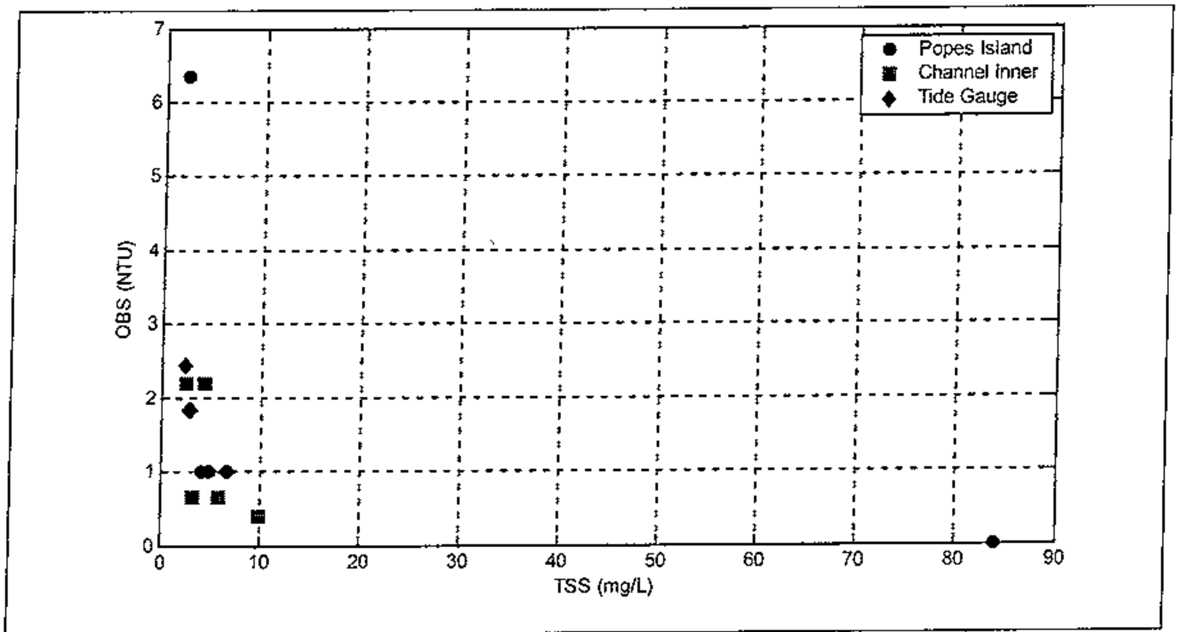


Figure 2-14. Optical backscatter plotted against total suspended sediment for the Popes Island (blue), Channel Inner (red) and Tide Gauge (black) stations.

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%.

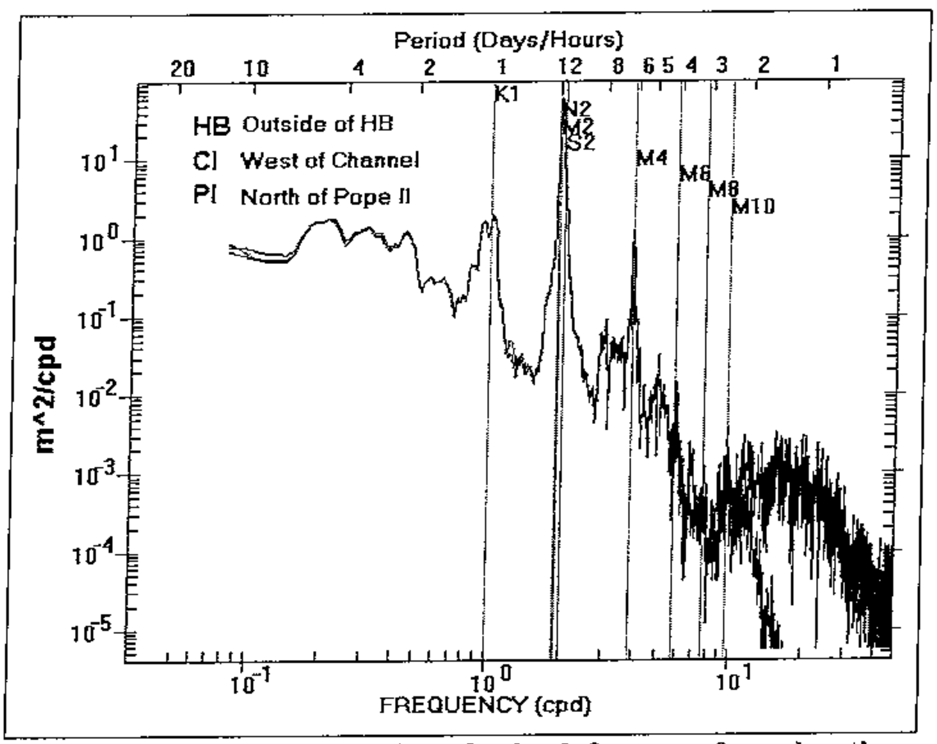


Figure 3-1. Energy spectrum distribution obtained from surface elevations at the long term deployment stations: HB(Hurricane Barrier), PI (Popes Island north), and CI (Channel Inner). Periods and frequencies of selected tidal constituents are shown.

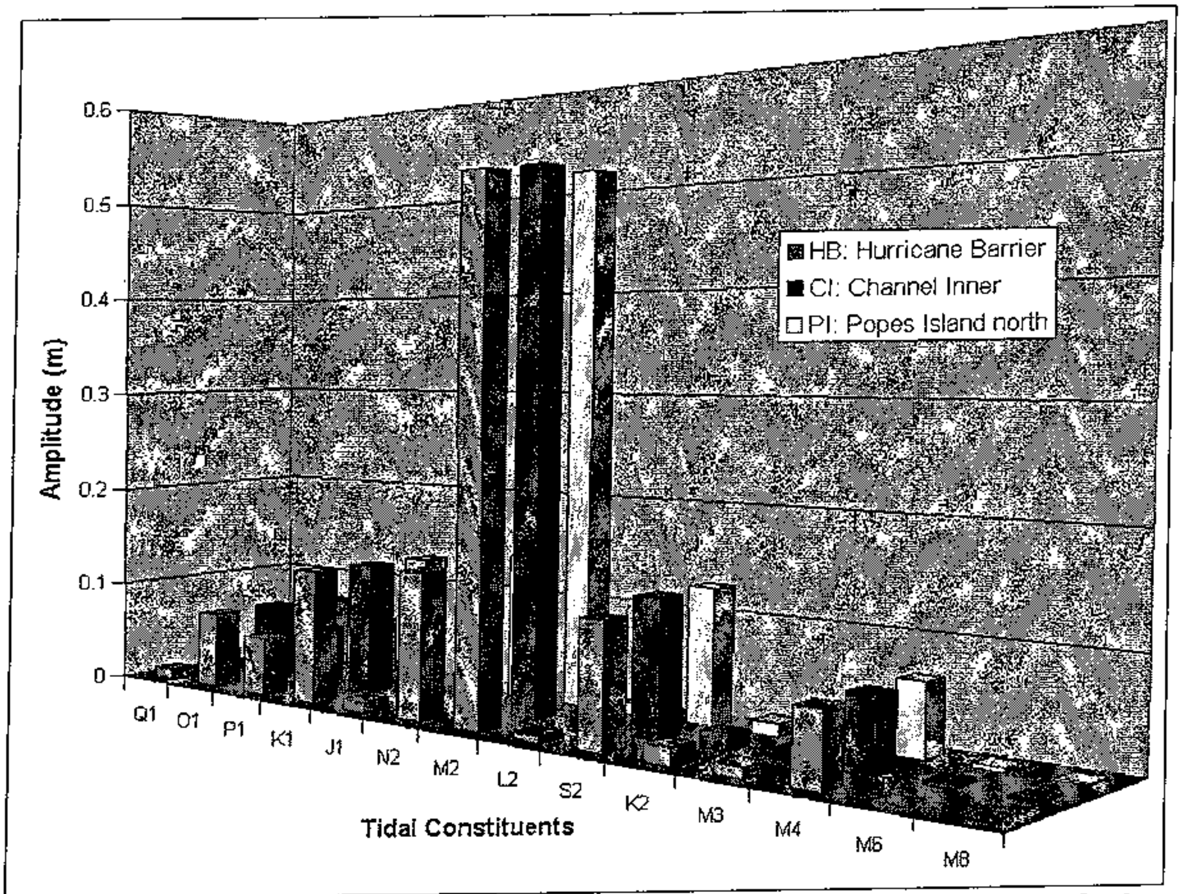


Figure 3-2. Tidal harmonic constituents obtained from surface elevations at the long term deployment stations (positioned in order from south (Hurricane Barrier) to north (Popes Island).

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.

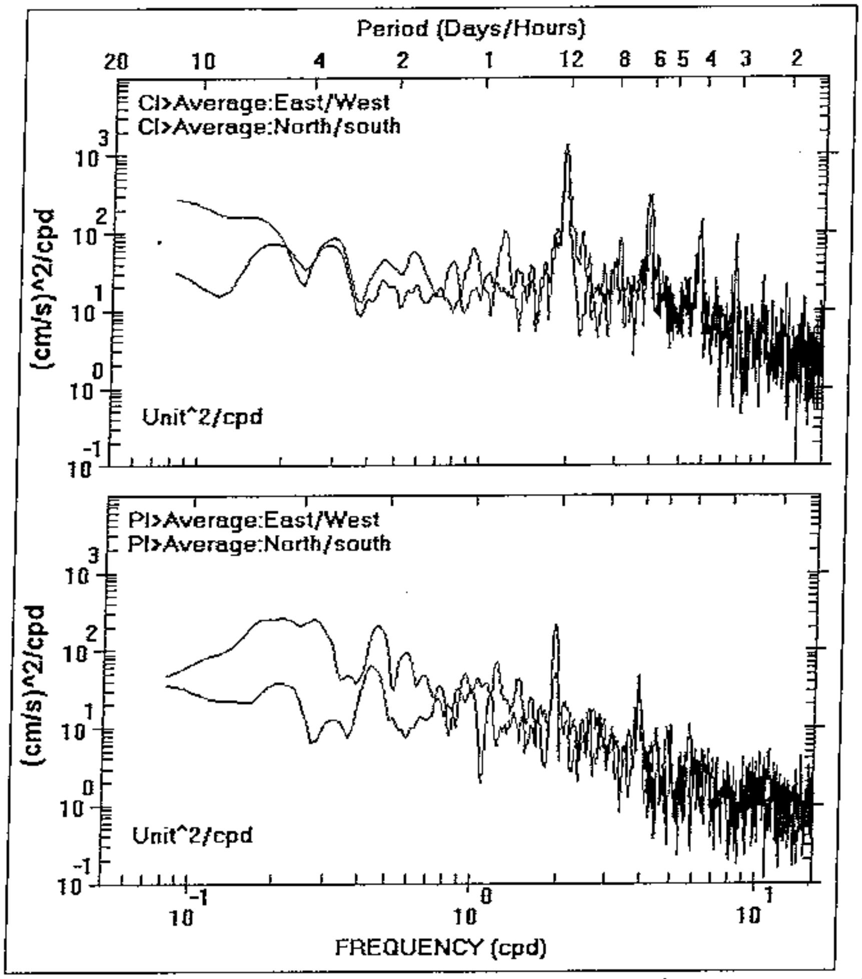


Figure 3-3. Energy spectrum distributions obtained from vertically averaged velocities at the long term deployment stations, Channel Inner (CI) and Popes Island (PI).

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.

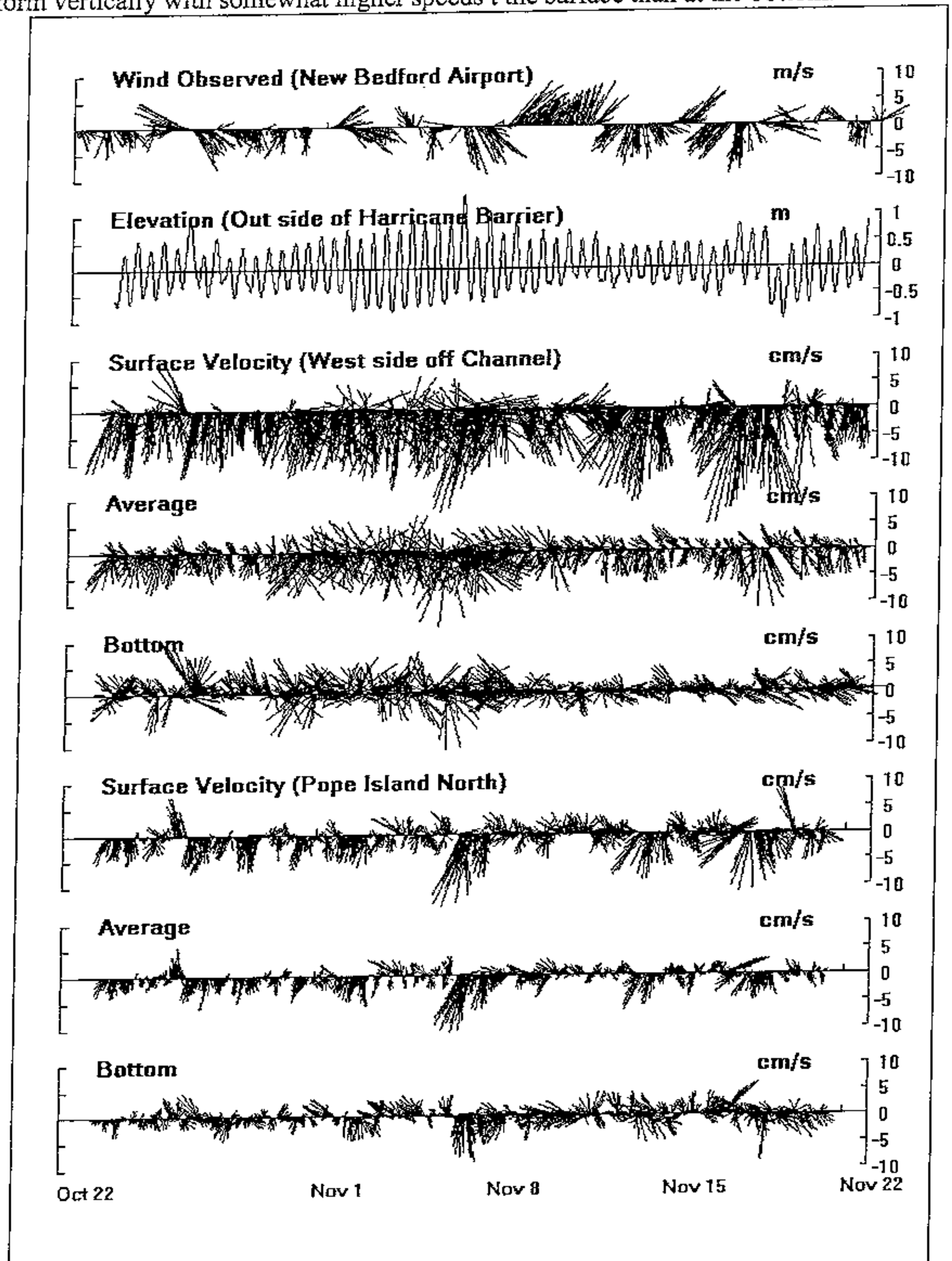


Figure 3-4. Time series stack plot of observed wind, elevation and velocity data.

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.

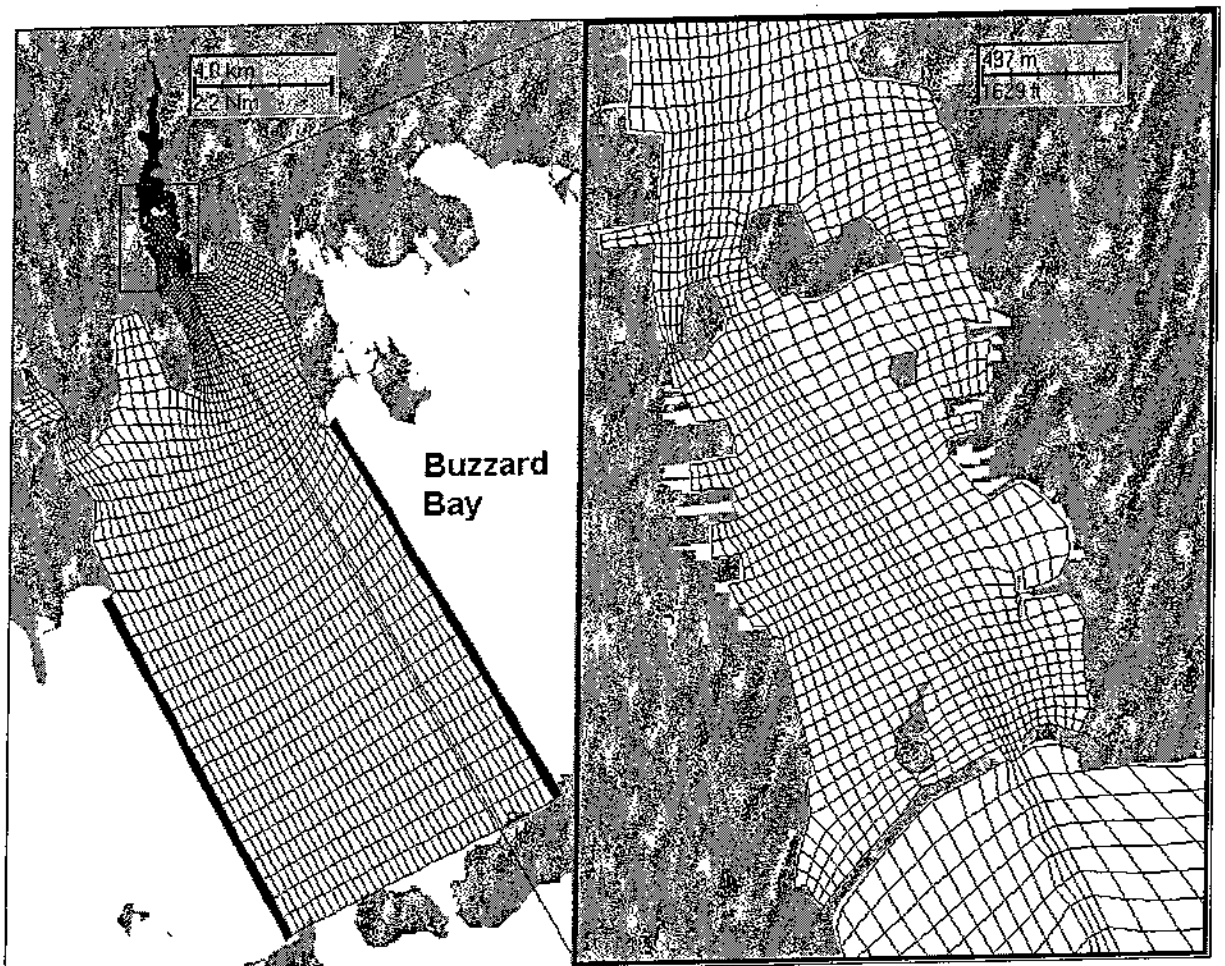


Figure 3-5. New Bedford harbor hydrodynamic model grid

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.

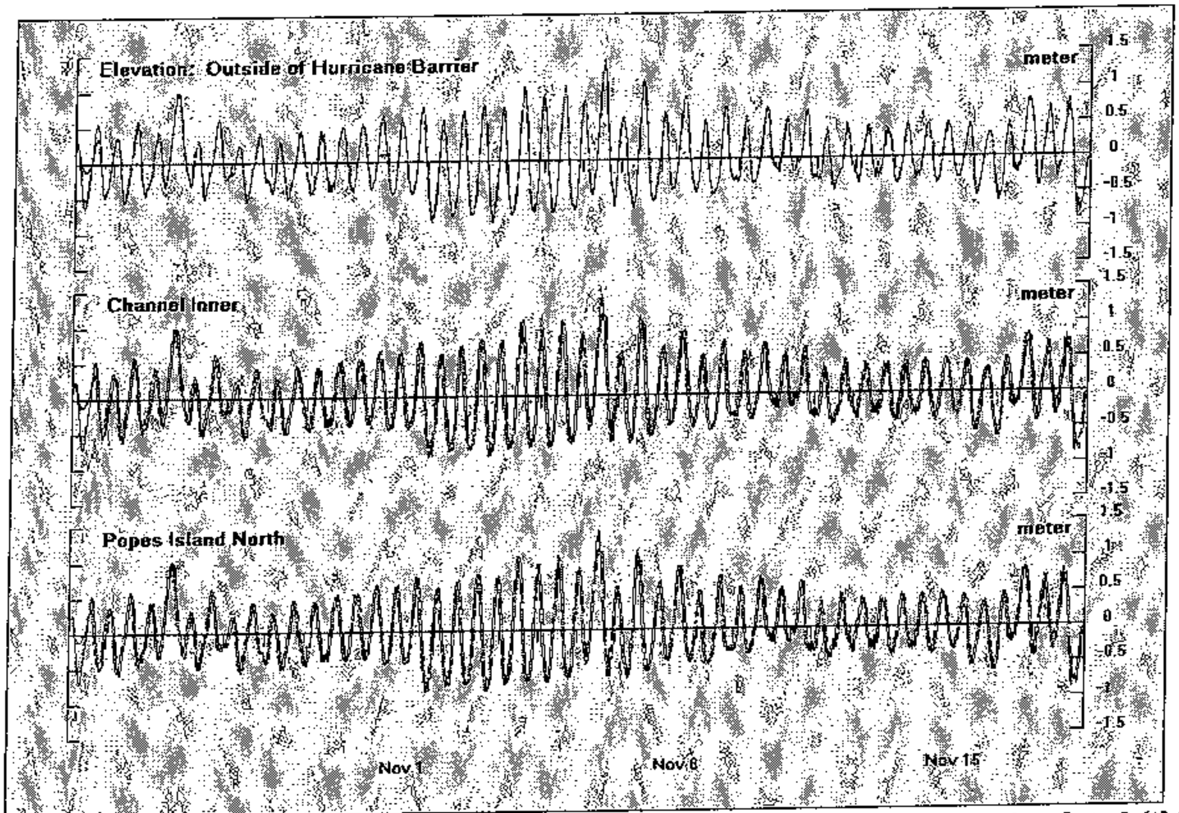


Figure 3-6. Comparisons of elevations: observed (thick blue line) versus simulated (thin red line).

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.

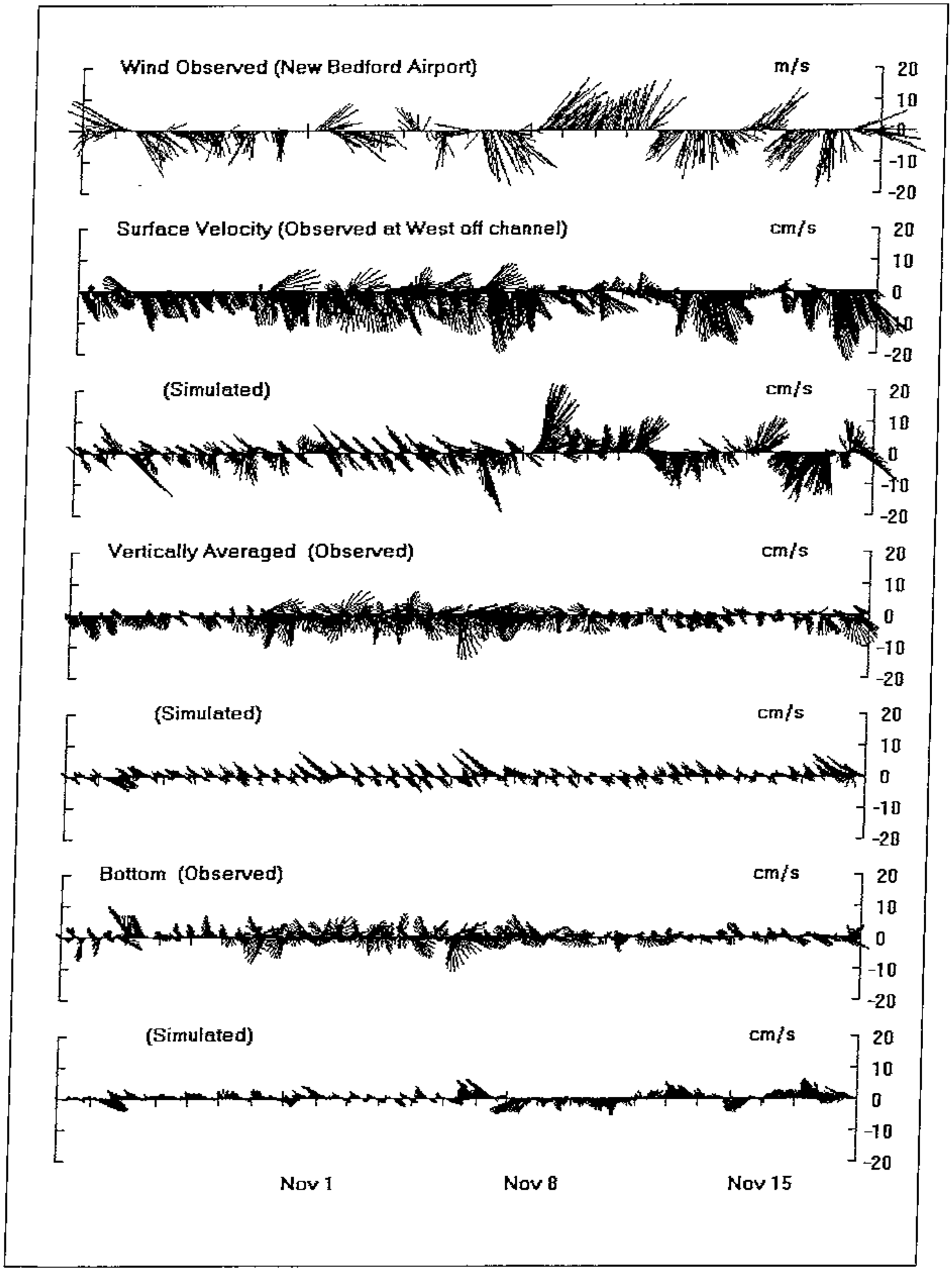


Figure 3-7. Comparison of observed versus simulated velocity at Channel Inner station.

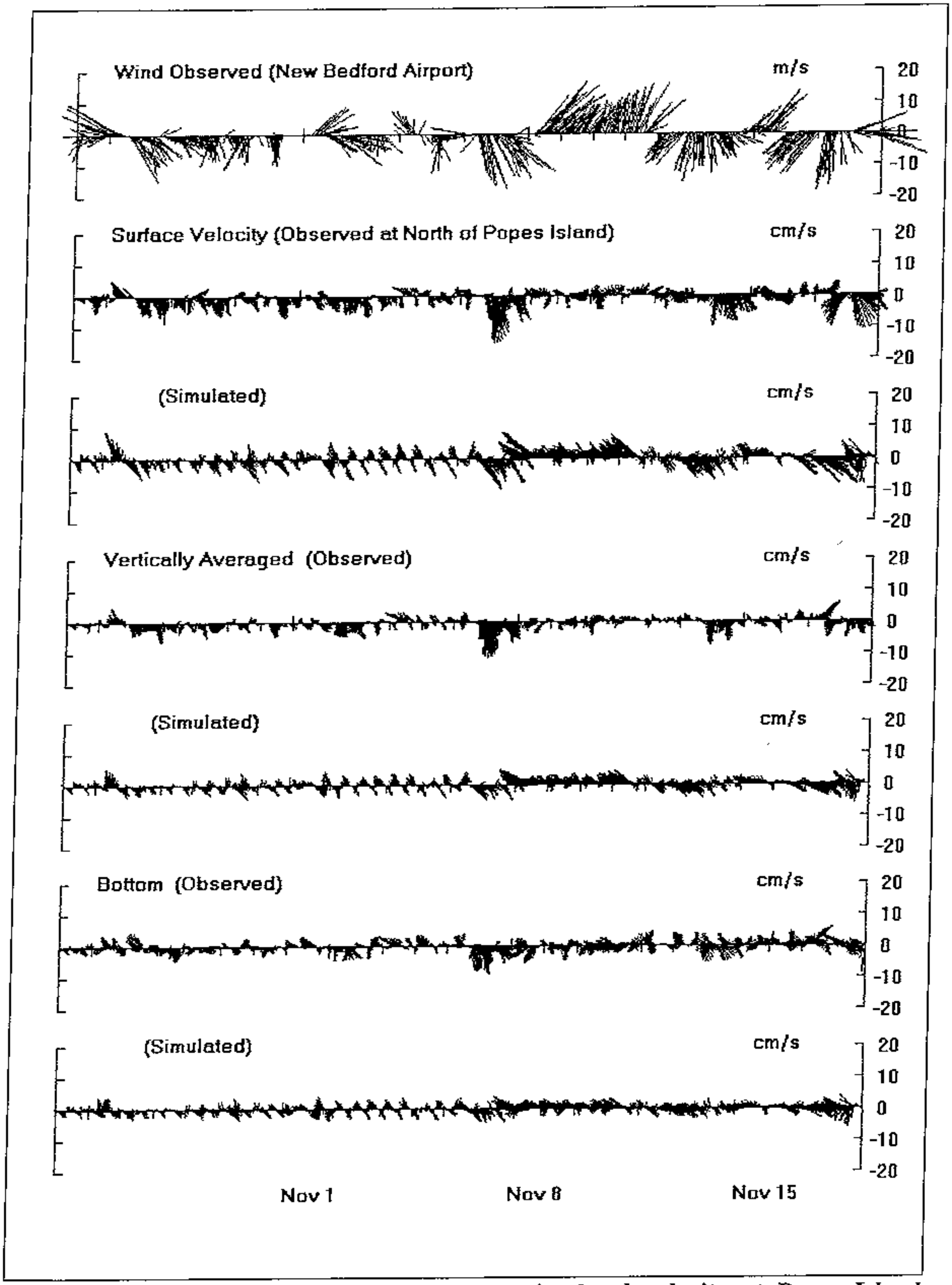


Figure 3-8. Comparison of observed versus simulated velocity at Popes Island north station.

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.

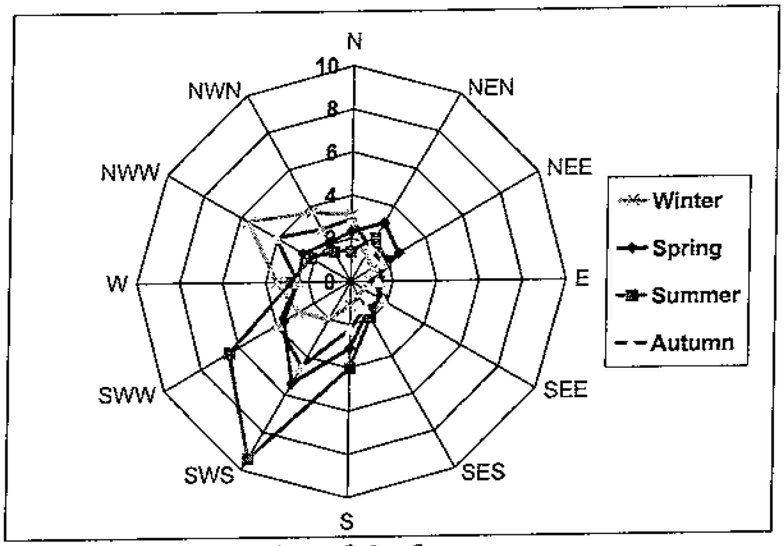


Figure 3-9. Probability of wind direction of the four seasons.

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.

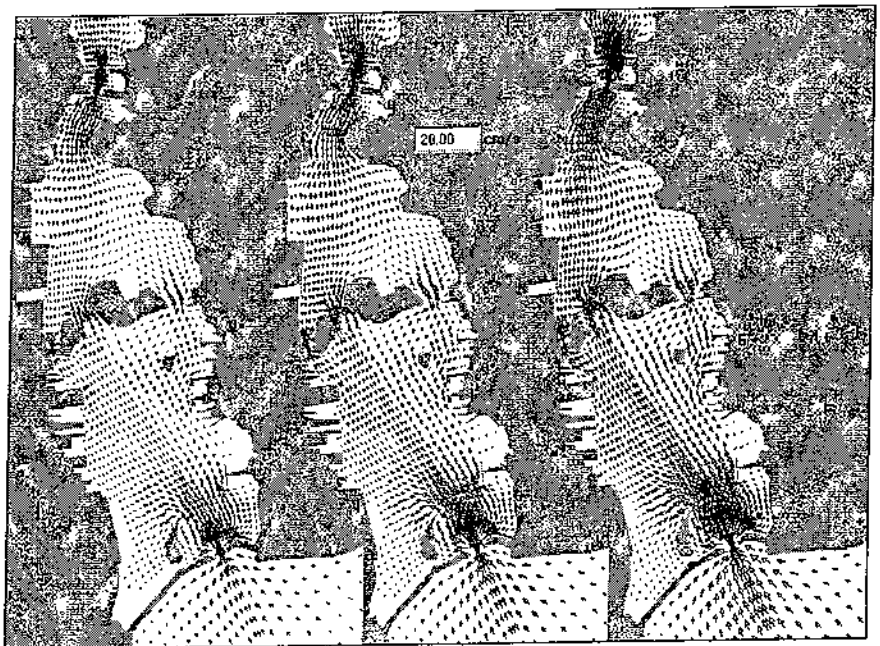


Figure 3-11. Surface flood velocity vectors for neap, normal, and spring (from left to right) tidal conditions under calm wind conditions.

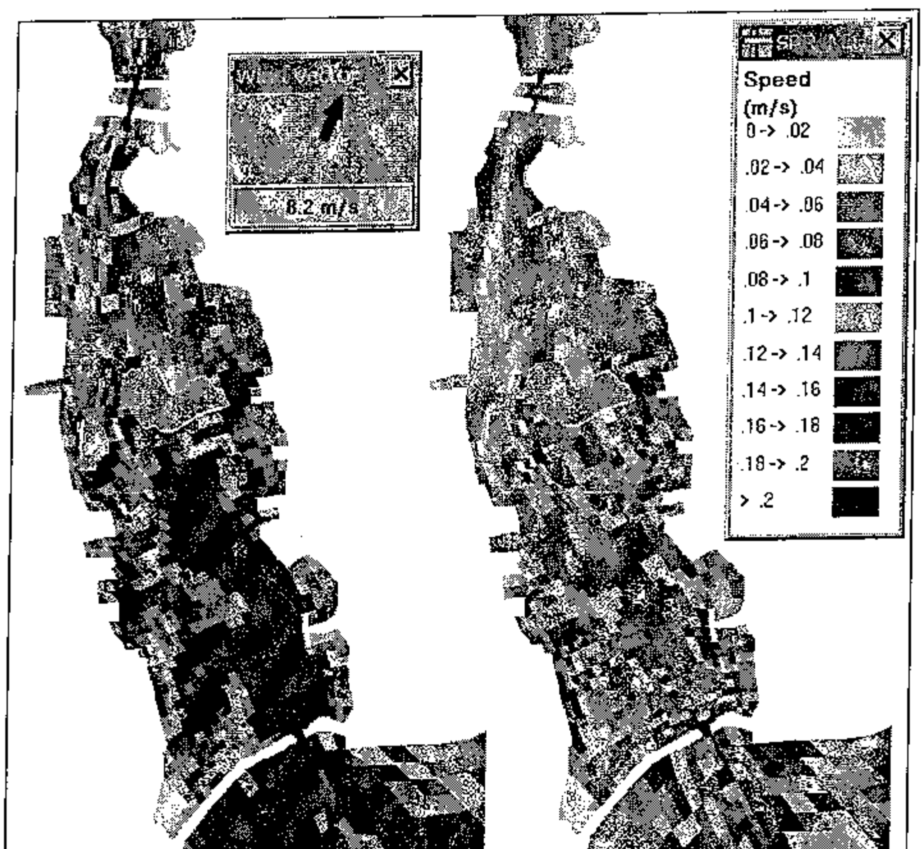


Figure 3-12. Surface (left) and bottom (right) speed contours for SWS wind.

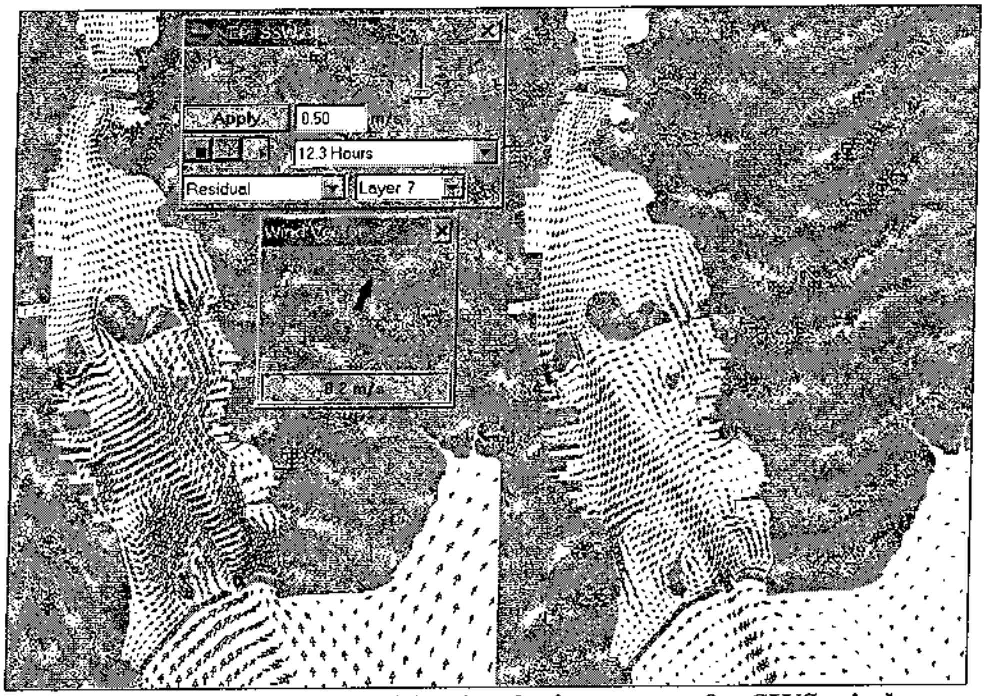


Figure 3-13. Surface (left) and bottom (right) velocity vectors for SWS wind.

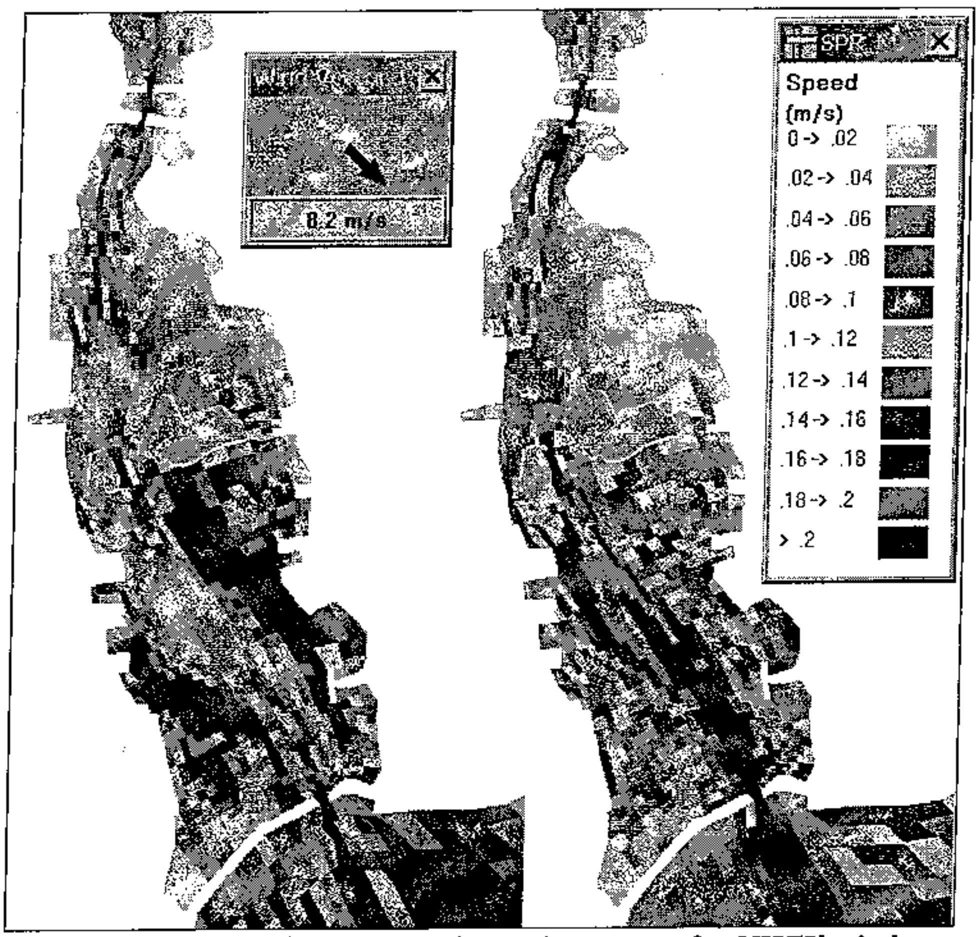


Figure 3-14. Surface (left) and bottom (right) speed contours for NWW wind.

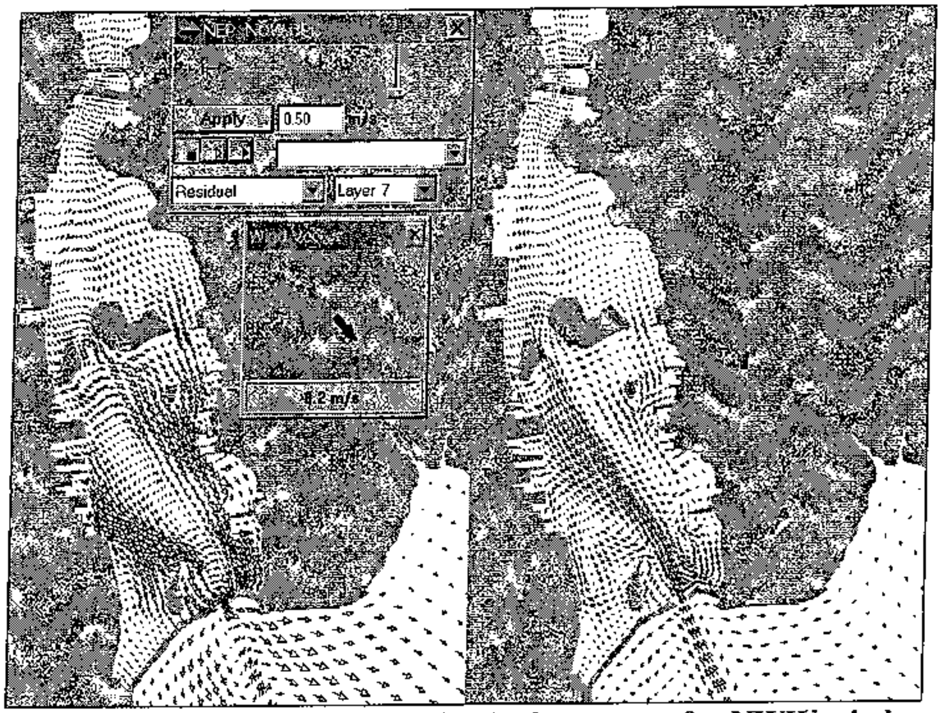


Figure 3-15. Surface (left) and bottom (right) velocity vectors for NWW wind.

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).

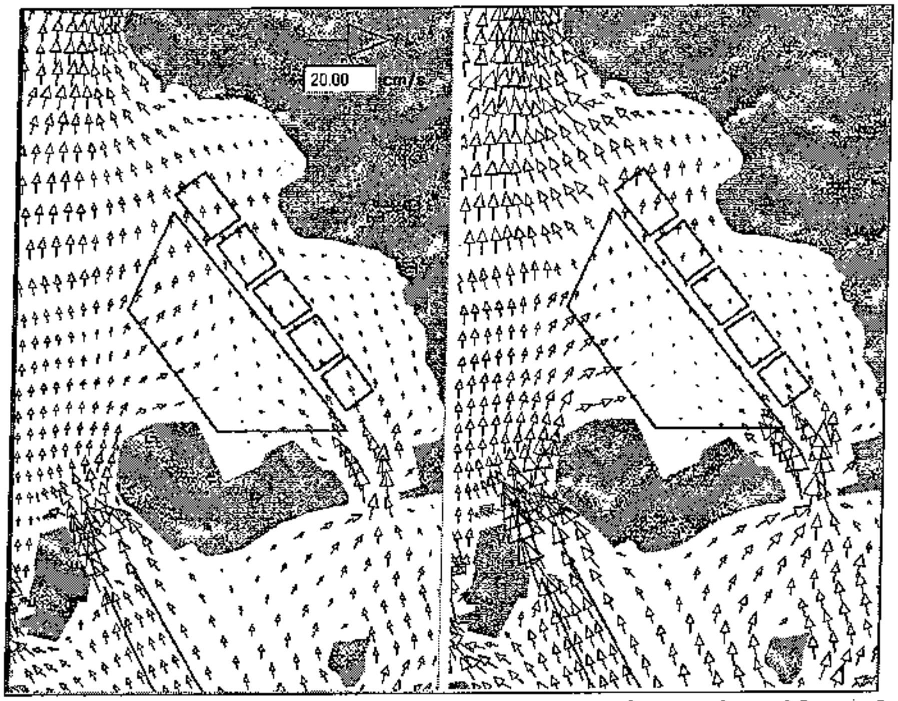


Figure 3-16 Comparison of flood surface velocity vectors for spring tide and calm winds: existing (left) versus excavated (right) bathymetry. Red polygons represent cells in the proposed CAD facility at north of Popes Island.

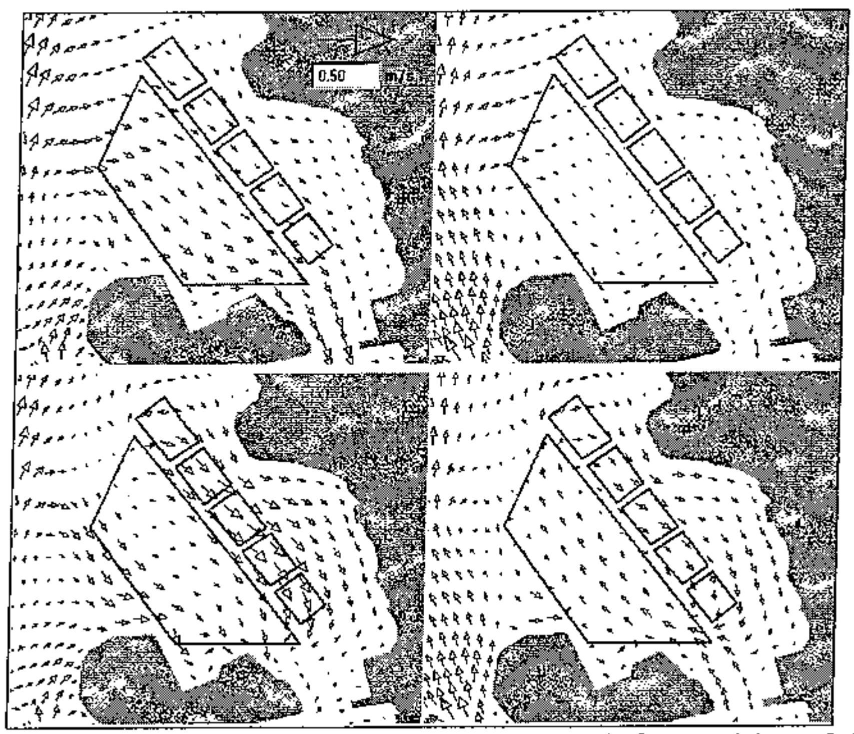


Figure 3-17 Comparison of velocity vectors at surface (left panels) and bottom (right panels) for the NWW wind case, existing (upper panels) versus excavated (lower panels) bathymetry. Red polygons represent cells in the CAD facility at north of Popes Island.

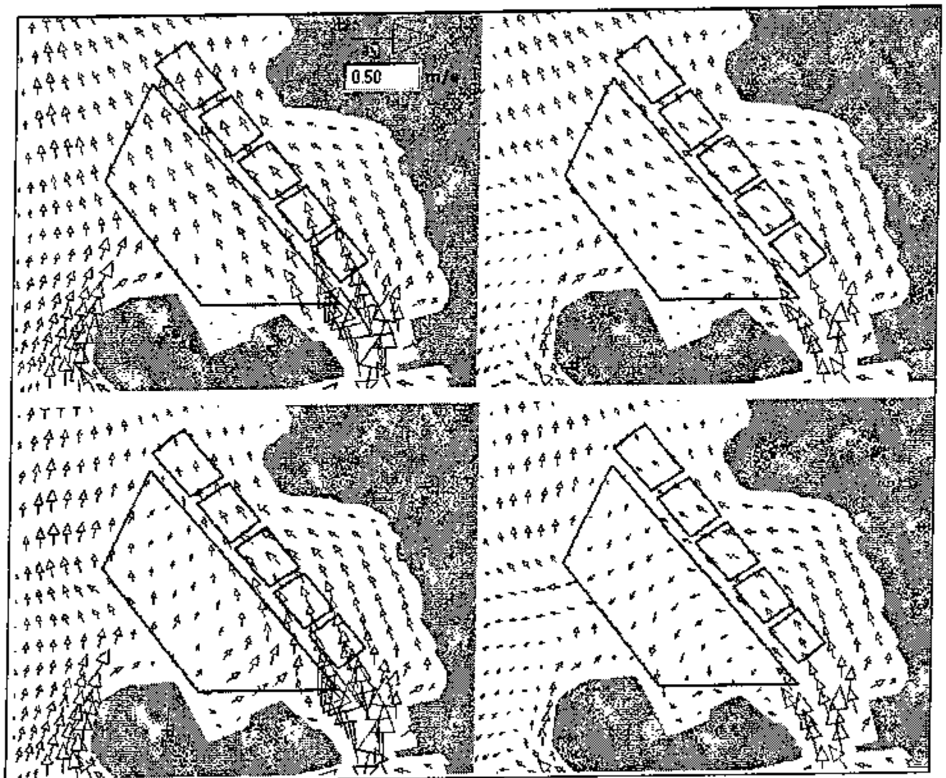


Figure 3-18 Comparison of velocity vectors at surface (left panels) and bottom (right panels) for the SWS wind case, existing (upper panels) versus excavated (lower panels) bathymetry. Red polygons represent cells in the CAD facility at north of Popes Island.

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,

$$(\text{loss rate}) \times (\text{production rate}) \times (\text{solid fraction}) \times (\text{density}) = 1.8 \text{ kg/s}.$$

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

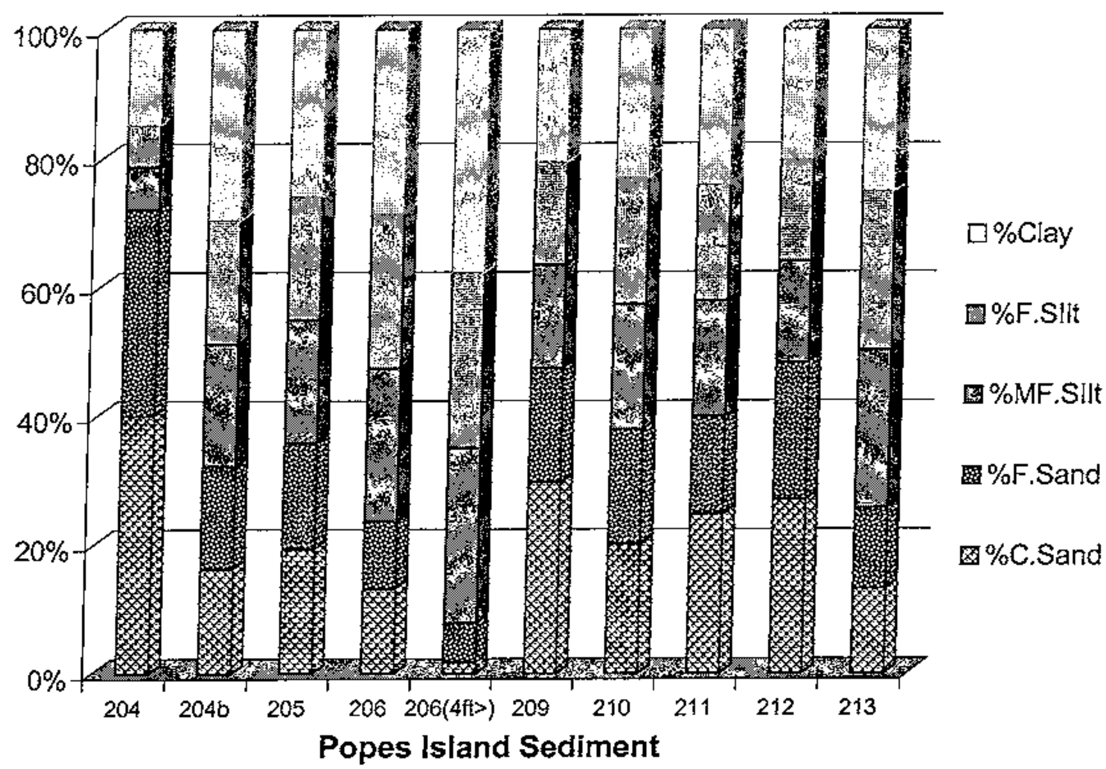


Figure 4-1 Sediment type distributions near the PIN-CAD cell site.

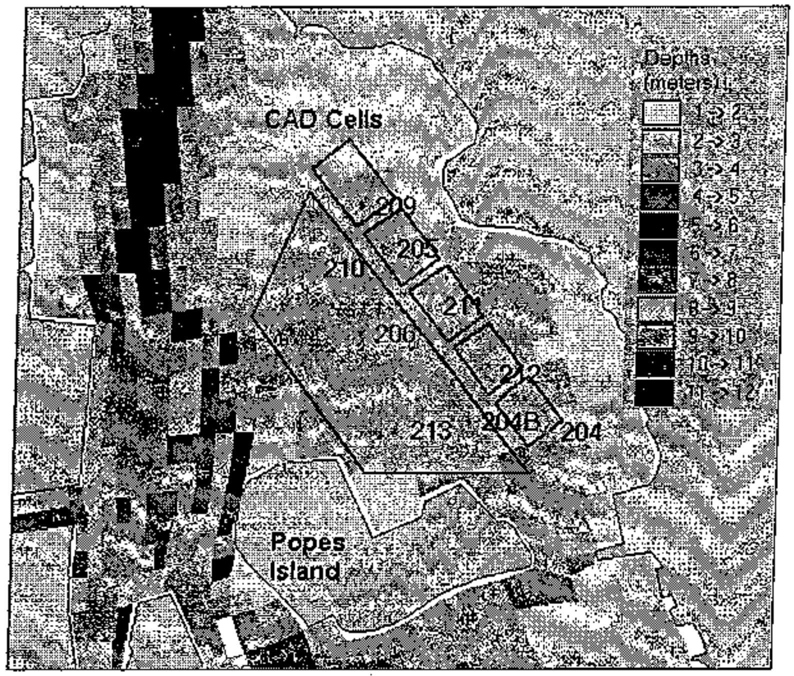


Figure 4-2 Map showing the PIN-CAD cells and sediment sampling stations.

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.

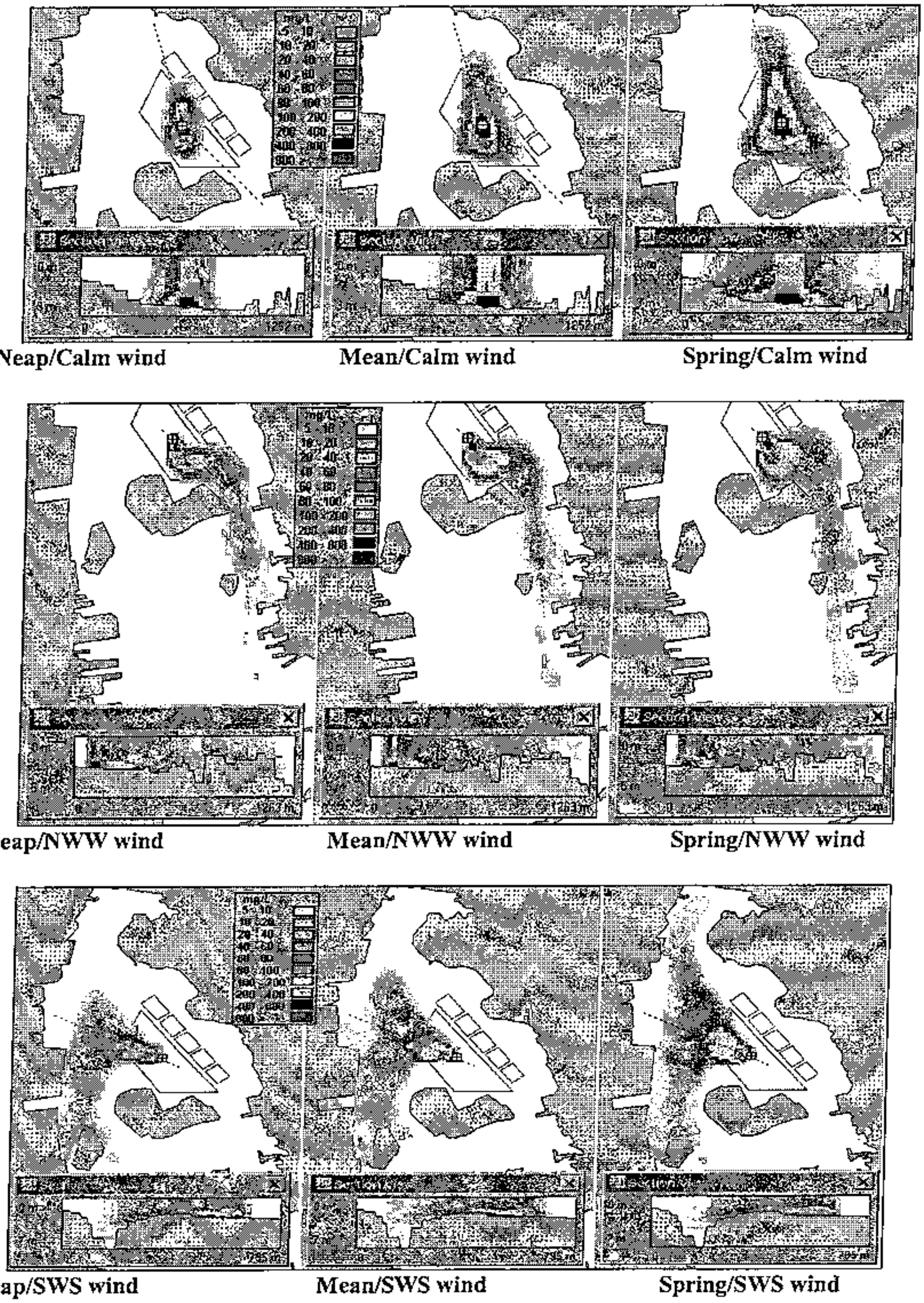


Figure 4.3 Maximum TSS concentrations for the nine circulation scenarios. Inserted in each plan view is a vertical section view along the dashed line.

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).

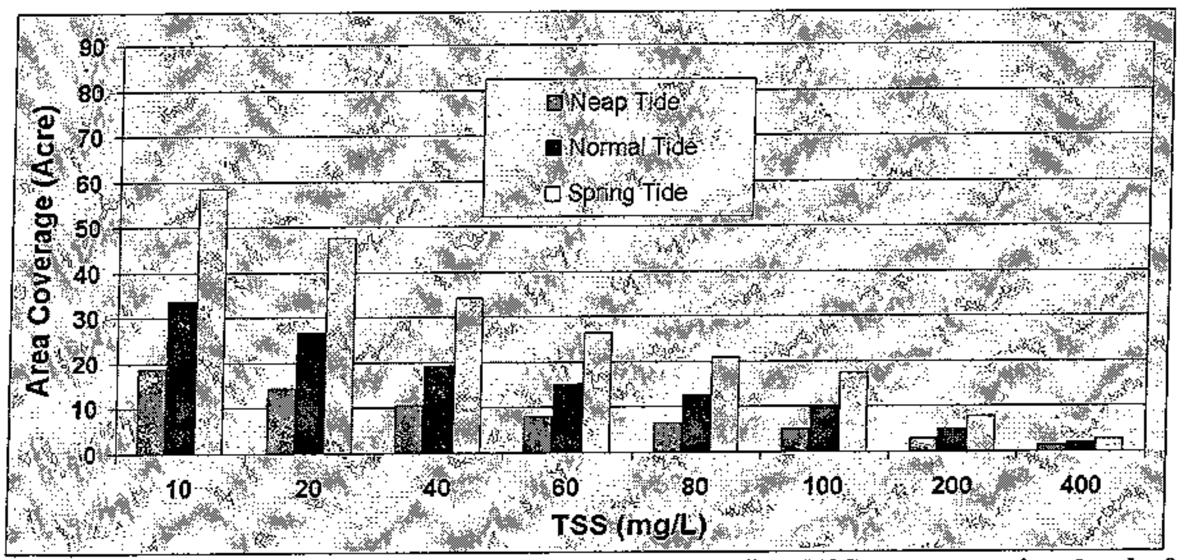


Figure 4-4 Area coverage (acres) of exceeding specified TSS concentration levels for the calm wind (tide only) condition.

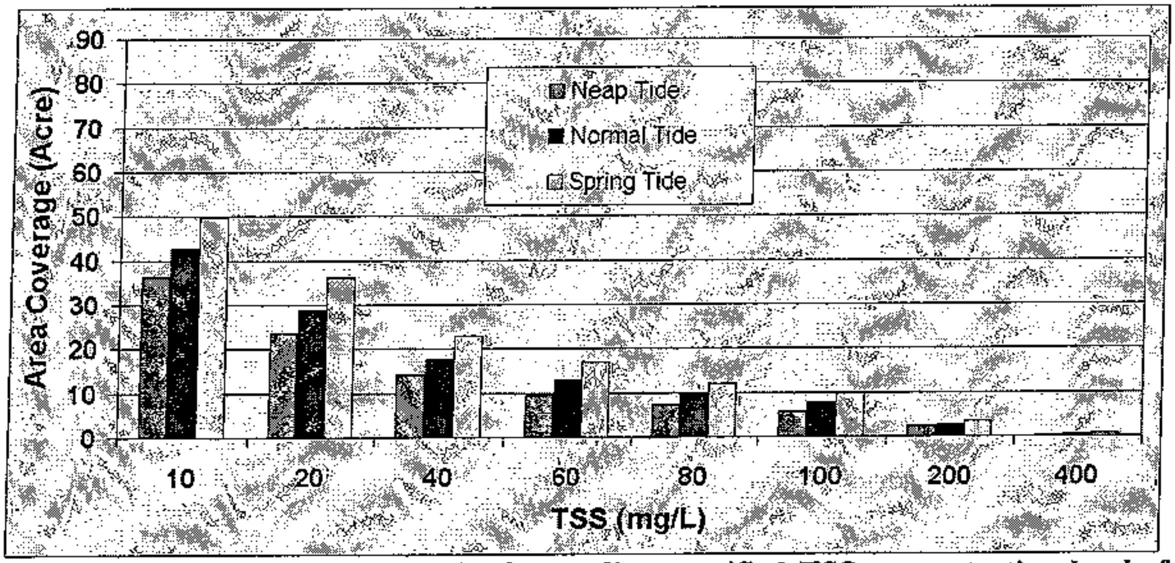


Figure 4-5 Area coverage (acres) of exceeding specified TSS concentration levels for the NWW wind case.

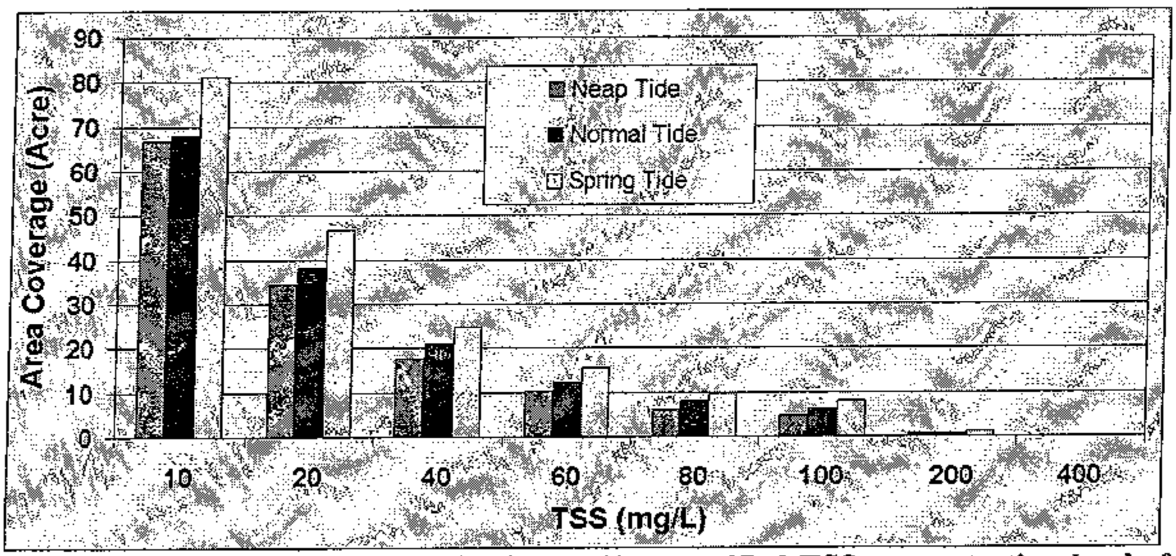


Figure 4-6 Area coverage (acres) of exceeding specified TSS concentration levels for the SWS wind case.

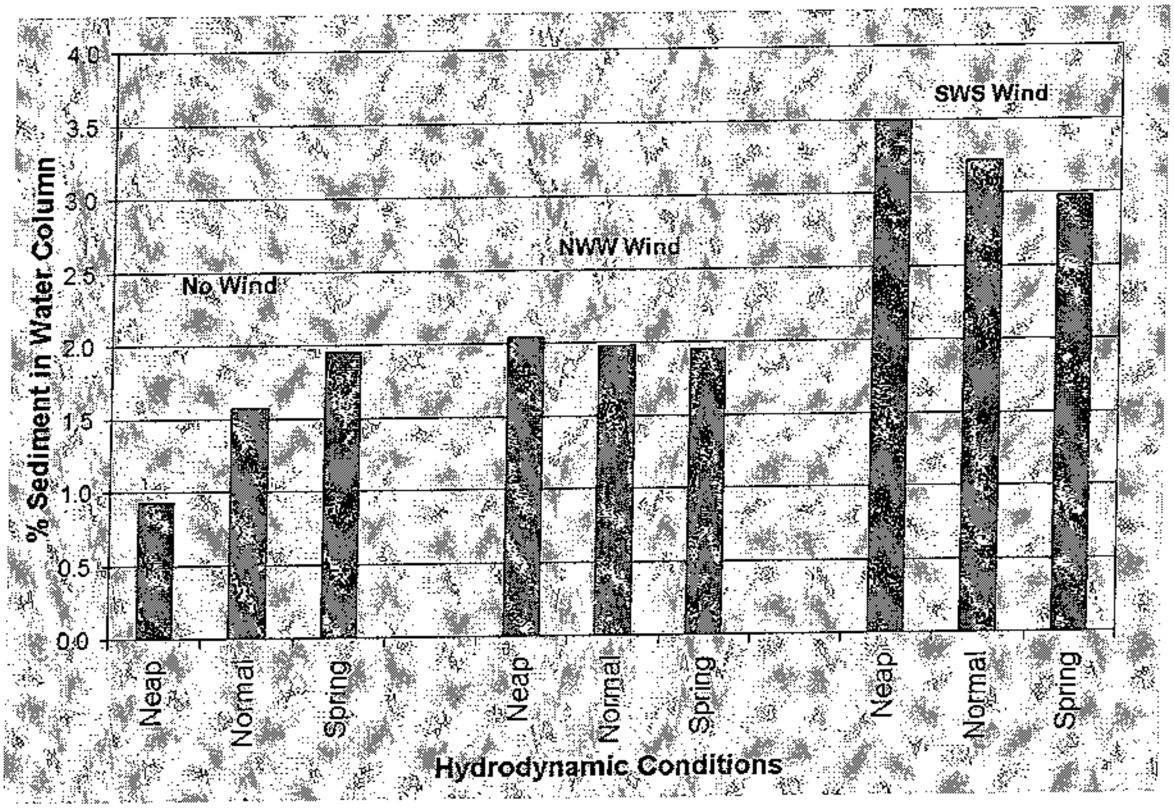


Figure 4-7 Sediment fractions in water column for various hydrodynamic conditions.

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

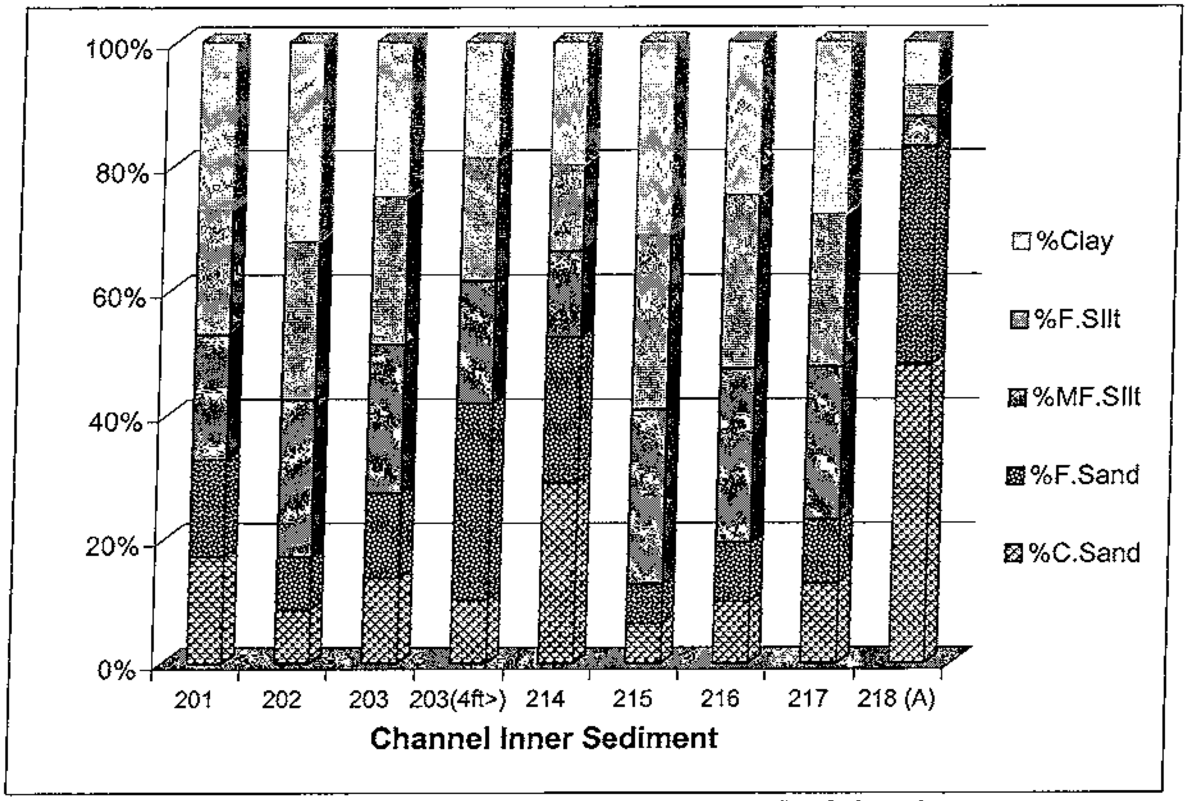


Figure 4-8 Sediment type distributions near Channel Inner dredging site.

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:

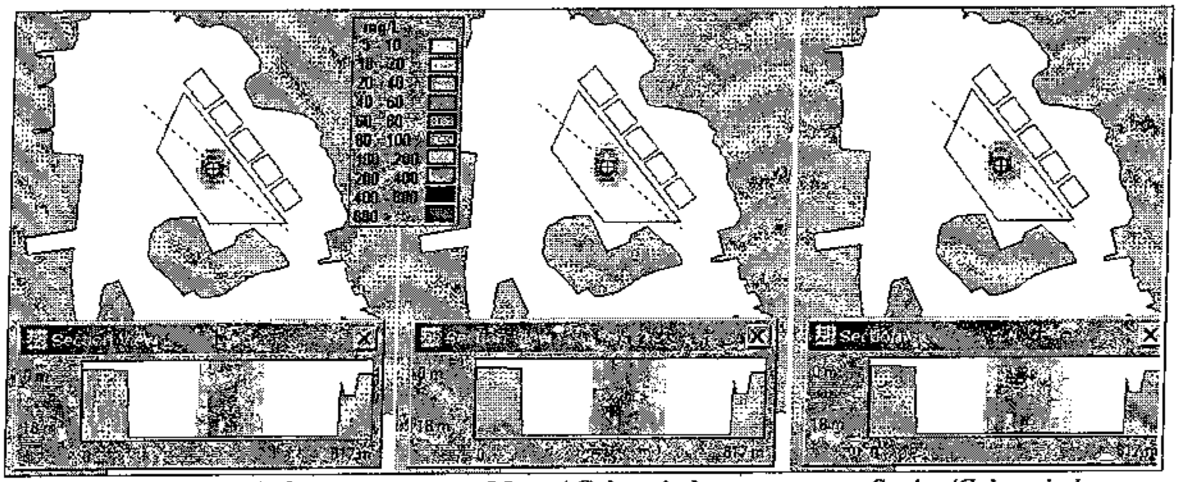
- Horizontal and vertical view of TSS distribution
- Time series of acreage of exceeding 10 mg/L concentration levels

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.

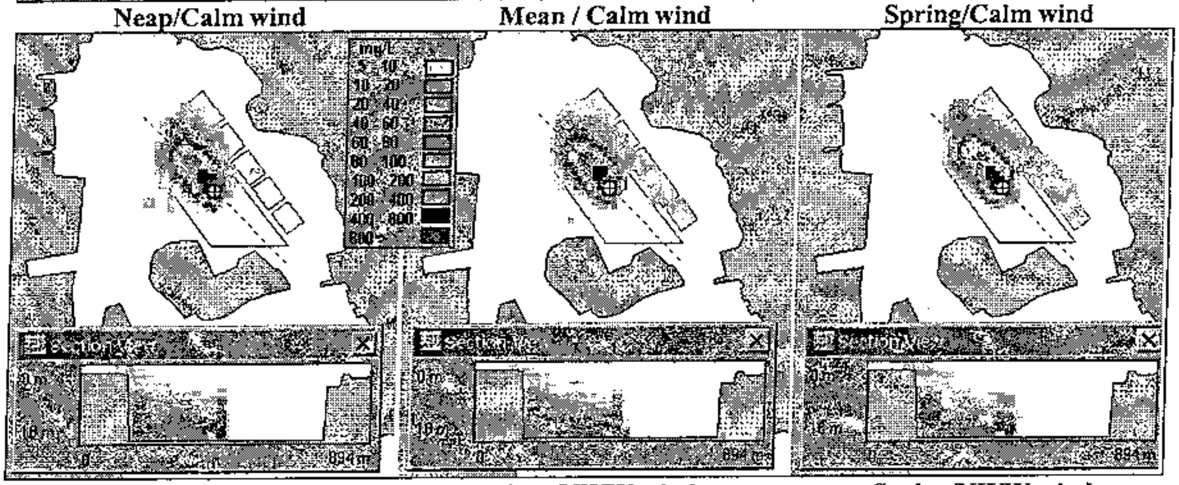
All TSS concentration distributions for the tide only scenarios were confined within the PIN-CAD cell since the circulation is too weak (see Figure 3-16) to transport material very far. For the NWW and SWW wind cases, sediment clouds reach the edge of the CAD cells, although most of the sediment remained 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.

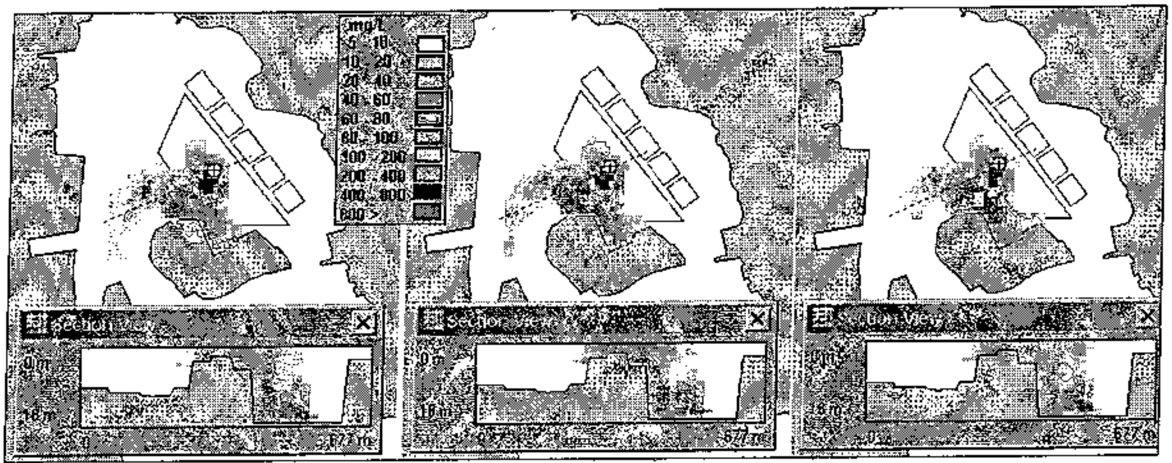
Figure 4-11 shows the area coverage that exceeds a TSS concentration of 10 mg/L (approximately the background threshold) in time. For the case of wind driven circulation, the sediment cloud dissipates within ~ 3 hours. The calm wind tide cases take much longer to settle as most sediment stays in the 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.

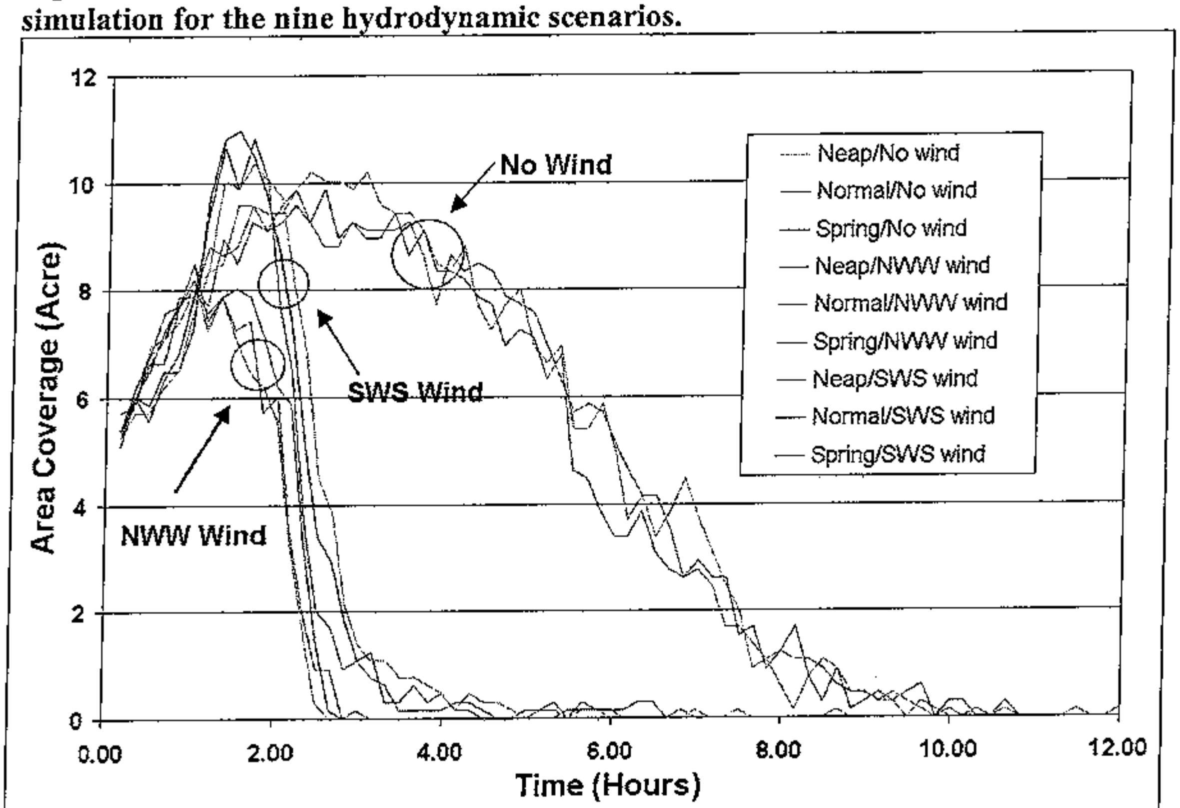


Figure 4-11. Time series of area coverage (acre) that exceeds TSS concentration of 10mg/L for the nine hydrodynamic scenarios.

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

$$
\begin{aligned}
m\ (\mu g) &= EV \\
&= E\ (\mu g/L) \times 0.9\ (L) \qquad (1) \\
&= 0.9\ E\ (\mu g)
\end{aligned}
$$

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/10^6μg).

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).

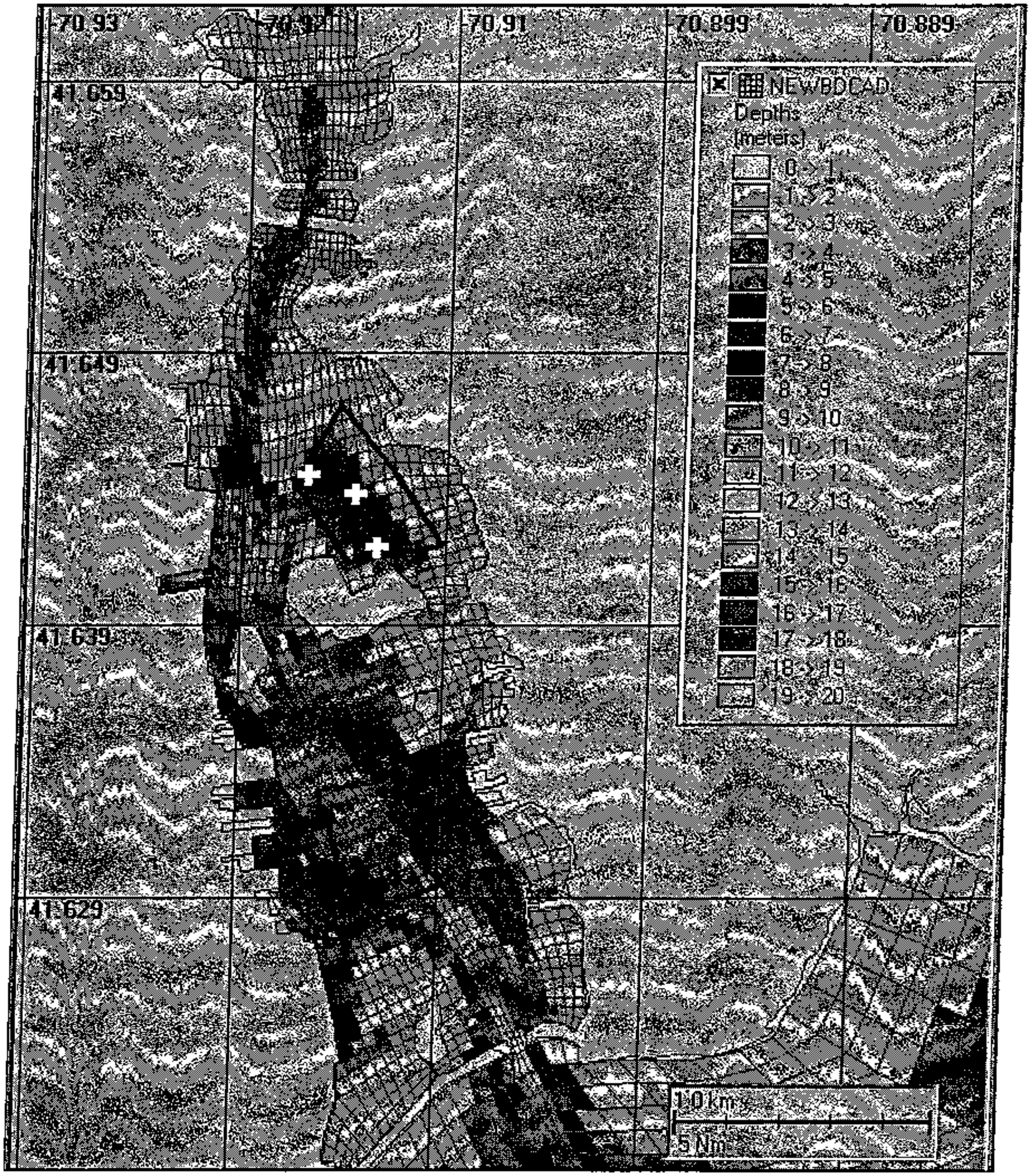


Figure 5-1. Modeled mass load locations (white crosses) used to simulate disposal operations in PIN-CAD site (black polygon), superimposed on bathymetry.

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 (≤ 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.

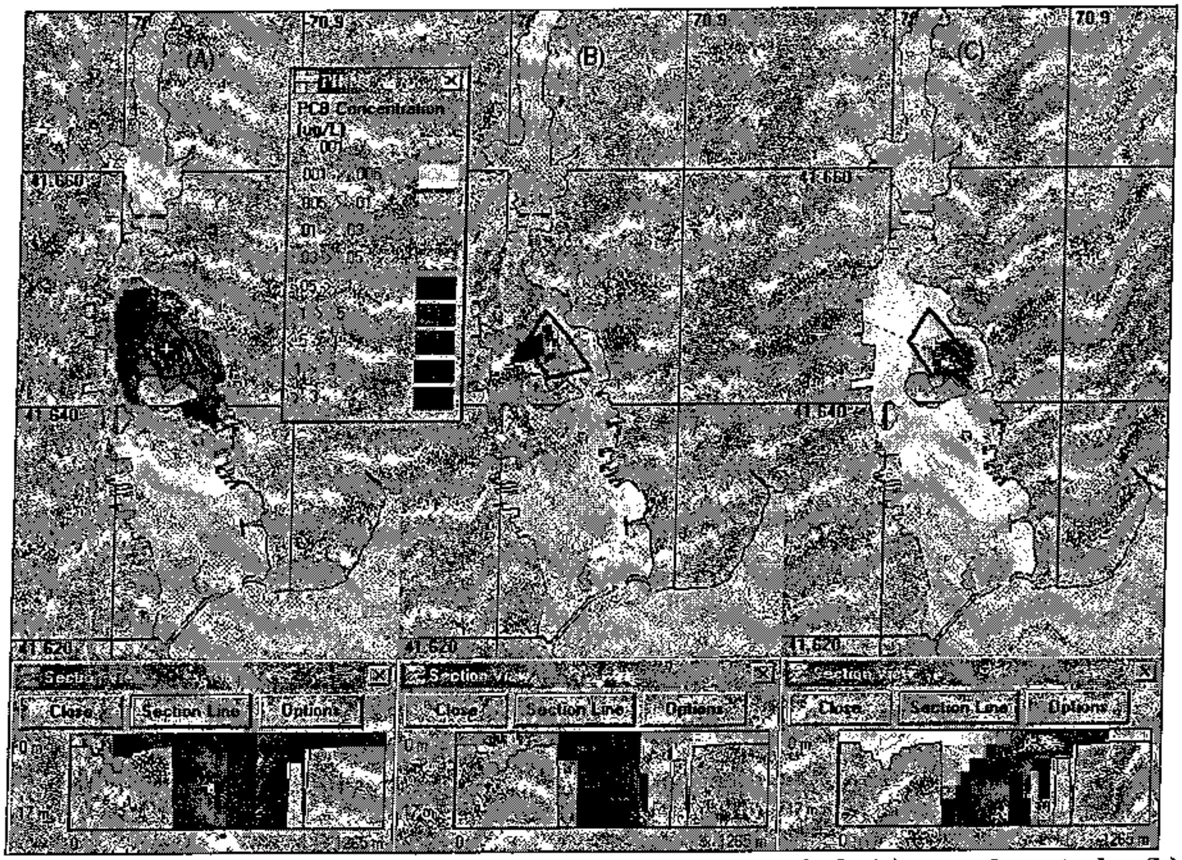


Figure 5-2. Simulated PCB distributions for calm wind (a), southwesterly (b) and northwesterly winds (c). Distributions are shown 1 hour after the final disposal event.

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

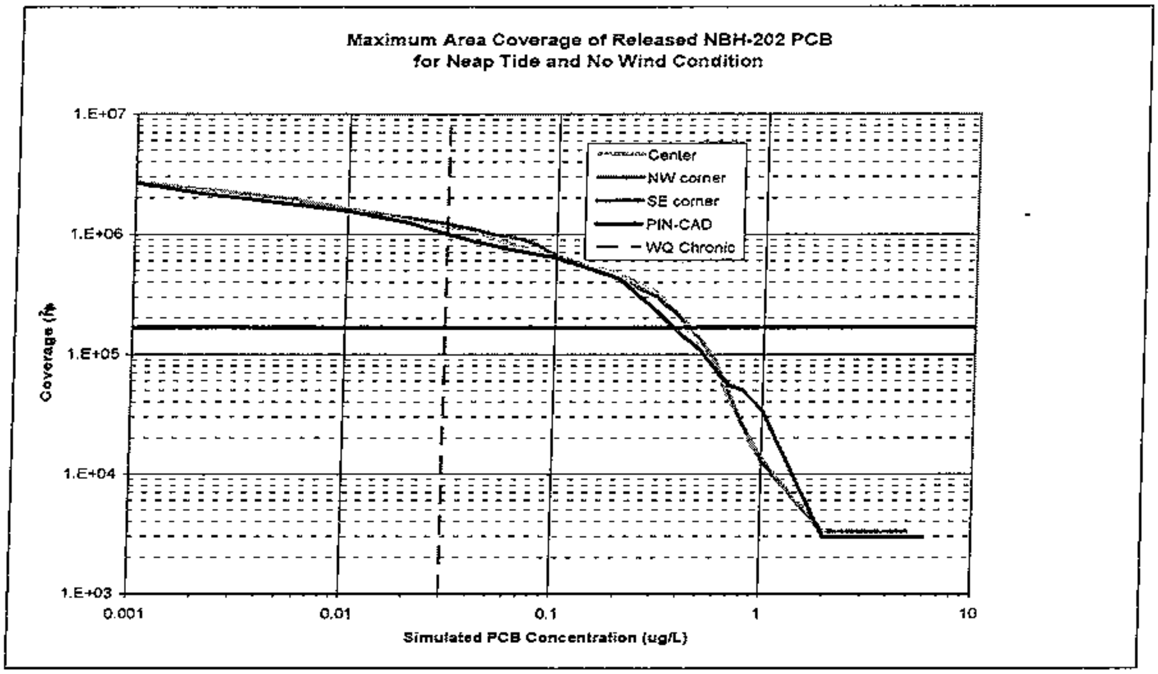


Figure 5-3. Maximum area coverages (y-axis) of PCBs vs. concentrations for neap tides and calm winds for three release sites using the NBH-202 station source strength. Both x- and y-axes are logarithmic scales. The PIN-CAD cell area (1.67×10^5 m^2) is shown with a black horizontal line and the U. S. EPA WQ chronic value for PCB (0.03 µg/L) is shown with a dashed vertical line.

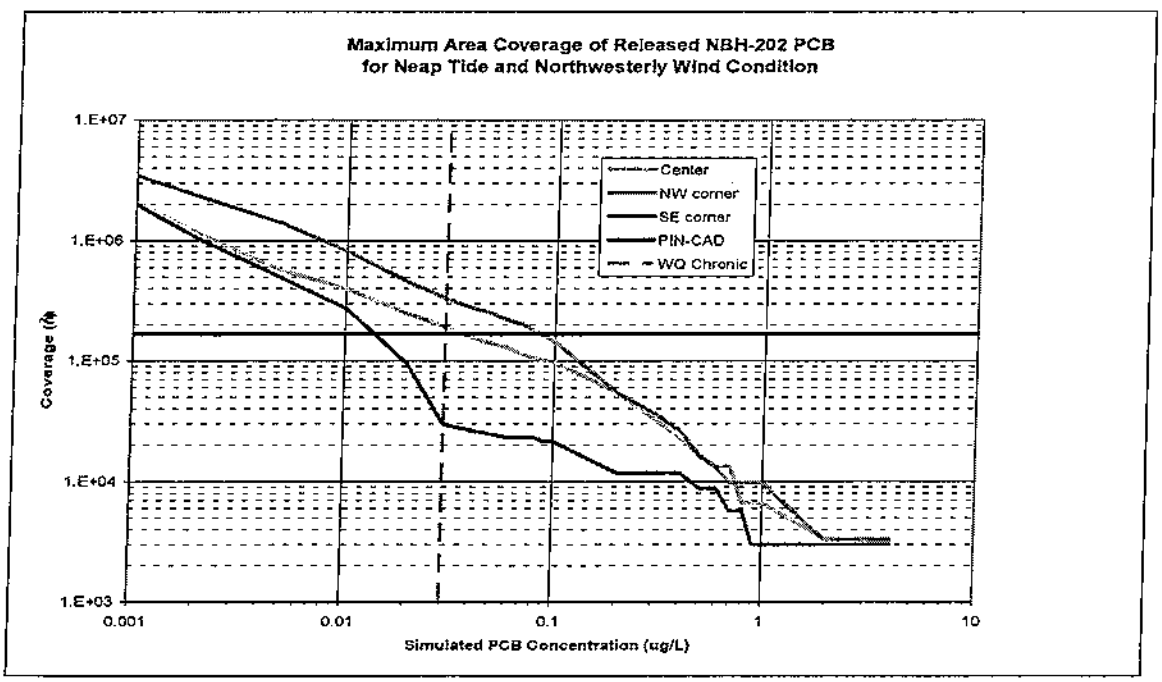


Figure 5-4. Maximum area coverages (y-axis) of PCBs vs. concentrations for neap tides and northwesterly winds for three release sites using the NBH-202 station source strength. Both x- and y-axis are logarithmic scale. The PIN-CAD cell area (1.67×10^5 m^2) is shown with a black horizontal line and the 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

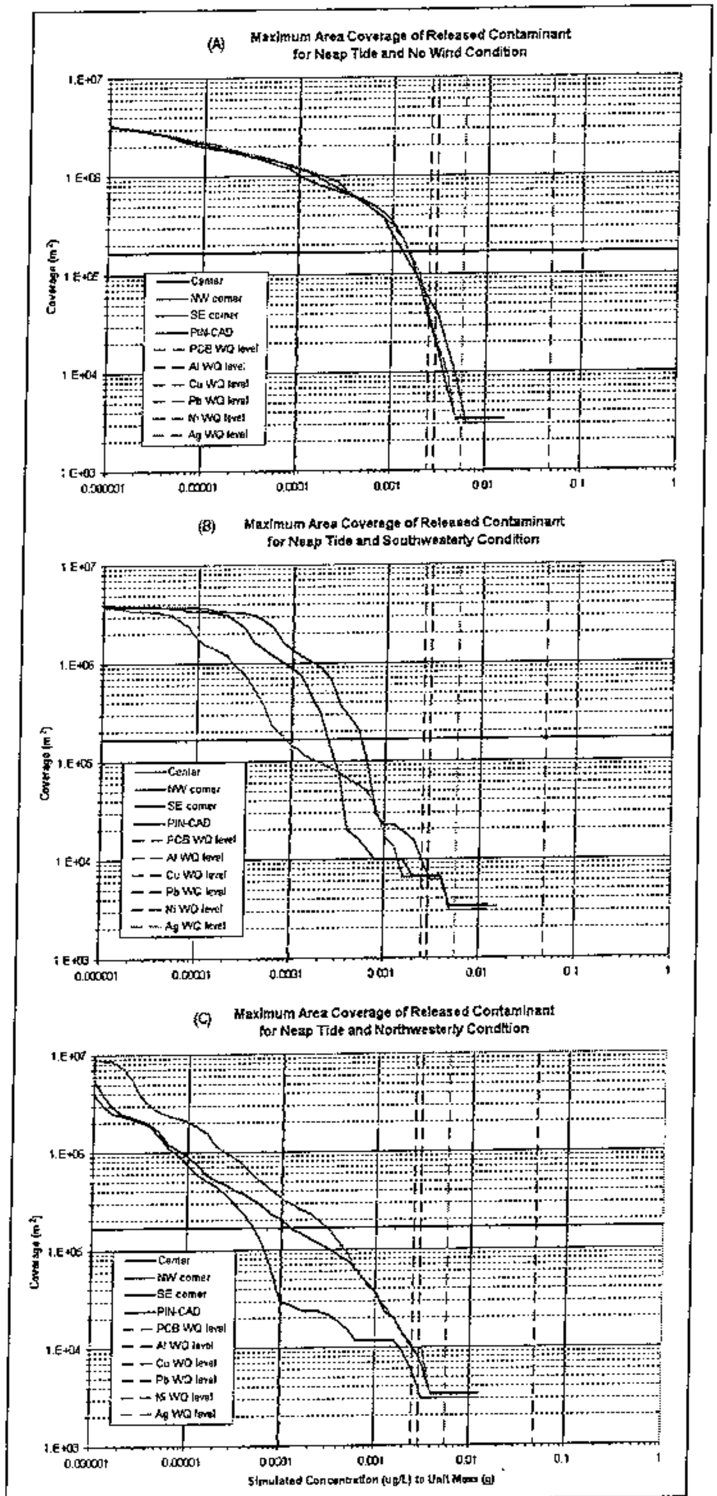


Figure 5-5. Maximum area coverages (solid lines) for neap tides and calm (a), southwesterly (b) and northwesterly winds (c). Dashed lines denote U. S. EPA WQ chronic concentrations normalized to input mass.

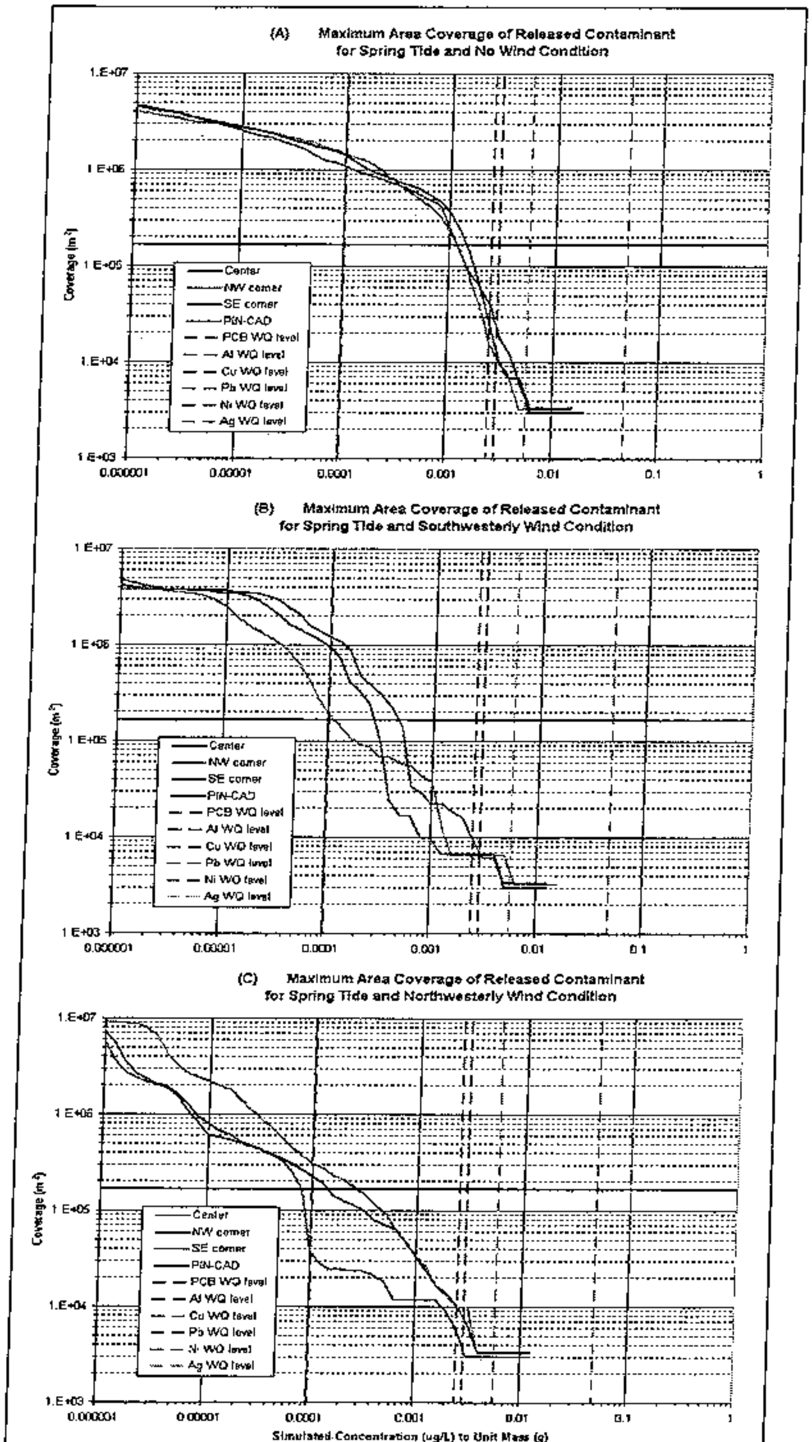


Figure 5-6. Maximum area coverages (solid lines) for spring tides and calm (a), southwesterly (b) and northwesterly winds (c). Dashed lines denote U. S. EPA WQ chronic concentrations normalized to input mass.

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.

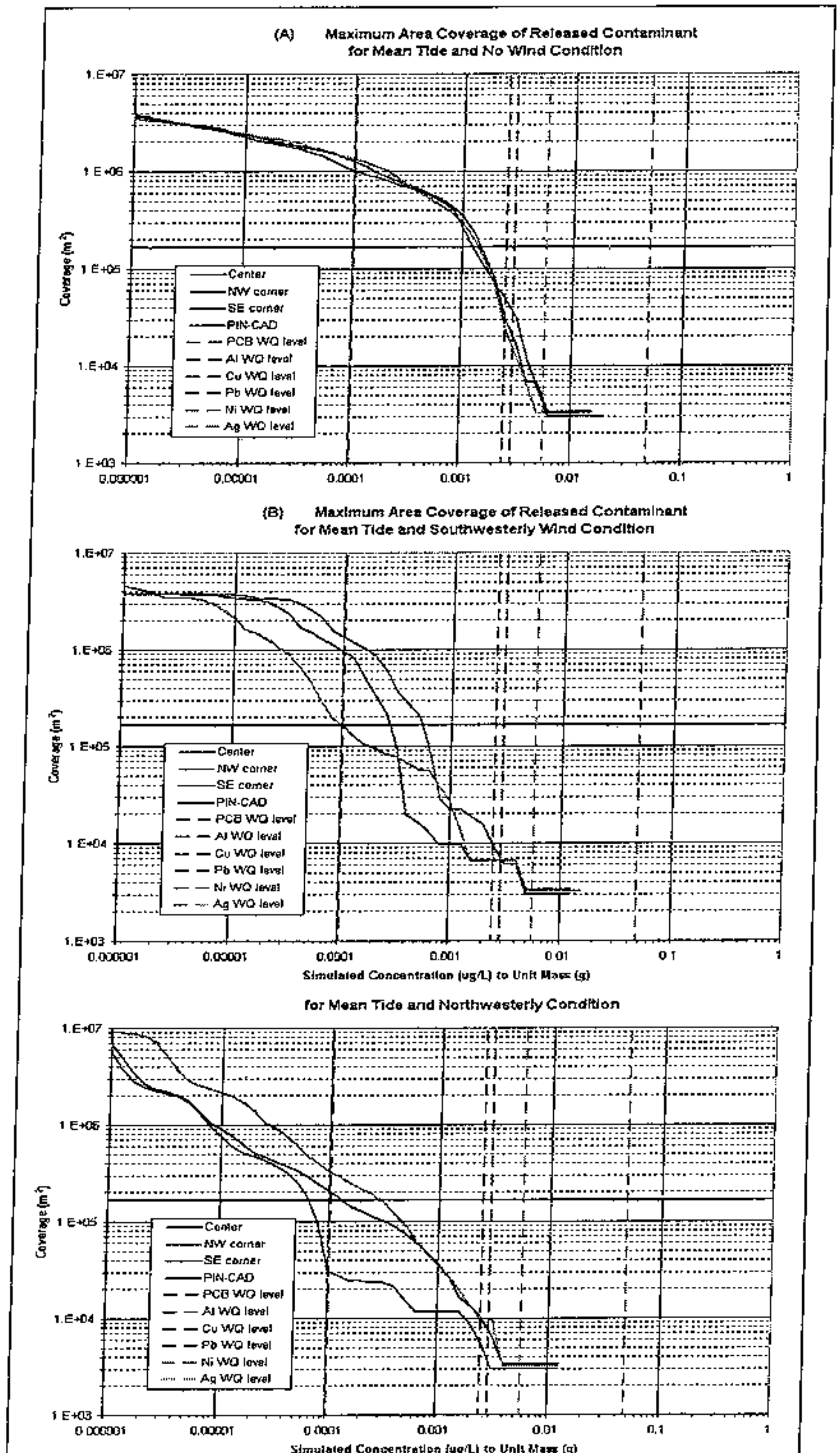


Figure 5-7. Maximum area coverages (solid lines) for mean tides and calm (a), southwesterly (b) and northwesterly winds (c). Dashed lines denote U. S. EPA WQ chronic concentrations normalized to input mass.

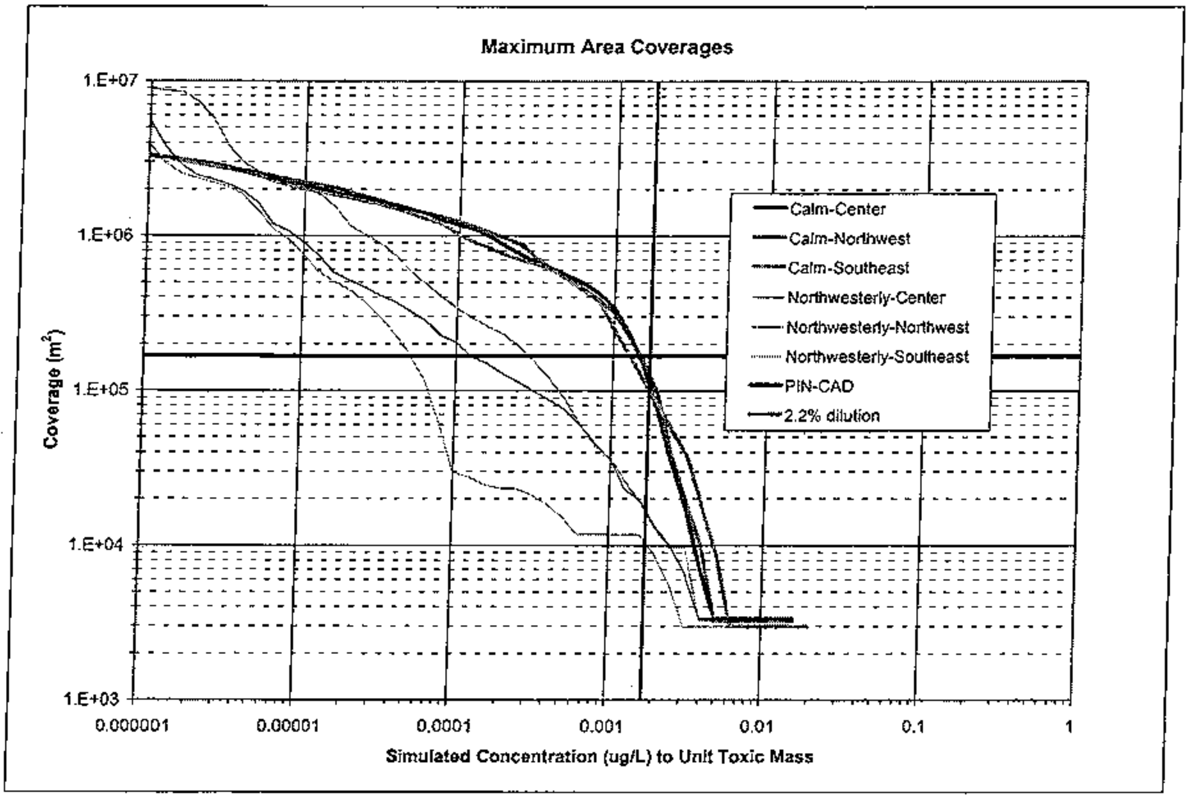


Figure 5-8. Maximum area coverage for released toxic material for calm and northwesterly winds.

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.

7. References

Abdelrhman, M. A. and E. H. Dettmann, 1995. Modeling of current circulation, residence time, and salinity distribution in New Bedford Harbor, MA. U. S. Environmental Protection Agency, Environmental Research Laboratory, Narragansett, RI.

Abdelrhman, M.A., Modeling How a Hurricane Barrier in New Bedford Harbor, Massachusetts, Affects the Hydrodynamics and Residence Times, Estuaries, Vol. 25. No. 2, P.177-196, April 2002.

Ambrose, R.B. et al, 1993. The Water Quality Analysis Simulation Program, WASP5 Part A: Model Documentation, Part B: The WASP5 Input Data Set. U.S. Environmental Protection Agency, Athens, GA.

Anderson, E., B. Johnson, T. Isaji and E. Howlett, 2001. SSFATE (Suspended Sediment FATE), a model of sediment movement from dredging operations. Presented at WODCON XVI World Dredging Congress, 2-5 April 2001, Kuala Lumpur, Malaysia.

Applied Science Associates, Inc, 1987. Selected studies of PCB transport in New Bedford Harbor. Applied Science Associates, Inc., Narragansett, RI. 193 pp.

Applied Science Associates, Inc., 1999. User's Technical Manual for WQMAP for Windows. Applied Science Associates, Inc. 126 pp.

Applied Science Associates, Inc, 2001. ASA 01-100 Report: Preliminary Dredged Material Transport Modeling in New Bedford Harbor. 30pp.

Applied Science Associates, Inc, 2003. Flushing Analysis in the Acushnet River Estuary. ASA Report 01-123. 138pp.

Averett, D. E., 1989. New Bedford Harbor Superfund Project, Acushnet River Estuary Engineering Feasibility Study of Dredging and Dredged Material Disposal Alternatives, Report 3, Characterization and Elutriate Testing of Acushnet River Estuary Sediment. Technical Report EL-88-15. Waterways Experiment Station, Corps of Engineers, Vicksburg, Mississippi.

Collection (TN DOER-E12). U.S. Army Engineer Research and Development Center, Vicksburg, MS. http: //www.wes.army.mil/el/dots/doer/pdf/doere12.pdf.

Coastal Zone Management, City of New Bedford and Town of Fairhaven, 2002. Draft Environmental Impact Report (DEIR) for New Bedford and Fairhaven Massachusetts. Dredged Material Management Plan (DMMP) EOEA No. 11669.

DOER Technical Notes Collection (TN DOER-E10). U.S. Army Engineer Research and Development Center, Vicksburg, MS. http: //www.wes.army.mil/el/dots/doer/pdf/doere10.pdf.

ENSR, International, 2002. Boston Harbor Navigation Improvement Project Phase 2 Summary Report.

Galagan C., Swanson, C., and T. Isaji, 2001. Simulations of Sediment Transport and Deposition from Jet Plow and Excavation Operations for the Cross Hudson Project, Prepared for Environmental Science Services, Inc. Wellesley, MA. ASA Project 99-063.

Johnson, B. H., 1990. User's guide for models of dredged material disposal in open water. Technical Report D-90-5. Waterways Experiment Station, Corps of Engineers, Vicksburg, Mississippi.

Johnson, B.H., E. Anderson, T. Isaji, and D.G. Clarke, 2000. Description of the SSFATE numerical modeling system.

Malcolm Pirnie, Inc. 1982. The Commonwealth of Massachusetts. Acushnet River Estuary, PCB Study. December 1982.

Mendelsohn, D, T. Isaji and H. Rines, 1995. Hydrodynamic and water quality modeling of Lake Champlain. *Report to Lake Champlain Management Conference*, Burlington, VT, ASA Report 92-034.

Muin, M. 1993. A Three-Dimensional Boundary Fitted Circulation Model in Spherical Coordinates. *Ph. D. Dissertation*, Department of Ocean Engineering, University of Rhode Island, Kingston, RI.

Muin, M. and M. L. Spaulding, 1996. Two-dimensional boundary fitted circulation model in spherical coordinates. In: *Journal of Hydraulic Engineering*, Vol. 122, No. 9, September 1996, and p. 512-521.

Muin, M. and M. L. Spaulding, 1997a. Application of Three-dimensional boundary fitted circulation model to Providence River. *ASCE Journal of Hydraulic Engineering*. Vol. 123, No. 1.

Muin, M. and M. L. Spaulding, 1997b. Three-dimensional boundary fitted circulation model. In: *Journal of Hydraulic Engineering*, Vol. 123, No. 1, pp. 2-12.
Officer, C. B., 1976. Physical Oceanography of Estuaries (and Associated Coastal Waters). John Wiley & Sons. 465pp.

National Geophysical Data Center, GEOphysical Data System for Hydrographic Survey Data, National Ocean Service, Ver. 4. 1998

NUS. 1984. Draft Feasibility Study of the Remedial Action Alternatives - Acushnet River Estuary Above Coggeshall Street Bridge, New Bedford, Massachusetts.

SAIC, 2002. Laboratory Testing in Support of Site Specific Water Quality Criteria Assessment and Hydrographic Data Collection for New Bedford Harbor, Task 2A, Suspended Particulate

Phase Toxicity Testing with Mysids, Data Report. Submitted by Science Applications International Corporation, Newport, RI, 12 December 2002.

Signell, R. 1987. Tide- and Wind-Forced Currents in Buzzards Bay, Massachusetts. WHOI-87-15 Technical Report. pp 86.

Swanson, J. C., 1986. A three dimensional numerical model system of coastal circulation and water quality. Ph. D. Thesis, Dept. of Ocean Engineering, University of Rhode Island, Kingston, RI.

Swanson, J.C., D. Mendelsohn, 1993. Application of WQMAP to upper Narragansett Bay, Rhode Island. Estuarine and Coastal Modeling III. Proceedings of the 3rd International Conference, sponsored by the Waterway, Port, Coastal and Ocean Division of the ASCE, Oak Brook, IL, September 8-10, 1993.

Swanson, C. J., and D. Mendelsohn, 1995. Modeling Results to Assess Water Quality Impacts from Dredged Material Disposal Operations for the Boston Harbor Navigation Improvement Project. Applied Science Associates, Inc. 53pp.

Swanson, J. C., and D. Mendelsohn, 1996. Water quality impacts of dredging and disposal operations in Boston Harbor. Presented at: *ASCE North American Water and Environmental Congress '96 (NAWEC '96)*, Anaheim, CA, June 22-28, 1996.

Spaulding, M., D. Mendelsohn and J.C. Swanson, 1999. WQMAP: An integrated three-dimensional hydrodynamic and water quality model system for estuarine and coastal applications. Marine Technology Society Journal, Vol. 33, No. 3, pp. 38-54, Fall 1999.

Swanson, C.J., T. Isaji, and M. Ward, 2000. Dredged Material Plume for the Providence River and Harbor Maintenance Dredging Project. Prepared for New England District, U.S Army Corps of Engineers, Concord, MA, ASA Project 99-063.

Swanson, J.C., T. Isaji, M. Ward, B.H. Johnson, A. Teeter, and D.G. Clarke, 2000. Demonstration of the SSFATE numerical modeling system. DOER Technical Notes

Swanson, C., C. Galagan, T. Isaji and H.-S. Kim, 2001. Simulations of sediment deposition from jet plow operations in New Haven Harbor. Draft Final Report to Environmental Science Services, July 2001, 13p.

U. S. Army of Corps of Engineers and Massachusetts Port Authority, 1995. Final Environmental Impact Report and Final Environmental Impact Statement: Boston Harbor, Massachusetts, Navigational Improvement Project and Berth Dredging Project. Volumes 1 through 3.

U. S. EPA, 1991. Evaluation of dredged material proposed for ocean disposal (testing manual). EPA 503/6-91/001, Environmental Protection Agency and Department of the Army. Washington, DC.