RETURN TO UAO AR INDEX

Fund Records Center
NEW BEDFORD
R: 6.4
R: 4/4/05

6.4
NBH

SDMS DocID 447661

Total Environmental Restoration Contract

New England Division

USACE Contract No. DACW33-94-D-0002

FOSTER WHEELER ENVIRONMENTAL CORPORATION

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

FINAL
EXCAVATION BASIS OF DESIGN / DESIGN ANALYSIS REPORT
NEW BEDFORD HARBOR SUPERFUND SITE
New Bedford Harbor, Massachusetts

October 2002

Prepared for

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

2002-017-0281
10/24/02

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

FINAL
EXCAVATION BASIS OF DESIGN / DESIGN ANALYSIS REPORT
NEW BEDFORD HARBOR SUPERFUND SITE
New Bedford Harbor, Massachusetts

October 2002

Prepared for

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

Prepared by

Foster Wheeler Environmental Corporation
133 Federal Street
Boston, Massachusetts 02110

Revision	Date	Prepared By	Reviewed By	Approved By	Pages Affected
1	10/24/02	L. Toroyan	N. Nicholson R. Czlapinski	M. Otten	All

2002-017-0281
10/24/02

TABLE OF CONTENTS

1.0 INTRODUCTION 1-1
1.1 Site Description 1-1
1.2 New Bedford Harbor Cleanup Remedy 1-2

2.0 SITE CONDITIONS AND INVESTIGATIONS 2-1
2.1 Geographic Location 2-1
2.2 Naming Conventions 2-1
2.3 Description of Excavation Areas 2-1
2.3.1 Cove and Inlet Mudflat Areas 2-1
2.3.2 Vegetated Areas 2-3

3.0 BASIS OF DESIGN AND DESIGN CRITERIA 3-1
3.1 Basis of Design 3-1
3.1.1 Sediment Management Units 3-1
3.1.2 PDFT Conclusions 3-2
3.1.3 Excavation Process Cost Estimation Summary 3-3
3.1.4 Excavation Volumes 3-5
3.1.5 Sediment Clean-up Levels 3-5
3.1.6 Air Pollution Control 3-5
3.1.7 Noise Control 3-5
3.1.8 Site Access and Navigation 3-6
3.1.9 Nighttime Navigation 3-6
3.2 Design Criteria 3-6
3.2.1 Mudflat Excavation Performance Criteria 3-12
3.2.2 Vegetated Excavation Performance Criteria 3-13
3.2.3 Environmental Protection Criteria 3-14
3.3 Shoreline Slope Stability 3-14
3.3.1 Treatment of Wetland/Beach Shorelines 3-15
3.4 Working Season and Hours 3-15

4.0 EXCAVATION DESIGN ANALYSIS 4-1
4.1 General 4-1
4.2 Excavation Sequence 4-1
4.2.1 One Pass Excavation 4-2
4.3 Sheet Pile Barriers 4-2
4.4 Slurry System for Mudflat Excavations 4-3
4.5 Excavation Sequence and Confirmation Sampling 4-3
4.6 Subcontractor Selection Procedure 4-3
4.7 Access Roads and Staging Areas 4-3

5.0 REFERENCES 5-1

LIST OF FIGURES

Figure 2-1 Upper Harbor Shoreline Features 2-4
Figure 3-1 Sediment Management Units 3-16
Figure 4-1 Access, Staging and Vegetated Excavation Areas 4-5

LIST OF TABLES

Table 3-1 PDFT Recommended Design Values 3-3
Table 3-2 Total Per Cubic Yard Process Costs 3-4
Table 3-3 Summary of Excavation Design Criteria 3-7

LIST OF APPENDICES

Appendix A Excavation Process Cost Estimation

ABBREVIATIONS AND ACRONYMS

AALs	Air Action Levels
ADA	Americans with Disabilities Act
ARARs	Applicable or Relevant and Appropriate Requirements
AWQC	Ambient Water Quality Criteria
BD/DA	Basis of Design/Design Analysis
CDFs	Confined disposal facilities
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CMR	Code of Massachusetts Regulations
DTM	Digital Terrain Model
EMR	Experience Modification Rates
ESD	Explanation of Significant Difference
GIS	Geographic Information Systems
GPM	Gallons per minute
HM	high marsh
LM	low marsh
MA DAQC	Massachusetts Department of Air Quality Control
MADEP	Massachusetts Department of Environmental Protection
MGL	Massachusetts General Law
MGD	Million gallons per day
MHHW	mean higher high water
MLLW	mean lower low water
MUs	Management Units
NE TERC	New England Total Environmental Restoration Contract
NESHAPS	National Emissions Standard for Hazardous Air Pollutants
NGVD	National Geodetic Vertical Datum
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PCBs	polychlorinated biphenyls
PDFT	Pre-Design Field Test
POTW	Publicly Owned Treatment Works
PVC	polyvinyl chloride
RD	Remedial Design
ROD	Record of Decision
SOQs	statement of qualifications
TMDL	Total Maximum Daily Load
TSCA	Toxic Substances Control Act
USACE	U.S. Army Corps of Engineers
USC	U.S. Code
USEPA	U.S. Environmental Protection Agency
VUs	Vegetated Management Units
WTP	water treatment plant

EXECUTIVE SUMMARY

Foster Wheeler Environmental Corporation (Foster Wheeler) has prepared this Basis of Design/Design Analysis (BD/DA) report for the excavation design at the New Bedford Harbor Superfund Site. The excavation design is being performed under Task Order No. 17 of the U.S. Army Corps of Engineers (USACE) New England Total Environmental Restoration Contract (NE TERC) No. DACW33-94-D-0002 as part of the Remedial Design (RD) of Operable Unit #1 (OU #1), Upper and Lower Harbor, New Bedford Harbor Superfund Site, New Bedford, Massachusetts.

The Harbor is comprised of subtidal, mudflat, and vegetated areas. This "excavation" report covers mudflat and vegetated areas only. Mudflat areas are intertidal areas above MLLW and below MHHW with no vegetation. This includes the non-vegetated channel of the Acushnet River north of Wood Street Bridge. Vegetated areas are areas above MLLW covered with vegetation. This includes intertidal areas (i.e., where the ground surface is between MLLW and MHHW) and adjacent upland areas (i.e., where the ground surface is above MHHW). Note that the vegetation line approximately corresponds to elevation 1.0 feet NGVD.

In order to manage the design and construction of this large project, the excavation and dredge areas need to be subdivided into "Management Units" (MUs). For ease of layout, these units extend across the harbor, including the deep channels and other areas that will be dredged. Only the areas above MLLW are included in this excavation design. The Upper Harbor has several coves and "inlets" and they are considered the mudflat MUs and are listed below.

Coves and Inlets	Management Unit	Description
Prouteau Street Cove and Inlet	MU-102	The cove on the eastern shore south and east of the Titleist plant. The inlet extends southeast from the cove.
Beech Street Cove	MU-103	The cove on the eastern shore between Prouteau Street Cove and the Comm Electric substation.
Coffin Avenue Cove	MU-104	The cove north of the Sawyer Street CDF and USACE trailer/offices.
Veranda Avenue Cove and Inlet	MU-105	The cove and inlet on the eastern shore due east of Sawyer Street and north of the Coggeshall Street Bridge.

The vegetated areas generally include the open grasslands above the vegetation line at 1.0-foot NGVD. Excavation in the vegetated areas is required in several discrete areas within the Upper Harbors as a result of PCB contamination. A wetland delineation conducted by Foster Wheeler identified four distinct wetland complexes associated with the eastern shoreline, known as Wetlands 2, 3, 4, and 5. The wetland areas and corresponding vegetated area MUs are listed below.

Wetland Location	Management Unit	Description
Wetland 3	VU-1	Area Around Prouteau Street Cove. This area runs along the eastern shore of the Acushnet River.
Wetland 3 & 4	VU-2	The area adjacent to Beech Street Cove and the area that extends down 1,400 feet below the southern shoreline of Beech Street Cove. This area runs along the eastern shore of the Acushnet River.
Wetland 4	VU-3	South of V-2 and stretches from south of Porter Street to north of Harding Road. This area runs along the eastern shore of the Acushnet River.
Wetland 4	VU-4	South of V-3 between Harding Road and Ryle Street. This area runs along the eastern shore of the Acushnet River.

In mudflat MUs, excavation accuracy will be equivalent to that of dredging because this allows for one contractor to do both the dredging and mudflat excavation if bid this way and also allows for different types of equipment to be used in the excavation process. The following excavation accuracy will be assumed for the mudflat excavation design:

- Vertical Plane, to Design Depth +0 to - 4 inches
- Horizontal 1.5 feet

In vegetated areas, the work will be done in the "dry", so that the vertical accuracy will be +0 inches to –2 inches.

Material transport from the point of mudflat excavation to the dewatering facility will be accomplished only by pipeline; thus, excavation using closed clamshell equipment will require a system to produce a slurry and pump it to the dewatering processes at the Sawyer Street site. The slurry will need to be pumped to a distance of up to approximately 7,000 feet.

The contractor must use sheet pile barriers when using tracked vehicles (i.e., low-ground pressure excavators). Sheet pile barriers shall remain in place until all contaminated sediment has been removed and the shoreline has been stabilized. During a long period of down time, the boards should be pulled from the weir system to allow for tidal flow to enter the cove to preserve biological functions. In mudflat management units, the subcontractor can choose where the sheet pile barrier will be installed. This allows a floating plant to dredge up to sheet pile barrier, and a low-ground pressure type excavator to excavate down to the sheet pile barrier.

Sediment transport from mudflats has the same criteria as dredging. However, there would be a cost savings if the excavator used the dredger's pipeline to transport to the desanding facility. This means that dredging and excavation would occur at the same time in management units that are adjacent.

The delivery of the excavated material shall match the capacity of the dewatering facility. Optimum operation of the dewatering facility calls for the delivery of a excavation slurry of 10 to 15 percent solids *by weight.* Excavation slurry may be produced in the traditional manner with ambient water at the cutterhead or similar, or may be produced using recycled water. Allowable variations in slurry percent solids by weight are as follows:

- Slurry concentrations below 10 percent solids by weight are permitted as long as the average for the day is above 10 percent; and
- Water used for flushing the discharge pipe and any other systems shall be included when calculating the average slurry density for the day.

The percent solids by weight that is sent to the desanding/dewatering processes cannot be adjusted by other than mechanical or physical means. No chemical additives may be used. Slurry produced shall meet the density requirements above and a contractor failing to meet these requirements will be back-charged for treatment of any ambient water added to produce a slurry above limits herein.

As practical, slurry shall be produced using recycled water. Any water needed to purge the discharge pipeline shall be recycled water.

Debris that cannot be transported via pipeline shall be separated and transported to the location shown on the plans. The debris will be handled and transported in leak-proof containers, including plastic truck

bed liners or containers on a barge, for loading into the appropriate disposal system. Containers shall be covered during transportation to prevent dust, odor, emissions, and falling debris during travel.

A system to continuously locate, control, and record the horizontal and vertical position of the cutting face or bucket will be required. A Real Time Kinematic Positioning System (RTK) will be used to provide the horizontal and vertical positioning for the dredge systems. A "heads up" computer display will be utilized to provide the dredge operator with real time horizontal and vertical dredge head or bucket position when dredging.

Water quality monitoring will be required during all dredging and excavation operations that occur below mean high water within the Acushnet River estuary. Water quality monitoring will be performed at varying levels of intensity during the course of the project, depending on dredge location and the specific operational activity. Turbidity monitoring will be the methodology employed and shall be performed using a backscatter nephelometer with an underwater sensor and direct surface readout.

The MA DAQC Policy 90-001 guideline for allowable sound emissions restricts new sources of noise to no more than 10 decibels above background. In the more remote areas, this may not be practical due to low background noise levels, and secondary criteria will be needed. It is recommended that the following criteria be used in residential areas near the excavation sites:

- 7:00 A.M. to 11:00 P.M. 65 dB
- 11:00 P.M. to 7:00 A.M. 50 dB
- Maximum Impulse 80 dB

Excavation operations near shorelines will require protection (or removal) of existing shoreline features and maintenance of shoreline slope stability. Shoreline features include stormwater and industrial outfalls (active and abandoned), timber piles and bulkheads, and water intake cribs. Additional survey data and information on existing shoreline features is required to maximize removal of sediment and to integrate the sediment remediation with adjacent shoreline remediation. A detailed evaluation of slope stability is required for final design, including identifying the geologic cross sections for each type of shoreline section and appraising soil and sediment parameters such as unit weight and shear strength obtained from design-level field analyses.

For excavation areas in the mudflats and vegetation that are being excavated by low-ground pressure vehicles, we are recommending that a one pass excavation approach be used. This is to prevent contaminated sediment from being dragged by the vehicle tracks. The contractor must excavate to full cut depth to make sure that they will only drive on clean material. All excavation will occur during Phase II of the project.

Management units containing mudflat excavation shall have access roads and staging areas. Each staging area shall include but not limited to the following:

- stations for decontaminating equipment and personnel;
- container for debris;
- parking for one work vehicle to transport personnel to and from the site; and
- and other items necessary for mobilization and demobilization of site.

1.0 INTRODUCTION

Foster Wheeler Environmental Corporation (Foster Wheeler) has prepared this Basis of Design/Design Analysis (BD/DA) report for the excavation design at the New Bedford Harbor Superfund Site. The design is being performed under Task Order No. 17 of the U.S. Army Corps of Engineers (USACE) New England Total Environmental Restoration Contract (NE TERC) No. DACW33-94-D-0002 as part of the Remedial Design (RD) of Operable Unit #1 (OU#1), Upper and Lower Harbor, New Bedford Harbor Superfund Site, New Bedford, Massachusetts.

Activities associated with and supporting the New Bedford Harbor project include excavation of contaminated wetland areas (vegetated and non-vegetated), dredging of sub-tidal areas, separation and dewatering of excavated and dredged sediments, water treatment, and site restoration. This document only addresses the excavating portions of the project. Separate BD/DA reports address the dredging, dewatering facilities, water treatment, and restoration. The excavation BD/DA has been written as a supplemental package to the dredging BD/DA. Items already covered in the dredging BD/DA are not repeated but made referenced to, unless deemed necessary for clarity.

The U.S. Environmental Protection Agency (EPA) and USACE entered into an Inter-Agency Agreement in February 1998, which gives the USACE responsibility to provide technical assistance to EPA on New Bedford Harbor. In October 1998, EPA authorized the USACE to perform RD activities associated with the Upper and Lower New Bedford Harbor cleanup. In the period December 1998 through April 1999, Foster Wheeler prepared a RD Work Plan and Cost Estimate for the design of the OU#1 remedial action for New Bedford Harbor. The USACE authorized Foster Wheeler to proceed with the RD work in January 1999. The Work Plan was finalized in April 1999. Modification No. 22 to the Work Plan for Remedial Design for OU#1 was finalized in June 2001.

This report provides the basis of design for the excavation portions of the remedial activities at New Bedford Harbor. The project area and cleanup remedy are described in Section 1.0. Site studies and site conditions relevant to the design are summarized in Section 2.0. Section 3.0 contains the design criteria developed from the ARARs in the Dredging BD/DA, Appendix A, and the site information in Section 2.0 of this report. The excavation design is presented in Section 4.0. References are presented in Section 5.0.

1.1 Site Description

The New Bedford Harbor Superfund Site (the site), located in Bristol County, Massachusetts, extends from the shallow northern reaches of the Acushnet River estuary south through the commercial harbor of New Bedford and into adjacent areas of Buzzards Bay. Industrial and urban development surrounding the Harbor has resulted in sediments becoming contaminated with high concentrations of many pollutants, notably polychlorinated biphenyls (PCBs) and heavy metals, with contaminant gradients decreasing from north to south.

The site has been divided into three areas - Upper, Lower, and Outer Harbor - based on geographical features and levels of contamination. OU#1 primarily covers the remediation of the Upper and Lower Harbor and a small area in the Outer Harbor as defined by cleanup goals in the Record of Decision (ROD) (USEPA, 1998). The Upper Harbor extends from an area approximately 1500 feet north of the Wood Street Bridge south to the Coggeshall Street Bridge. The area north of Wood Street Bridge has already been designed. It is currently under construction and will not be discussed in this report. The Lower Harbor extends from the Coggeshall Street Bridge to the New Bedford Hurricane Barrier. The

Outer Harbor is the area between the Hurricane Barrier and an imaginary line drawn from Rocky Point southwesterly to Negro Ledge and then southwesterly to Mishaum Point.

1.2 New Bedford Harbor Cleanup Remedy

In the Upper Harbor north of Coggeshall Street, sediments with PCB concentrations above 10 mg/kg (ppm) will be removed, while in the Lower Harbor and in the salt marshes, sediments with PCB concentrations above 50 ppm will be remediated. Inter-tidal sediments in specific areas adjacent to homes or in areas prone to beach combing will be removed if PCB levels are above 1 and 25 ppm, respectively.

In accordance with the ROD for OU #1, the sediments were to be placed in confined disposal facilities (CDFs). The EPA has subsequently issued an Explanation of Significant Difference (ESD) and dredged or excavated sediments will be dewatered and shipped off-site for appropriate disposal. Initial separation of coarse sediments will be performed near CDF C, while the fine sediment dewatering facility will be located in the area previously designated as CDF D. Seawater separated from these sediments will be treated to remove contaminants before discharge back to the Harbor. A larger capacity water treatment plant (WTP) will be located adjacent to the existing water treatment plant and will consist of a series of physical and chemical processes to remove suspended solids, heavy metals, and PCBs.

2.0 SITE CONDITIONS AND INVESTIGATIONS

The following sections provide summary information from site investigations relevant to the excavation design. Additional detailed information is available in individual investigation reports as referenced in each section.

2.1 Geographic Location

New Bedford Harbor is an urbanized tidal estuary on the western shore of a larger estuary, Buzzards Bay, in southeastern Massachusetts. The Harbor is comprised of subtidal, mudflat, and vegetated areas. The Harbor is located in Bristol County approximately 83 miles south of Boston via the Cape Cod Canal. The City of New Bedford to the west and the towns of Fairhaven and Acushnet to the east border the Harbor. The Acushnet River flows from north to south into the New Bedford Harbor estuary. The Harbor includes all the tidewater lying north 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 the town of Acushnet (NOAA, 2001).

2.2 Naming Conventions

The Upper Harbor has several coves and "inlets." The following describes these coves and inlets:

- Prouteau Street Cove and Inlet – The cove on the eastern shore south and east of the Titleist plant. The inlet extends southeast from the cove.
- Beech Street Cove (a new designation) – The cove on the eastern shore between Prouteau Street Cove and the Comm Electric substation.
- Coffin Avenue Cove (also referred to as King Philip Cove) – The cove north of the Sawyer Street CDF and USACE trailer/offices.
- Veranda Avenue Cove and Inlet – The cove and inlet on the eastern shore due east of Sawyer Street and north of the Coggeshall Street Bridge.

The nomenclature conventions are as follows:

- "Subtidal" indicates areas below MLLW.
- "Mudflat" indicates areas above MLLW and below MHHW with no emergent vegetation.
- "Vegetated Areas" are areas above MLLW covered with emergent vegetation.

The edge of the Vegetated Areas aligns very closely with the elevation +1.0 ft. NGVD contour.

2.3 Description of Excavation Areas

2.3.1 Cove and Inlet Mudflat Areas

The coves are all indentations in the shoreline that are separated from the deeper channel running down the middle of the river. The bottom of the coves generally lies at and above MLLW and therefore tends to be exposed during low tide conditions. Inlet areas are natural channels that are cut through mudflats by the discharge of freshwater from upland drainage areas.

The coves and inlet areas have distinct limits on several sides consisting of vegetated areas or higher elevation uplands. These areas are also shallow intertidal areas. Both of these features make them natural units for the planning of sediment excavation. Their configuration also suggests that devices such as sheet pile barriers may have potential application in the isolation of these MUs during sediment excavation.

Prouteau Street Cove and Inlet is on the eastern shore south and east of the Titleist plant. Prouteau Street Cove has a general triangular form and is bordered by the salt marsh vegetated areas of Wetland 3 on its northeast and south sides. The Acushnet River channel forms the western boundary of the cove. Natural drainage channels incise the mudflats. They begin in deeper water east of the river channel and generally run in a direction perpendicular to the river thalweg. The drainage channel axes are regularly spaced across the width of the mudflat in the north-south direction. The northern four drainage channels extend across the mudflats to points just offshore of the vegetation line of the wetland where they end in dendritic patterns of shallower channels and the main channel definition is lost. The southern channel follows the same general pattern but curves southward when it approaches the eastern edge of the mudflats. It serves as the flow path from the inlet in the southeastern corner of the cove.

Sediment deposits in the cove are expected to have generally uniform grain size characteristics except along the margins of the southern channel. This channel handles the upland drainage from the inlet and is more likely to contain larger average grain size particles than the other channels. This channel occasionally handles storm water discharges with higher velocities and suspended sediment loads than other areas that are principally tidally affected, thus having the capability to carry larger particles on a regular basis. The apparent strength and depth of the flow in areas such as this will be important considerations in the planning of the excavation of inlet areas.

Beech Street Cove is on the eastern shore between Prouteau Street Cove and the Comm Electric substation. The cove has a quadrilateral form with wetlands on three sides and the river-cove line as the fourth side. The cove narrows gradually from the western river-cove boundary to the eastern wetland boundary. Portions of Wetland 3 form a narrow fringe between the cove and upland areas.

The mudflat is incised by a series of natural drainage channels generally running east to west from the eastern wetland toward the Acushnet River channel. Two large channels occur in the central portion of the cove. A third large channel hugs the southern edge of the mudflat. This channel appears to carry the upland flow that enters the cove in its southeastern corner. Visual evaluation of the channel features in aerial photographs suggests that this point appears to drain a significantly smaller area than the inlet at Prouteau Street Cove.

Coffin Avenue Cove is on the western shore, north of the Sawyer Street CDF and USACE trailer/offices. The cove is generally rectangular in shape. Upland areas slope down directly to the landward edge of the mudflat.

A small peninsula extends out from the western cove shore in an eastward direction. It partially isolates a portion of the cove and mudflat in the southwestern corner of the cove. Upland drainage may be responsible for a channel feature that runs along the axis of this partially isolated area.

In the main portion of the cove, higher elevations of the mudflat fringe the upland shoreline. A lower area exists in the outer central region of the cove. There is also evidence of a deeper hole that may be a remnant of previous "hot spot" dredging activity.

There are manmade features on the edges of Coffin Avenue Cove that require consideration in excavation planning. Building foundations extend to the water's edge at the northeast corner of the cove. There is a concrete foundation along portions of the southern edge of the cove. Riprap slope protection of the CDF is on the outer portion of the southern shore of the cove. There is also a 10-inch diameter polyvinyl chloride (PVC) outfall from the CDF at the southeast corner of the cove.

Veranda Avenue Cove and Inlet are on the eastern shore, due east of Sawyer Street and north of the Coggeshall Street Bridge. The cove is generally rectangular in form. A rectangular shaped inlet area extends from the northeast corner of the cove and runs in a northeast direction nearly to Sawyer Street.

The mudflat surface is saucer-like. Higher elevations fringe the shoreline and inlet areas. Lower elevations occur in the outer central portion of the cove.

Wetland 4 abuts the northern boundary of the cove, the inlet area, and the northern half of the eastern shore. There is a rock wall at the industrial site. This wall forms the southern half of the eastern shore of the cove. Wetland 5 begins as a fringe marsh in the southeastern corner of the cove and continues around the cove, forming the southern boundary of the mudflat. Riprap slope protection begins at the southern limit of Wetland 5. This is also the southern limit of the mudflat.

2.3.2 Vegetated Areas

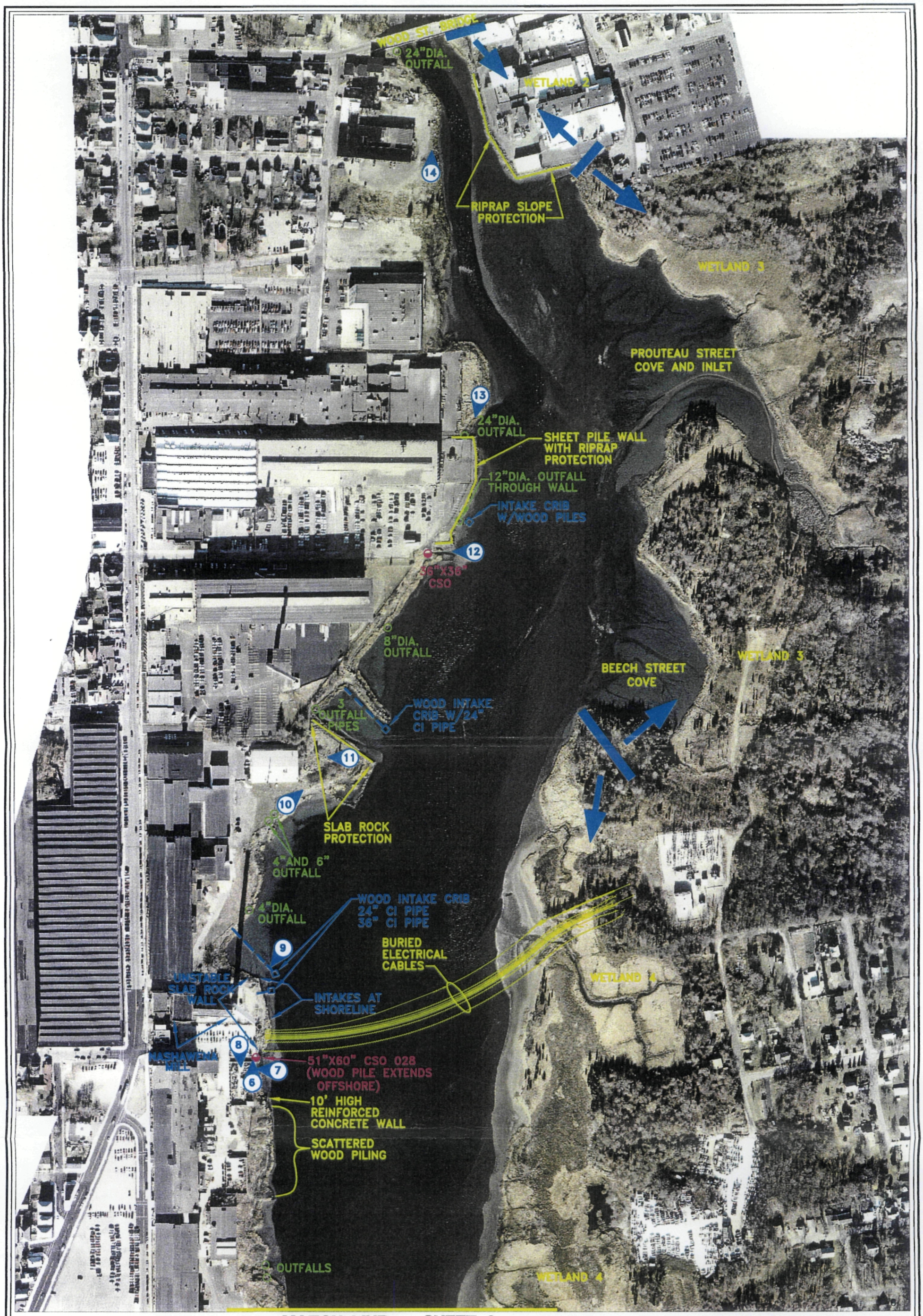
The eastern shoreline extends from the Wood Street Bridge south to the Coggeshall Street Bridge and industrial land uses. A wetland delineation conducted by Foster Wheeler Environmental between August and October 2001 (FWENC, 2001k) identified four distinct wetland complexes associated with the eastern shoreline, known as Wetlands 2, 3, 4, and 5. These wetland complexes are described in the following paragraphs and shown on Figure 2-1.

Wetland 2 is located south of the Wood Street Bridge and west of the Titleist facility in the town of Acushnet. A protective riprap bank and disturbed vegetated upland are associated with the shoreline in this area. The wetland forms a narrow fringe along the riverside of the Titleist facility.

Wetland 3 is located southeast of Wetland 2 and north of the electrical substation in Acushnet. Prouteau Street Cove is a dominant feature of the shoreline in this area, containing extensive mud flats, low marsh (LM) and high marsh (HM) vegetation, five intertidal creeks, and an upland island. Beech Street Cove is located south of Prouteau Street Cove, and consists of extensive mud flats, LM and HM vegetation, as well as a small linear strip of sand/cobble-gravel beach.

Wetland 4 is located south of Wetland 3 and north of the bus station off Sycamore Street, and spans the towns of Acushnet and Fairhaven. This section of shoreline extends approximately 1 mile and consists of two sand/cobble-gravel beaches west of the electrical substation, extensive mud flats, LM and HM vegetation, four intertidal creeks, numerous mosquito ditches, and Veranda Cove and Inlet. Immediately south of Wetland 4 is one of two sections of the eastern shoreline not associated with wetlands. The shoreline adjacent to the bus station parking area consists of a rock bulkhead with little intertidal area.

Wetland 5 is located north of the Coggeshall Street Bridge and south/southwest of the bus station. This section of shoreline consists of mudflats, LM and HM vegetation, and a cobble-gravel beach. Approximately 175 feet of the shoreline in this area is not designated as wetland and consists of a riprap-protected slope adjacent to an industrial facility parking area.



MATCH LINE SHEET 2

LEGEND:

CSO	COMBINED SEWER OVERFLOW
	OUTFALL
	INTAKE LINE
DIA	DIAMETER
CI	CAST IRON

(2) PHOTOGRAPH NUMBER, LOCATION, AND DIRECTION
NOTE: PHOTOS ARE IN APPENDIX D

DIVIDING LINE BETWEEN WETLANDS

N

0 300 600
SCALE IN FEET

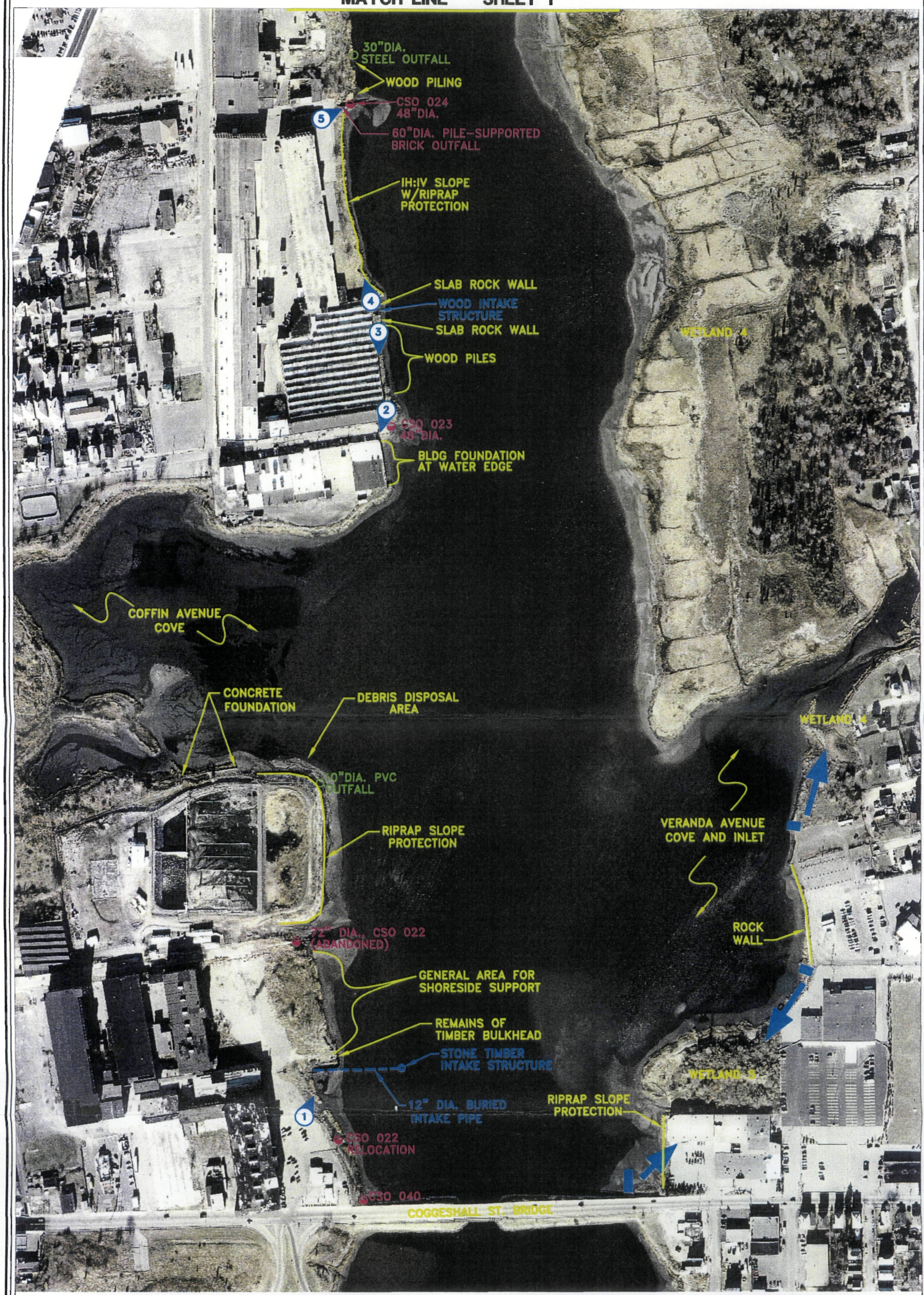
FIGURE 2-1

NEW BEDFORD HARBOR SUPERFUND SITE
NEW BEDFORD, MASSACHUSETTS

UPPER HARBOR SHORELINE FEATURES

SCALE: AS SHOWN | SHEET 1 OF 2

CAD FILE: 9202-001.DWG



LEGEND:

CSO — COMBINED SEWER OVERFLOW

OUTFALL

INTAKE LINE

DIA — DIAMETER

CI — CAST IRON

PHOTOGRAPH NUMBER, LOCATION, AND DIRECTION
NOTE: PHOTOS ARE IN APPENDIX D

DIVIDING LINE BETWEEN WETLANDS

N

0 300 600
SCALE IN FEET

FIGURE 2-1

NEW BEDFORD HARBOR SUPERFUND SITE
NEW BEDFORD, MASSACHUSETTS

UPPER HARBOR SHORELINE FEATURES

SCALE: AS SHOWN | SHEET 2 OF 2

CAD FILE: 9202-001.DWG

3.0 BASIS OF DESIGN AND DESIGN CRITERIA

3.1 Basis of Design

3.1.1 Sediment Management Units

The excavation and dredging work at New Bedford will be done over large areas with differing conditions over several years. In order to manage the design and construction of this large project, the excavation and dredge areas need to be subdivided into Management Units (MUs).

MUs will be used throughout the design, implementation and monitoring to evaluate and document remedial action progress, confirmatory sampling, and ultimately long-term environmental monitoring. The MUs will be used for items such as:

- Projecting annual remedial resource requirements;
- Improving accuracy of material balance calculations;
- Specifying sequence of removal;
- Providing bidders data on sediment types for each unit; and
- Monitoring remedial progress.

MUs will also be used as acceptance units for remediation Subcontractors and as measurement and payment units for Subcontractors. Sediment chemical and physical data for each unit may be compiled from the project database and GIS to provide unit-specific data. For example, within each unit the maximum, minimum, and mean of PCB concentrations, organic content, water content, and percent clay and sand may be calculated and made available to Contractors and Subcontractors in tabular and contour mapped form.

During sediment removal, water quality, air quality, PCB levels in the newly exposed sediment surface, and dredge accuracy could all be monitored and reported by excavation/dredge unit. Material balances will also be made for each management unit to support cost loading of the project schedule and to be used as an earned value tool during remediation.

Sediment MUs have been defined within the following areas of the Upper, Lower, and Outer Harbors:

1. Subtidal Areas: Harbor where mud line is below MLLW or elevation –1.44 feet NGVD.
2. Mudflat Areas: Intertidal areas above MLLW and below MHHW with no vegetation. This includes the non-vegetated channel of the Acushnet River north of Wood Street Bridge.
3. Vegetated Areas: Areas above MLLW covered with vegetation. This includes intertidal areas (i.e., where the ground surface is between MLLW and MHHW) and adjacent upland areas (i.e., where the ground surface is above MHHW). Note that the vegetation line approximately corresponds to elevation 1.0 feet NGVD. The actual edge of the vegetation has been surveyed and is shown in Figure 1-2.

Generally, sediments to be removed from below MLLW are defined as materials to be dredged, and sediments to be removed from above MLLW (typically the mud flat areas and the vegetated salt marshes) are defined as materials to be excavated. This is a convention adopted to clarify the planning and design of the project. It does not necessarily follow the usual definition of dredging, which is the "removal of more than one cubic yard of material from beneath the water."

There are approximately 30 acres of mudflat where the elevation is between –1.44 feet and the vegetation line which generally corresponds +1.0 feet NGVD. In this elevation range, either excavation or dredging could be performed with either low-ground pressure equipment at low tides behind sheet pile walls or with floating equipment at high tides.

The vegetated areas generally include the open grasslands above the vegetation line at 1.0-foot NGVD. Excavation in the vegetated areas is required in several discrete areas within the Upper and Lower Harbors as a result of PCB contamination. MUs will be established for each discrete area of excavation. Mudflat and vegetated excavation areas are shown on Figure 3-1.

Prouteau Street Cove and Inlet lie within the limits of the sediment management unit MU-102 (MF). MU-1 and MU-2 lie offshore of MU-102. Sediment management unit MU-103 comprises the entire mudflat of Beech Street Cove. Sediment management units MU-104 and MU-19 lie entirely within Coffin Avenue Cove. MU-19 covers the deeper areas of the mudflat including the apparent hot spot dredging hole. MU-19 is considered a dredging management unit and not a excavation management unit. Sediment management unit MU-105 covers the Veranda Avenue Cove and Inlet.

Two vegetated management units are in Wetland 3. Management unit VU-1 is the area around Prouteau Street Cove. Management unit VU-2 includes the area adjacent to Beech Street Cove. Three vegetated management units constitute most of the extent of Wetland 4. VU-2 overlaps between Wetland 3 and 4 and extends down 1,400 feet below the southern shoreline of Beech Street Cove. Management unit VU-3 stretches from south of Porter Street to North of Harding Road along the eastern shore of the Acushnet River. Management unit VU-4 continues south of VU-3 between Harding Road and Ryle Street. Wetland 5 does not have any designated vegetated area management units. Instead, it is included as portions of sediment management unit MU-31.

3.1.2 PDFT Conclusions

A hybrid mechanical/hydraulic dredging system was developed for and tested in New Bedford Harbor as a demonstration program to determine the accuracy and production that could be achieved under actual site conditions. The demonstrated dredge performance values exceeded those, which have previously been achieved at the New Bedford Harbor site in the areas of dredge production, accuracy, and slurry solids concentrations. Both the sediment removal data and PCB data acquired indicated that the dredging technology used for the PDFT is effective. For full-scale remediation activities, the dredge performance design values in Table 3-1 were recommended.

The value of this information to the design of the mudflat excavation work is the development of a common set of standards of accuracy in sediment removal. It is proposed that mudflat excavation work be performed to the levels of accuracy set forth in Table 3-1 below. The PDFT report states that 90 percent of the areas were dredged within +/ –4 inches of design cut. The design value recommended in the PDFT report is + 0 inches to –4 inches. Since vegetated areas will be excavated in the "dry", the excavation tolerance will be +0 inches to –2 inches.

Table 3-1
PDFT Recommended Design Values

Dredge Performance Parameter	Recommended Design Value
Dredging Accuracy, Vertical Plane, to Design Depth	+ 0 inches to – 4 inches
Dredging Accuracy, Vertical Plane, using Visual Approach	+/- 0.5 ft
Dredging Accuracy, Horizontal	+/- 1.5 ft
Average Solids Concentration of Dredged Slurry	10% - 20% solids by wt
Use of Recirculation System for reuse of Dredged Effluent Water from CDF	Recommended

3.1.3 Excavation Process Cost Estimation Summary

As part of the Excavation Design, Foster Wheeler investigated and evaluated excavation systems and the associated costs for removing contaminated materials from the mudflats and vegetated areas. The purpose of this evaluation was to determine which excavation and transportation systems would offer reasonably economic methods of removing the contaminated sediments from the vegetated wetlands and mudflats and disposing of the materials in a proper manner. The Excavation Process Cost Estimation memo summarized the findings of several equipment and transportation alternatives that would accomplish the excavation and disposal and derived per cubic yard costs for excavation and transportation for each. The goal of the work was to determine which excavation and transportation systems are feasible and use them in preparation of specifications that would allow contractors to competitively bid their equipment to ensure the lowest reasonable cost of the work is achieved. The Excavation Process Cost Estimation is in Appendix A.

The primary method for removing contaminated soils in the mud flats and vegetated areas will be excavation with low ground pressure equipment. Earlier studies of equipment alternatives demonstrated that a number of manufacturers could provide track-mounted, low ground pressure equipment that will accomplish the excavation.

This section of the Basis of Design addresses the estimated costs of excavating the sediments and vegetation using readily available land based equipment and transporting the excavated materials to the dewatering facility.

Low ground pressure tracked and rubber tired equipment for use with almost every reasonable piece of excavation and transportation equipment are readily available. Therefore, a wide variety of excavator types, bucket selections, and dump carriers to haul materials across the mud flats and wetlands exist for material removal, the proper selection of which should optimize performance. Assuming that the flexibility in excavation equipment will result in optimum material removal rates, this report focuses on the cost evaluation of the mode of transportation of the excavated material, since that is the most significant difference between alternatives.

Three major modes of transportation are focused on: 1) "Dry DREdge" or positive displacement pumping (PD) to the dewatering facility or to a truck containing geotubes; 2) open and closed loop slurry pumping to the dewatering facility; and 3) ground/truck transportation.

To perform an evaluation of costs of appropriate alternatives, a number of scenarios that included various combinations of excavation and transportation to the desanding facility were established. The cost estimates do not include items common to all alternatives, such as capital cost of the desanding facility, dewatering facility and water treatment plant and costs of running material and water, as that is not necessary for a comparison of costs for the alternatives.

The anticipated production rates that will drive some costs for the evaluations will allow for repair, maintenance, and other downtime occurrences. Production rates used in the cost calculations were obtained from Means Cost Data 2001, adjusted for the New Bedford Harbor area and for a wet environment.

Costs associated with each option have been tabulated below in Table 3-2.

Table 3-2
Total Per Cubic Yard Process Costs

Option	Cost Per Cubic Yard
Dry Dredging to Geo-bags on Barges	$89.34
Dry Dredging Direct to Dewatering Facility	$140.27
Single Pipe Slurry Return System	$7.53
Closed Loop Slurry Return System	$11.35
Dry Dredging to Geo-bags on Trucks	$106.98
Direct Excavation to Truck	$21.81
Vegetative Growth Excavation	$27.72

Of the options, all three Dry DREdge operations were found to be the most expensive at $89.34, $140.27, and $106.98 per cubic yard. This is due to additional costs from geotubes and bypassing the desanding and dewatering processes at the facilities. The Dry DREdge system can only be used for the mudflats, and this system includes geotubes into which the in-situ sediment is pumped. The geotubes carry an additional cost of $2,280,000 for the volumes calculated. Dry DREdge may be a viable option only if combined with the dredging operations. The Dry DREdge could pump to a hopper on a barge that is already transporting dredged material to the dewatering facility. Otherwise, using geo-tubes is costly and cumbersome.

The systems that use either a single pipe or closed loop pipe slurry return system have more reasonable estimated costs of $7.53 and $11.35 per cubic yard, respectively. These two systems will cause less impact to the environment than the direct excavation to truck, which is estimated to cost $21.81 per cubic yard. This is because direct excavation to truck encompasses the marsh buggy moving continuously in the mudflats to the truck carrying the excavated materials, which will stir up the sediments.

Given that desanding and dewatering facilities will be built for the dredging portion of the project, these two facilities offer a less expensive solution for transportation of the TSCA sediment. Therefore, a single pipe or closed loop pipe slurry return system reduces both costs of transportation from the excavation site to a shipping site and from a shipping site to a TSCA facility. Because the desanding facility will remove the sand from the slurry and the dewatering facility will remove the water, this also creates less tonnage of TSCA sediment to be transported, and costs are reduced.

The truck option does not have a dewatering solution and may become more expensive. This is only a viable option if the slurry system has broken down and excavation work must continue.

3.1.4 Excavation Volumes

The excavation design for North of Wood Street Bridge has already been completed, but an explanation of how it was done is pertinent to future design work for the rest of the harbor. Excavation volumes North of Wood Street Bridge were determined by a series of steps. Using the bathymetry and the topography surveys, a digital terrain model of the existing surface was created utilizing two dependent software called InRoads and MicroStation. A geostatistical analysis was done of the samples that were taken throughout the harbor, and this provided a Northing, Easting and elevation cut depth for use in the design. This information was used to create an excavation design surface. The existing surface and the excavation design surface were subtracted from each other and volumes were calculated by the software and shown in the North of Wood Street design package. This would be the appropriate method to determine volumes for excavation management units in the future when design drawings are to be completed.

The total volume of sediment to be removed in OU #1 is presented in the *Final Dredging Basis of Design / Design Analysis Report*. The total volume for the vegetated areas is given in Domain 1C. The mudflat volume is included as part of the total for Domain 1B. Volume estimates for each MU will be presented in the future *Mass Balance* report.

3.1.5 Sediment Clean-up Levels

Sediment clean-up levels have been discussed in the *Final Dredging Basis of Design / Design Analysis Report*. Volumes associated with the mudflat and vegetated areas have taken into consideration the various levels of clean-up that the ROD requires. In the Upper Harbor north of Coggeshall Street, sediments with PCB concentrations above 10 mg/kg (ppm) will be removed, while in the Lower Harbor and in the salt marshes, sediments with PCB concentrations above 50 ppm will be removed. Inter-tidal sediments in specific areas adjacent to homes or in areas prone to beach combing will be removed if PCB levels are above 1 and 25 ppm, respectively. The approximate locations of the areas to be excavated are shown in Figure 1-2.

3.1.6 Air Pollution Control

Air pollution control has been discussed in the *Final Dredging Basis of Design / Design Analysis Report*.

3.1.7 Noise Control

Engineering controls will be used during dredging operations to minimize noise emissions such that the activities do not cause or contribute to unnecessary or excessive noise emissions (310 CMR 7.10(1) and (2)). Such engineering controls may include modifying the equipment by having enclosures to reduce sound or having the equipment operated in a manner that minimizes sound. Use of supplemental or replacement mufflers or other sound-suppression devices on equipment must meet the manufacturer's specifications for the original device. Sound levels will be monitored near residential areas that could potentially be affected by the noise. The MA DAQC Policy 90-001 guideline for allowable sound emissions restricts new sources of noise to no more than 10 decibels above background. In the more remote areas, this may not be practical due to low background noise levels, and secondary criteria will be

needed. It is recommended that the following criteria be used for residential areas near the excavation sites:

- 7:00 A.M. to 11:00 P.M. 65 dB
- 11:00 P.M. to 7:00 A.M. 50 dB
- Maximum Impulse 80 dB

3.1.8 Site Access and Navigation

Roads and bridges in the area are regulated by the state. The state has been contacted to determine weight limits on local bridges and roads that may limit transport of heavy equipment of materials, and this information will be incorporated in the design stage.

In order to comply with the Rivers and Harbors Act, the TERC Contractor will minimize impacts to navigation in New Bedford Harbor. The TERC Contractor will notify the Harbormaster before excavation activities begin and a "Notice to Mariners" will be issued. Flagging, lights, flashing lights, or buoys will be used to mark discharge piping and equipment to make it visible to Harbor vessel operators. All floating plants will be oriented to minimize impacts on navigation and water circulation in the Harbor to the extent possible.

3.1.9 Nighttime Navigation

No regulations limiting the use of lights for the excavation project have been found. Lights will be used as needed for safety, operational visibility, and visibility of equipment, piping, and cables during excavation under low light conditions. Adequate lighting is a safety concern for project personnel as well as for mariners who may be near the project area. Lighting will be directed away from residential areas when possible to prevent excess light pollution.

3.2 Design Criteria

The excavation design criteria were developed in accordance with the ARARs, ROD requirements, USACE Engineering Guidance, the work plan, the Excavation Process Cost Estimation in Section 3.0, and the Dredging and Excavation Technology Report. Results of additional studies described in Section 3.0 of the dredging BD/DA were also used to develop the design criteria, and conclusions are repeated below. The excavation design criteria are described in detail in the following sections and summarized in Table 3-3.

Design criteria for dredge/excavation management units have been discussed in the *Final Dredging Basis of Design / Design Analysis Report.*

Table 3-3
Summary of Excavation Design Criteria

Performance Standard	Design Objective	Design Criteria
Fish and Wildlife		
Avoid or minimize potentially adverse affects to fish and wildlife.	Incorporate the results of USACE conversations with the Fish and Wildlife Service and appropriate state agencies.	USEPA Region I have consulted with the MA Dept of Marine Fisheries. USEPA has told Foster Wheeler that project activities may occur throughout the year, and there is no constraint due to fish migration. The USACE will make the final determination about wildlife (such as Roseate Tern) with the appropriate agencies.
Consultation required with appropriate state and federal agencies if a threatened or endangered listed species or their habitat may be affected by a federal action (16 USC Part 1531 et. Seq; 40 CFR 6.302 (h))	Develop mitigation measures for dredging activities affecting the identified feeding grounds of the Roseate Tern.	
Cultural Resources		
Determine project impacts to cultural resources eligible for, nominated to, or listed on the National Register of Historic Places.	Conduct an assessment of the potential project impacts to these cultural resources.	USACE must notify the State Historic Preservation Officer of the proposed excavation activities.
Water Quality		
Comply with Section 404 of the federal Clean Water Act. Meet the minimum requirements for minimizing and/or mitigating the impacts of dredging activities on the environment (40 CFR 230.70-76). Also, comply with Section 401 of the federal Clean Water Act and MADEP (314 CMR 9.06(1) and (2)) by implementing the best practicable means for remediating harbor contaminated sediments.	• Vary the cleanup standards for sediments to minimize dredging of the sediments	• Per the ROD, cleanup standards vary: 50 ppm PCBs for wetlands, 25 ppm for intertidal beachcombing areas, 1 ppm for intertidal areas adjacent to residential areas
	• Minimize sediment disturbance and migration by minimizing the movement of equipment over the mud flats and wetland areas.	• Plan the daily work to minimize equipment movements. Require a daily equipment activity plan for approval. • Orient the booster pump barges to minimize impacts to water currents.
	• Segregate larger areas of excavation to contain disturbed sediments in the water column	• Use steel sheet pile walls to control water movement and the contaminated sediments carried by the water. • Monitor water quality to ensure that no measurable increase in total suspended sediment over background concentrations occurs outside the steel sheet pile walls.
	• Replace filled/disturbed salt marsh areas dredged on the eastern shore on a 1:1 ratio based on equivalent wetlands functions and values	

Table 3-3 – *Cont'd*
Summary of Excavation Design Criteria

Performance Standard	Design Objective	Design Criteria
Wetlands Protection		
• Massachusetts Wetlands Protection Regulations (310 CMR 10.00) contains the following performance standards: • Projects shall not alter the bottom topography in a manner that increases the potential for storm damage or erosion of nearshore areas. Project activities should attempt to avoid areas with eelgrass or widgeon grass and high densities of polychaetes, mollusks, or macrophytic algae (310 CMR 10.25)	• Minimize the period of loss of vegetative cover in the wetlands • EPA will review the proposed excavation program to evaluate the potential for erosion and storm damage. The TERC Contractor will design a protective measure if areas will be impacted.	• Schedule restoration to closely follow excavation of vegetated wetland areas • Schedule the restoration plantings to match periods of high growth rates for the involved plant species, when possible • Include results of EPA review
• Water-dependent projects on tidal flats should be designed and constructed to minimize adverse effects to marine fisheries and wildlife habitat caused by alterations in water circulation, distribution of sediment grain size or changes in water quality (310 CMR 10.27).	• Excavation activities will occur within tidal flats as needed to meet cleanup levels. The habitat is now so degraded by contamination that the need for remediation exceeds the desirability of protecting fish and wildlife in the highly contaminated areas.	
• Massachusetts water quality standards must be met for dredging operations (310 CMR 10.27).	• The Contractor will treat all sediment dewatering supernatant prior to discharge. The treated supernatant will meet the current numerical AWQCs for cadmium, chromium and lead. The AWQCs for PCBs and copper will be met through the phased TMDL approach. If these limits cannot be met, the treated supernatant will be sent to the New Bedford POTW. • The Contractor will follow the approved sedimentation and erosion control plan during excavation to minimize sedimentation in New Bedford Harbor.	• See design criteria in the WTP Basis of Design Report
• Excavation should not destroy any portion or have an adverse effect on a salt marsh (310 CMR 10.32).	• The Contractor will replace the salt marshes (on the eastern shore) on a 1:1 ratio for functions and values.	• Restoration design is included in the Draft Restoration Basis of Design/Design Analysis Report (90%)
• If the excavation area underlies an anadromous or catadromous fish run, the project should not impede or obstruct the migration of fish, change the volume or rate or flow of water within the fish run or impair the capacity of the spawning or nursery habitat.	• The USACE will consult with the MADEP Division of Marine Fisheries and/or other appropriate entities regarding timing of work activities.	• The USEPA Region I have consulted with the US Dept. of Marine Fisheries. USEPA has told Foster Wheeler that project activities may occur throughout the year, and there is no constraint due to fish migration.

Table 3-3 – *Cont'd*
Summary of Excavation Design Criteria

Performance Standard	Design Objective	Design Criteria
Site Access and Navigation		
All excavation activities will be coordinated and carried out with the participation and approval of the USACE per the Rivers and Harbors Act	• Minimize impacts to navigation in New Bedford Harbor	• The Contractor will issue notification to the New Bedford Harbormaster prior to excavation activities and a "Notice to Mariners" will be issued as required covering pipelines, barges, and the dredge or excavation equipment or any other hazards to navigation. • Discharge piping, barges, and any other floating plant or boats will be marked with buoys, flags, or lights as required by the USACE Safety Manual or the US Coast Guard to make it visible to harbor vessel operators.
Massachusetts Chapter 91 Waterways Licenses Law (91 MGL 1.00 et. Seq.) and MADEP 310 CMR 9.40 contain the following performance standards: • Navigational impacts from the excavation and dredging must be minimized.	• Foster Wheeler anticipates minimal navigational impacts from excavation or dredging activities because the contaminated nature of the area minimizes navigation traffic in the affected areas. All required measures will be taken to mitigate any navigational impacts associated with dredging.	• Discharge piping, barges, and any other floating plant or boats will be marked with buoys, flags, or lights as required by the USACE Safety Manual or the US Coast Guard to make it visible to harbor vessel operators
• Design and timing of excavation and sediment material disposal should avoid interference with anadromous and catadromous fish runs; no activity between March 15th and June 15th without approval from Division of Marine Fisheries (310 CMR 9.40(2)).	• The USACE will consult with Mass MADEP and other appropriate authorities regarding proposed design and timing of work activities.	• The USEPA Region I have consulted with the US Dept. of Marine Fisheries. USEPA has told Foster Wheeler that project activities may occur throughout the year, and there is no constraint due to fish migration.
• Design and timing of dredging and dredge disposal should minimize adverse effects on shellfish beds, fisheries resources and submerged aquatic vegetation (310 CMR 9.40(2)).	• The USACE will consult with Mass MADEP and other appropriate authorities regarding proposed design and timing of work activities. However, it should be noted that the area is "off limits" for shellfish and fisheries harvest because of the contamination.	• Conduct excavation activities to minimize adverse effects on shellfish beds, fisheries resources, and submerged vegetation as possible while meeting the ROD PCB cleanup standards. The long term improvement to the quality of the habitat will likely over-ride the concerns over temporary adverse impacts.
• Shoreward extent of dredging should be a sufficient distance from adjacent marshes (at least 25 feet from marsh boundary) to avoid slumping; bottom slope should be adjusted with placement of clean fill after dredging (310 CMR 9.40(3)).	• Excavation will occur within salt marshes as necessary to meet cleanup goals.	• Design excavation within salt marshes to meet the ROD cleanup standards with minimum impact to salt marshes. • Closely follow excavation of wetland areas with the wetlands restoration program construction. • Information to be incorporated in final design documents.

Table 3-3 – *Cont'd*
Summary of Excavation Design Criteria

Performance Standard	Design Objective	Design Criteria
Air Pollution Control		
National Emissions Standard for Hazardous Air Pollutants (NESHAPS) (40 CFR 63) "site remediation" source category is under development.	Comply with applicable "site remediation" NESHAPS requirements, which are proposed to be finalized in May2002.	Information to be incorporated in final design documents.
310 CMR 7.02 requires that any new source of air contaminants with potential emissions greater than one ton per year obtain an air permit. Emissions from excavation will likely not exceed this threshold.		Develop a plan for record keeping to ensure that the one ton per year threshold for air emissions is not exceeded. Implement engineering controls to minimize air emissions to the extent practicable.
310 CMR 7.09 requires that construction or demolition activities do not contribute to a condition of air pollution, which includes generation of excessive odors or fugitive dust.	Minimize generation of odors and fugitive dust.	Implement engineering controls during construction of facilities and during excavation to minimize generation of odors and fugitive dust. Since the excavation will occur in areas that are naturally inundated or wetted twice a day, this is not expected to be a problem.
Comply with the air monitoring program described in Development of PCB Air Action Levels (AALs) for the Protection of the Public (FWENC, 2001g).		• Conduct air monitoring as recommended by the ambient air management program developed for remediation operations at New Bedford Harbor. • Track ambient PCB concentrations for the duration of the project to ensure that exposure does not exceed the cumulative exposure budgets.
Noise		
Do not cause or contribute to unnecessary emissions that may cause noise (310 CMR 7.10(1) and (2)). MA DAQC Policy 90-001 guideline for allowable sound emissions restricts new sources of noise to no more than 10 decibels above background.	Minimize noise above existing background levels. Make use of engineering controls that reduce or muffle sound.	Comply with the MA DAQC Policy 90-001 by limiting noise from excavation operations to no more than 10 decibels above background to the extent practicable. In the more remote areas, this may not be practical due to low background noise levels, and secondary criteria will be needed. It is suggested that this secondary criteria be established as • 7:00 a.m. to 11:00 p.m. 65 dB • 11:00 p.m. to 7:00 a.m. 50 dB • a maximum impulse of 80 dB at a distance of 300 feet from the operating equipment.
Light Pollution Control		
Limit light pollution in residential areas where practicable.		Lights will be used as needed for safety, operational visibility, and visibility of equipment, piping, and cables during excavation conducted under low light conditions. Generally, due to the small quantities involved in the excavation, night operations are not seen as needed for the project. Lighting will be directed away from residential areas when possible to prevent excess light pollution.

Table 3-3 – *Cont'd*
Summary of Excavation Design Criteria

Performance Standard	Design Objective	Design Criteria
Working Season and Hours		
Complete the project in a timely manner		• USEPA has directed that there will be no restriction on when work can be accomplished. • Working hours will be 24 hours a day in non-residential areas and 8 am to 10 pm near residential areas.
Excavation Parameters		
Develop production rates for the excavation design based on historical data from similar construction elsewhere in similar environments.	Optimize the production system to achieve design criteria production rates.	• The peak hourly flow rate to the desanding facility will be limited to 2,500 gallons per minute (gpm), subject to a maximum production volume of 1.6 million gallons per day (mgd), based on an average slurry content of 15% solids by weight. Because of the small quantity involved, lower production rates are acceptable and desirable due to a need to minimize noise impacts and light pollution by avoiding working at night.
Estimate excavation quantities for use in the design of excavation MUs.		• An estimated 85,000 cy of sediment will be excavated from the upper and lower harbors.
Establish design criteria for excavation accuracy and precision.	Match dredging criteria to simplify the procedure and eliminate confusion.	• Vertical Plane, to Design Depth + zero to - 4 inches • Horizontal 1.5 feet
Establish an over-excavation limit for use in the design calculations and subcontract terms.		• Allowable over-excavation is 4 inches below design depth.

3.2.1 Mudflat Excavation Performance Criteria

Prior dredging efforts in New Bedford Harbor as referred to in the *New Bedford Harbor Superfund Pilot Study*, the *Report on the Effects of the Hot Spot Dredging Operations,* and the *Final Pre-Design Field Test Dredge Technology Evaluation Report* established that both hydraulic cutterhead dredges and a closed clamshell dredge were capable of removing contaminated sediments while minimizing resuspension. The mudflat equipment can range from marsh buggy type tracked excavators with closed clamshell buckets to small closed clamshell dredges but must be able to excavate up to +1.0 foot NGVD. A cutterhead type dredge would not be suited to working in the mudflats because of the depth of water required for the equipment to operate effectively and the minimum depth such equipment can cut.

The equipment type anticipated to be used in performing the excavation includes any of a number of commercially available low ground pressure excavators and hauling equipment. These can include tracked vehicles such as manufactured by Marsh Buggies Inc. or by any of a number of other companies specializing in low ground pressure equipment. Many of these pieces of equipment are capable of floating and can be fitted with any reasonably sized excavator arm and cab. They can also be provided with dump bodies for hauling material to trucks at cleaning stations and can be fitted with slurrying equipment and pipelines for moving the slurrying process and delivery system anywhere in the marsh.

Material transport from the point of mudflat excavation to the dewatering facility will be accomplished by pipeline. Therefore, excavation of the mudflats using a closed clamshell system will also require a system to produce and transport a slurry to the dewatering facility.

The delivery of the excavation material shall match the capacity of the dewatering facility. Optimum operation of the dewatering facility calls for the delivery of excavated slurry with a density of 10 to 15% solids ***by weight.*** Excavated slurry may be produced in a traditional manner with ambient water at the cutterhead or similar processing unit, or may be produced using recycled water. Allowable variations in slurry density are as follows:

- Slurry concentrations below 10% are permitted as long as the average for the day is above 10%.
- Water used for flushing the discharge pipe and any other systems shall be included when calculating the average slurry density for the day.

As practical, slurry will be produced using recycled water. Any water needed to purge the discharge pipeline will be recycled water, assuming a two-pipeline system is in use. Discharges to the bay of potentially contaminated water will not be permitted.

The PDFT dredging demonstration program proved that a +/- 4 inch vertical accuracy could be accomplished consistently out in the open water and in shallow areas 90 percent of the time. The dredge performance criteria require that a dredge meet the minimum recommended design values from Table 3-1 for vertical and horizontal accuracy of the PDFT. Even though tracked equipment could possibly provide better results, the same minimum accuracy for dredging will also be required for the excavation process. This allows for one contractor to do both the dredging and excavation if bid this way and also allows for different types of equipment to be used in the excavation process. Based on the PDFT recommended design values, the following excavation accuracy will be assumed for the excavation design:

Vertical Plane, to Design Depth	+ 0 inches to – 4 inches
Horizontal	+/- 1.5 feet

The PDFT recommended using a clamshell bucket dredge and stated that a consistent dredging production rate of 35 cubic yards per hour in -2 to -4 feet NGVD of water and 95 cubic yards per hour in water greater than -4 feet NGVD could easily be achieved. Excavation will occur in the four coves mentioned in Section 2.0 where excavation elevations range from –2.4 feet NVGD to the vegetation line, which is approximately +1.0 foot NGVD. Therefore, small dredges will have slower production rates and excavators will have higher production rates in this area. Most excavators have an average production rate of 50 cubic yards per hour in wet conditions.

The excavation production rate needs to be matched to the throughput capacity of the desanding and dewatering facilities, as there is no planned storage facility to handle excavated materials in excess of this quantity on a regular basis. The peak hourly flow rate to the desanding facility will be limited to 2,500 gpm, subject to a maximum production volume of 1.6 mgd, based on an average slurry content of 15% solids by weight. If excavation occurs at the same time as dredging, then production rates of both must meet the peak hourly flow rates and maximum production volume above.

The reason for this limitation on production rates is that the processing facilities, combined with the temporary storage, cannot handle larger volumes, and production would have to cease when the processing and storage capacity limits are met.

Haul roads will be necessary to bring equipment and workers to the site, remove debris, and decontaminate equipment and personnel. Concept designs have been prepared for decontamination stations at the ends of haul roads to serve the wetlands excavation work. Possible future locations of haul roads and the decontamination areas can be found in Attachment E of Appendix A. Actual locations for haul roads will be determined after the chemistry data evaluation is complete and final management units are chosen.

Debris that cannot be transported via pipeline shall be separated and transported to the location shown on the plans. The debris will be handled and transported in leak-proof containers, including plastic truck bed liners or containers on a barge, for loading into the appropriate disposal system. Containers shall be covered during transportation to prevent dust, odor, emissions, and falling debris during travel.

3.2.2 Vegetated Excavation Performance Criteria

The vegetated areas present a special case. A dense root mat from 10 to 14 inches thick typifies them overlying the contaminated sediments. The root mats are also contaminated and must be removed in accordance with the removal criteria previously stated. The dewatering equipment cannot process the root mat, so this material must be transported to the appropriate landfill without dewatering. The only practical means of accomplishing removal of the sediment and vegetation that must be sent to a TSCA landfill is excavation by low ground pressure equipment followed by intermodal truck transportation to the dewatering facility for loading into a railcar for eventual transport to the acceptable landfill. Hourly production rates are expected to be comparable to the mudflat excavation hourly rates, but the requirement to transport the materials by truck and the inability to dewater them will adversely affect costs. Daily production rates for vegetated areas are limited to working hours specified in Section 3.4.2, where mudflat excavation does not have these limitations.

In the vegetated areas, conventional type, low ground pressure excavators can be used. Depending on location and soil type, excavators may be required to be tracked low-pressure type excavators. Excavators will then place excavated materials into lined intermodal trucks. Containers shall be covered during transportation to prevent dust, odor, emissions, and falling debris during travel.

Material transport from vegetated areas to the dewatering facility will be accomplished via truck over haul roads. Haul roads will also be necessary to bring equipment and workers to the site, remove debris, and decontaminate equipment and personnel. Concept designs have been prepared for decontamination stations at the ends of haul roads to serve the wetlands excavation work. Possible future locations of haul roads and the decontamination areas can be found in Attachment E of Appendix A. Actual locations for haul roads will be determined after the chemistry data evaluation is complete and final management units are chosen.

When performing the first pass of excavation, clamshell or other mechanical excavation means shall have the bucket sized to reflect the cut thickness and be full of sediment on retrieval. Auger, cutterhead or other methods shall be kept in the cut face at all times and operated in a manner which minimizes resuspension (e.g., slowest practical rotation speed and swing rates).

3.2.3 Environmental Protection Criteria

Operations shall meet all Water Quality Criteria set forth below. Turbidity will be monitored daily and net flux weekly. Corrective measures as set forth in the specifications, or as may be required to prevent exceeding Water Quality Criteria, shall be accomplished as directed by the EPA.

- Amphibious or low-ground pressure excavation equipment shall be operated behind the steel sheet pile walls shown on the drawings at all times when in an area where such walls are proposed.
- Monitoring of water quality will be performed on the exterior of the steel sheet pile walls in the immediate vicinity of the weir sections when excavation is in progress in an enclosed area.
- If turbidity is found to be excessive, excavation activities must cease until the problem is resolved. This is necessary to prevent recontamination of adjacent areas which may not be contaminated or which may have already been cleaned.

3.3 Shoreline Slope Stability

Since removal of sediment proximate to the shoreline and shoreline features (e.g., outfalls) has the potential to result in slope failure or displacement after excavation, the design criteria for excavation must include provisions for maintaining a stable shoreline and protecting the integrity of existing shoreline features. For protection of workers and existing vegetation, a detailed evaluation of slope stability would be required to maximize the volume of material removed adjacent to the shoreline. This evaluation would include identifying the geologic cross sections for each type of shoreline section and appraising soil and sediment parameters, including unit weight and shear strength obtained from design-level field analyses.

Using this site-specific information, analyses could be conducted to determine excavation limits for a range of depths that would maintain an adequate factor of safety for slope stability. The analysis should evaluate short-term stability effects, assuming excavated areas are backfilled, or long-term stability if restoration does not require replacement of removed material.

3.3.1 Treatment of Wetland/Beach Shorelines

The *Draft Restoration Basis of Design/Design Analysis Report (90%)* (The Bioengineering Group, 2002) presents three alternatives for restoration of wetland areas. The selected alternative (Alternative 3) will restore wetland functions and values on a net basis, allowing for establishment of "out-of-kind" elements to ensure no net loss. Since final restoration of wetlands will likely lag the excavation work, interim restoration activities following excavation of wetland areas must be conducted in a manner consistent with the final restoration design.

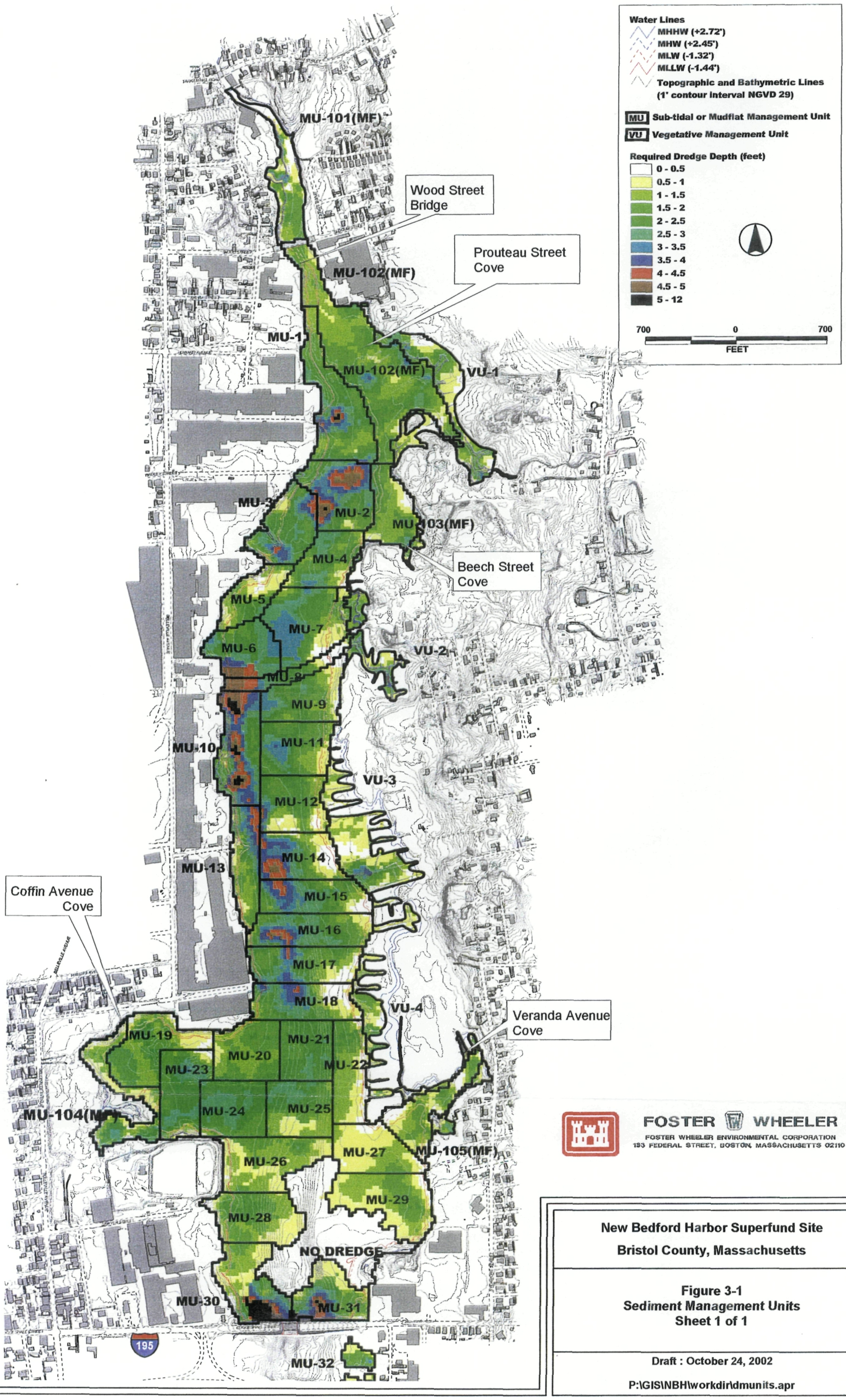
Generally, wetlands are low energy areas with little potential for erosion. They typically are composed of smaller particles of sediment deposited because of the low energy of the area. Interim stabilization measures may be required in select areas to ensure slope stability and the successful implementation of long-term restoration activities, particularly in areas where restoration will lag excavation by a significant period. Interim stabilization methods may include bioengineering treatments that use plants, plant materials, and geotextile fabrics. This will also include replacement of excavated sediment/soil with uncontaminated fill to pre-excavation elevations and regrading.

3.4 Working Season and Hours

Massachusetts Wetlands Protection Regulations (310 CMR 10.00) and (310 CMR 9.40(2)) direct that dredging should be timed to avoid the critical life stages of polychaetes, mollusks, macrophytic algae, shellfish beds, fisheries resources and submerged aquatic vegetation whenever practicable. USEPA has directed that there will be no seasonal limits for this project.

No written restrictions on working hours in the Harbor have been found. Maximum work hours for the purposes of designing the mudflat excavation project will be assumed to be 24 hours per day.

The Fairhaven Police recommended restricting work near Fairhaven's residential areas to reasonable working hours. Therefore, in the vegetated areas (which are near residential areas on the East side of the Upper harbor), excavation and hauling work should be restricted to the period from 8:00 A.M. to 10:00 P.M.



New Bedford Harbor Superfund Site

Bristol County, Massachusetts

Figure 3-1
Sediment Management Units
Sheet 1 of 1

Draft : October 24, 2002

P:\GIS\NBH\workdir\dmunits.apr

4.0 EXCAVATION DESIGN ANALYSIS

4.1 General

Excavation design will conform to the various criteria and standards stated in the previous section. Due to the annual funding limitations, the number of management units to be excavated will be revised as required to fit the funding available.

Design will consider the quantity of excavation that can be funded in a given year, including the necessary access roads, decontamination facilities, related support facilities, transportation costs, and temporary stabilization of embankments to prevent erosion. Based on the quantity that can be accommodated within the funding limit, the design will lay out the management units to be accomplished in a given funding year.

It is proposed that excavation of vegetated management units be delayed until the last of the excavation program. The reason for this is to minimize the influence of potential re-deposition of contaminated sediments in these highly valuable habitat areas.

Restoration of excavated areas will usually be done a year or more after the original excavation. Whether or not an area is restored in the same year it is excavated in is dependent on the area and use such as residential property, public parks, and other public access areas. This is outlined in the Restoration BD/DA analysis and will be finalized after all analysis is complete.

Design drawings will establish the areas and depths to be excavated in each management unit. Because of the uncertainties in available funding from year to year, a grouping of management units will be decided upon and combined annually. This annual decision of grouping management units will be undertaken by the TERC contractor in consultation with the USACE, USEPA, other involved agencies, and the selected contractor and subcontractors.

Project specifications will be less subject to annual change and will provide the requirements stated earlier in this report. The specifications will cover such issues as excavation accuracy, environmental protection measures, health and safety requirements, production rates, restoration details, schedules, decontamination, disposal, transportation, working hours, protection of cultural resources, and the other issues defined above.

Project specification revisions may occur at any time during construction as needed.

4.2 Excavation Sequence

The sequence of excavation will be performed by management units. It has been determined that the cleanup of the harbor will start with the highly contaminated areas first. This will occur during Phase I of the project in the first few years. These areas are located in the dredging management unit areas and do not exist in the excavation management unit areas. Therefore, all excavation will occur during Phase II of the project. Mudflat management units will be excavated first, and the vegetated management units will follow. Because excavation with excavators is obtrusive to the sediment but impossible to avoid in shallow areas, it has been determined that only one pass for the excavation is necessary so that the excavator will move away from the clean area it just excavated. This allows all for work being done behind a sheet pile wall to be removed sooner.

4.2.1 One Pass Excavation

For one pass excavation, the Contractor will excavate each management unit to the lines and grades shown on the drawings. Each pass will be complete, and there will be no stockpiling in the water or on land. Leveling of a completed excavated surface by dragging a beam or the bucket is not permitted. All high spots will be removed by excavation.

Side slopes will be step cut in one-foot increments. Where the depth of the cut is one foot, box cuts are allowed. Material that sloughs into the excavated area is assumed to be contaminated and a final pass along the toe of the slope will be made prior to requesting a post excavation acceptance survey.

4.3 Sheet Pile Barriers

When excavators move around on and excavate in the mudflats, the sediment will be stirred up in the water around the excavator. This stirring will suspend sediment in the water column, and tidal action will move the suspended sediment to different parts of the harbor. This can cause contaminated sediments to travel to previously dredged areas and recently excavated areas due to the normal tidal action. Therefore, there is an apparent need to minimize the moving of suspended sediments around by tidal action.

A freestanding sheet pile wall should be used to stop tidal water from rushing into the excavation site by allowing only controlled flows. The unsealed connections will allow water to seep through in a much slower fashion, and weir areas should be included to ensure flows are adequate to eliminate unacceptable differential head levels. By properly sizing the sheet pile thickness and embedment, a sheet pile wall and weir system should be designed by the subcontractor to withstand the forces involved, including water and waves.

There are four coves that are slated for excavation. Longer periods of time are necessary to excavate these areas, thus resulting in additional potential for stirring up the existing sediments. Each cove will be single management unit. It is our recommendation that sheet pile barriers enclose an entire cove. During a long period of down time, the boards should be pulled from the weir system to allow for tidal flow to enter the cove to preserve biological functions. This recommendation is to provide lower costs to the project.

The excavation subcontractor should recommend to the TERC Contractor if a particular management unit should be excavated or dredged. If it is accepted to dredge and excavate a part of a single management unit, then the sheet pile barrier should be initially designed to meet that requirement. In other words, the sheet pile barrier should be planned to separate the dredging and excavation areas as established by the TERC Contractor. Figure 6-1 in Appendix A shows the various locations that have been preliminarily chosen for sheet pile.

Smaller areas that are approximately 100 feet between the shoreline and MLLW will not require sheet pile barriers because these areas do not require long periods to dredge, thereby minimizing the amount of resuspension and redistribution of contaminated sediments. Because the dredge will already be set up during dredging operations, these areas are small enough that, during high tide, the dredge will have the capability to reach these narrow areas.

4.4 Slurry System for Mudflat Excavations

The slurry system at minimum should consist of a slurrying device, pump, pipeline, and associated fittings. The pump should be sized per the requirements in Section 3. The pipeline should be any size HDPE pipe that is suited to the capacity of the subcontractor's equipment. The subcontractor should match the termination of the pipeline to the receiving 10-inch connection at the desanding facility. If the excavation subcontractor is also the dredging contractor, then sediment should be piped to the dredging slurry system instead.

Preventative measures shall be taken to avoid spills from joints. This should be accomplished by requiring extensive pressure testing of the pipeline before beginning of excavation. Secondary containment should be provided around the slurrying device, pump, and pipeline. The subcontractor should be responsible for the function and safety of his equipment. The specifications will establish the appropriate requirements.

4.5 Excavation Sequence and Confirmation Sampling

The excavation sequence and confirmation sampling approach have been discussed in the *Final Dredging Basis of Design / Design Analysis Report.*

4.6 Subcontractor Selection Procedure

The subcontractor selection procedure has been discussed in the *Final Dredging Basis of Design / Design Analysis Report.*

4.7 Access Roads and Staging Areas

The excavation process will require certain shoreside support and facilities, which will depend on phases of the project. These are: 1) mobilization and assembly of the excavation and slurry system with pipelines at a suitable location or locations on or adjacent to the shoreline; 2) excavation of mudflats; 3) excavation of vegetated areas; and 4) demobilization/disassembly.

The excavation system will likely include the following elements, depending on the subcontractor selected and the equipment he proposes to use. When operating, shore and offshore support associated with the excavation activities will include the following:

- Systems will include:
  - Tracked excavators
  - Access roads
  - Pipelines and pumps
  - Slurry mixer and pump
  - Tracked sediment haul vehicle
  - Dump trucks
  - Decontamination stations
  - Barges with booster pumps
  - Boats to move barges
  - Water trucks
  - Vacuum trucks

- Support Activities will include:
  - Movement of personnel from shore to barges and back – These activities would include crew shift changes, access by site superintendents, regulatory oversight, fueling operations, access by QC and field sampling personnel, and access by any other observers. This activity would typically be accomplished by a crew/supply boat.

  - Provisioning – The excavation equipment operating in the mudflats and grassed areas will require periodic fueling, topping up and changes to lubrication and engine fluids, provisioning of items such as drinking water, cleaning supplies, rags and other consumables, and service of a portable toilet. Most of these activities would be accomplished with a dedicated support/crew all-terrain vehicle. It is envisioned that fuel would be transferred from a tank truck at the end of an access road to the operating equipment in the field, and then pumped from the support equipment to the excavating equipment. Other items could be manually handed to the support equipment, or transferred to the equipment via a small crane. Should any spills occur, the area of contaminated sediment should be excavated and disposed of by either pipeline or by a lined intermodal truck.

  - Debris – Debris generated during excavation will need to be separated and transported to trucks for disposal. Debris will be considered contaminated and therefore kept separated and subject to special handling. It is envisioned that debris could be placed on a suitable decontamination pad at the end of an access road until a large enough quantity was accumulated to warrant loading it onto a truck and transporting it to the desanding facility. In the alternative, the debris can be decontaminated on shore at one of the decontamination pads where the wash water can be collected and treated. Once tested or delivered to the desanding facility, decontaminated debris can be disposed of in an approved location/landfill, or be recycled.

Optimally, shoreside facilities should provide safe and reliable all weather access for personnel transfers to the crew/supply boat, the ability to move consumables and miscellaneous equipment to and from the barges, and the ability to transfer potentially contaminated debris to a shore processing facility for decontamination.

In addition to the operations associated with the excavation process, the excavation subcontractor will require a secure laydown area for his equipment (excavators, pipe, floats, etc), space for at least one Conex or similar steel container for secure storage of tools and supplies, adequate space to set up an office/trailer; adequate space for parking for his staff and labor, and adequate space to maneuver trucks to handle debris and deliver supplies.

Excavation areas, staging areas and access routes must avoid impact to known cultural resources to the extent practical. Therefore, work must be limited to those areas where cultural resource assessments have been completed. Figure 4-1 shows vegetated excavation areas, staging areas and access routes where cultural resources assessment are currently being performed. These areas may have to be revised in final design, depending on the results of these assessments.

SDMS TARGET SHEET

US EPA New England
Superfund Document Management System
Image Target Sheet

SDMS Document ID # : 417661

Site Name: NEW BEDFORD

File Number: PAGE 37

Purpose of Target Sheet:

[X] Oversized [ ] Color

[ ] Non-Paper Media [ ] Other (Provide purpose below)

Document Type this Target Sheet Replaces:

[X] Map [ ] Photograph [ ] Graph/Chart

[ ] Video [ ] Compact Disc [ ] Other (Specify below)

Description or Comments: FIG 4-1 ACCESS, STAGING AND VEGETATED EXCAVATION AREAS

Retrieval:

[ ] Stored outside site file [ ] Available in PDF

To View This Document, Please Contact the EPA New England Office of Site Remediation and Restoration Records and Information Center- Telephone (617) 918 1440

5.0 REFERENCES

Aerial Orthophotos, James W. Sewall Company, Horizontal Datum NAD 83, Vertical Datum NGVD 29, National Map Accuracy Standards 1"=40', December 2, 1998.

Bathymetric Mudline Elevations, U.S. Army Corps of Engineers New England District, 1999.

The Bioengineering Group. 2002. *Draft Restoration Basis of Design/Design Analysis Report (90%) Remedial Design for New Bedford Harbor Superfund Site, New Bedford, Massachusetts.* January.

Foster Wheeler Environmental Corporation (Foster Wheeler). 2001j. *Draft Dredge and Excavation Technology Assessment, New Bedford Harbor Superfund Site, New Bedford, Massachusetts.* October.

Foster Wheeler Environmental Corporation (Foster Wheeler). 2001g. *Draft Final Development of PCB Air Action Levels for the Protection of the Public, New Bedford Harbor Superfund Site, New Bedford Harbor, Massachusetts.* August.

Foster Wheeler Environmental Corporation (Foster Wheeler). 2001e. *Final Dredging, Excavation, Restoration, and Dewatering Design Work Plan, Modification No. 22 to the Work Plan for the Remedial Design to the Operable Unit #1, New Bedford Superfund Site, New Bedford, Massachusetts.* June.

Foster Wheeler Environmental Corporation (Foster Wheeler). 2001h. *Final Pre-Design Field Test Dredge Technology Evaluation Report. New Bedford Harbor Superfund Site, New Bedford, Massachusetts.* August.

Foster Wheeler Environmental Corporation (Foster Wheeler). 2002. *Excavation Process Cost Estimation Preliminary Draft Excavation Basis Of Design / Design Analysis Report. New Bedford Harbor Superfund Site, New Bedford, Massachusetts.* March.

Foster Wheeler Environmental Corporation (Foster Wheeler). 2002. *Final Dredging Basis of Design / Design Analysis Report. New Bedford Harbor Superfund Site, New Bedford, Massachusetts.* February.

Geotec Associates, Vicksburg, Mississippi, Jack Fowler, 601-636-5475.

Heavy Construction Cost Data, 15th Annual Edition, RS Means CMD Group, 2001.

Tanks Direct, Beltsville, Maryland, 800-865-5555.

The Bioengineering Group. 2002. *Draft Restoration Basis of Design/Design Analysis Report (90%) Remedial Design for New Bedford Harbor Superfund Site, New Bedford, Massachusetts.* January.

Upland Photogrammetric Survey, James W. Sewall Company, Horizontal Datum NAD 83, Vertical Datum NGVD 29, December 1998.

U.S. Army Corps of Engineers (USACE), New England Division (USACE). 1990. *New Bedford Harbor Superfund Pilot Study, Evaluation of Dredging and Dredged Material Disposal.* May.

U.S. Environmental Protection Agency (USEPA) – Region I. 1998. *Record of Decision for the Upper and Lower Harbor Operable Unit, New Bedford Harbor Superfund Site, New Bedford, Massachusetts.* September.

U.S. Environmental Protection Agency (USEPA) – Region I, USEPA's Narragansett, RI Marine Research and Development Laboratory, USACE, and Roy F. Weston, Inc. 1997. *Report on the Effects of the Hot Spot Dredging Operations, New Bedford Harbor Superfund Site.* March.

WRS Infrastructure and Environment, Inc., Eagleville, Tennessee, Michael Duke, 615-368-7976.

Appendix A
Excavation Process Cost Estimation

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

APPENDIX A

EXCAVATION PROCESS COST ESTIMATION
PRELIMINARY DRAFT
EXCAVATION BASIS OF DESIGN / DESIGN ANALYSIS REPORT
NEW BEDFORD HARBOR SUPERFUND SITE

New Bedford Harbor, Massachusetts

April 2002

Prepared for

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

2002-017-0084-App_A
4/9/02

TABLE OF CONTENTS

1.0 INTRODUCTION 1
- 1.1 Principles of Evaluation 1
- 1.2 Source Information For Cost Estimates 2

2.0 SCENARIO I - DRY DREDGE 2
- 2.1 Barge Transportation 2
- 2.2 Direct to Dewatering Facility 4

3.0 SCENARIO II - SLURRY RETURN 5
- 3.1 Single Pipe Slurry Return System 5
- 3.2 Closed Loop System 5

4.0 SCENARIO III – TRUCKING 6
- 4.1 Dry DREdge 6
- 4.2 Direct Excavation to Trucks 7

5.0 VEGETATIVE GROWTH EXCAVATION 8

6.0 OPTIONAL COST ADDITIONS 8
- 6.1 Sheet Pile Barrier 9

7.0 CONCLUSIONS 11

LIST OF TABLES

Table 2-1 Dry Dredging to Geotubes on Barges 4
Table 2-2 Dry Dredging Direct to Dewatering Facility Estimate 4
Table 3-1 Single Pipe Slurry Return System Estimate 5
Table 3-2 Closed Loop Slurry Return System Estimate 6
Table 4-1 Dry DREdge to Geotubes on Trucks Estimate 7
Table 4-2 Direct Excavation to Trucks 7
Table 5-1 InterModal Cars with Direct Fill Estimate 8
Table 6-1 Sheet Pile Barrier Costs 9
Table 7-1 Total Per Cubic Yard Process Costs 11

LIST OF FIGURES

Figure 6-1 Sheet Pile Locations 10

LIST OF ATTACHMENTS

Attachment A Cost Data
Attachment B Dry Dredge Operations Cost
Attachment C Geotubes Material Cost
Attachment D Decontamination Station Cost
Attachment E Access Road Cost

1.0 INTRODUCTION

As part of the Excavation Design subtask (20.92), Foster Wheeler was to investigate and evaluate excavation systems and the associated costs for removing contaminated materials from the mudflats and vegetated areas. The purpose of this evaluation was to determine which excavation and transportation systems would offer reasonably economic methods of removing the contaminated sediments from the vegetated wetlands and tidal flats and disposing of the materials in a proper manner. This memo detailed several equipment and transportation alternatives that would accomplish the excavation and disposal and derived per cubic yard costs for excavation and transportation for each. The goal of the work was to determine which excavation and transportation systems are feasible and use them in preparation of specifications that would allow contractors to competitively bid their equipment to ensure the lowest reasonable cost of the work is achieved.

1.1 Principles of Evaluation

The primary method for removing contaminated soils in the mud flats and vegetated areas will be excavation with low ground pressure equipment. Earlier studies of equipment alternatives demonstrated that a number of manufacturers could provide track mounted, low ground pressure equipment that will accomplish the excavation.

This section of the Basis of Design addresses the estimated costs of excavating the sediments and vegetation using readily available land based equipment and transporting the excavated materials to the dewatering facility.

Low ground pressure tracked and rubber tired equipment for use with almost every reasonable piece of excavation and transportation equipment are readily available. Therefore, a wide variety of excavator types, bucket selections, and dump carriers to haul materials across the mud flats and wetlands exist for material removal, the proper selection of which should optimize performance. Assuming that the flexibility in excavation equipment will result in optimum material removal rates, this report focuses on the cost evaluation of the mode of transportation of the excavated material, since that is the most significant difference between alternatives.

Three major modes of transportation are focused on: 1) "Dry DREdge" or positive displacement pumping (PD) to the dewatering facility or to a truck containing geotubes; 2) open and closed loop slurry pumping to the dewatering facility; and 3) ground/truck transportation.

To perform an evaluation of costs of appropriate alternatives, a number of scenarios that included various combinations of excavation and transportation were established. The cost estimates do not include items common to all alternatives, such as capital cost of the dewatering facility and water treatment plant and costs of running material and water through both, as that is not necessary for a comparison of costs for the alternatives.

The anticipated production rates that will drive some costs for the evaluations will allow for repair, maintenance, and other downtime occurrences. Production rates used in the cost calculations were obtained from Means Cost Data 2001, adjusted for the New Bedford Harbor area and for a wet environment.

1.2 Source Information For Cost Estimates

A brief description of the different sources of information and assumptions used in the cost estimates can be found in Attachment A. These sources are current and the latest versions available as of the writing of this report. However, due to the iterative nature of cost estimation and project development, these sources should be periodically checked for updated information prior to preparing any updated cost estimates for this work.

The calculated volume used in the mudflat scenarios in Section 3.2, 3.3, and 3.4 is 56,110 cubic yards. The calculated volume for the vegetated areas scenario in Section 3.5 is 28,040 cubic yards.

2.0 SCENARIO I - DRY DREDGE

Scenario 1 primarily consists of equipment and materials required for transporting materials via a "Dry DREdge" system (proprietary equipment). The Dry DREdge system utilizes in-situ moisture content to mix excavated material to a paste-like consistency. This paste-like slurry is then pumped with positive displacement pumps to its destination. Dry DREdge is slower than other processes due to the small diameter pumps involved and the head losses resulting from a thick slurry, but becomes potentially more economically feasible when considering the cost of treating large volumes of contaminated water used in other slurrying processes.

Material handled in the Dry DREdge process also does not require processing in the dewatering facility. This is because the Dry DREdge system transports the material as a slurry with no additional water. This material ranges from 43 to 75 percent solids by weight for the mud flats at New Bedford Harbor. The dewatering facility is only designed to handle slurried material from 15 to 20 percent solids by weight.

Bypassing the dewatering facility is a critical factor in the cost estimate for the Dry DREdge due to the sand removal process proposed for other alternatives. PCB's do not readily adhere to coarse materials. Therefore, any coarse material removed from the sample is shipped to an in-state special waste landfill at a significant cost reduction. Any sand and gravel delivered in the Dry DREdge slurry will not be separated and will have to be sent to the TSCA landfill at a higher cost than if the sand and gravel is removed and sent to a local landfill. Cost for shipping and disposing of this additional material may be offset by the cost saved by bypassing the dewatering facility.

Below, different forms of transportation costs are analyzed for handling materials from the Dry DREdge system. Monetary values used in the following tables can be found in the Appendices.

2.1 Barge Transportation

A barge is one available form of transportation for moving sediment. High solids content "Dry DREdge" material can be pumped into geotubes on pre-positioned barges. Geotubes are bags that are made of woven polypropylene fabric. For the case of contaminated sediment, an additional impermeable outer bag would be provided to prevent contaminated water from leaking back into the environment. The bags include a vacuum system built in to partially dewater the sediment. The bags can hold a total volume of 30 cubic yards. The geotubes would be placed on the deck of a barge, and dewatering of the geo-tubes could occur either on the barge or at the dewatering facility.

On-barge dewatering will require a barge mounted pump and holding tank for the contaminated water. The benefits of dewatering on the barge are reduced weight of the bags, resulting in lighter required lifting

loads and less dock time at a dewatering station. The dewatering may even take place during barge transit. Upon reaching the dewatering facility, the water in the holding tank on the barge can be pumped to the water treatment plant.

Dewatering at the facility would require a pump and hose that can connect with a barge at the dock and pump contaminated water to the facility contaminated water holding tank. The benefit of dewatering at the facility is that equipment requirements are reduced to a single unit with a possible redundant backup. Other benefits include eliminating concern about exceeding the barge mounted holding tank capacity and no size restriction on dewatering pump equipment (allowing for larger, faster pumps and easier maintenance of equipment).

After geo-tubes are dewatered, a crane that runs from dockside to the railcar loading area must lift the bags and place them in the railcars. A crane is not included in the design of the dewatering facility, but if this option was to occur then it would be required. Lifting the geo-tubes in this manner may cause these large bags to rip or break. This can create leakage problems on deck and in the dewatering facility. The geo-tubes are not practical due to issues with the safety of lifting bags and additional design requirements of a dockside crane.

A major disadvantage of barge transportation is the possible down time due to low bridge clearances and large tide cycles. The barge must pass under two bridges that range in clearance from 8 to 12 feet. However, specialized barges can be built to deal with these issues. A specialized barge has been considered in the cost estimate.

Sediments are contaminated in the waterfront area of the dewatering facility and along all areas to be excavated or dredged. Therefore, another obstacle would be on-site docking requirements. Impact on contaminated sediments must be minimized and, consequently, barges will not be allowed to run aground or to be operated by a tug in shallow water. This will require the approval and installation of a temporary pile, anchoring, or dock system for each excavation site. As this is more a regulatory and constructability issue, the cost for the docking or anchorage system is not included in the estimate. The regulatory issue concerns Section 10 of the River and Harbors Act of 1899, which states "that the creation of any obstruction not affirmatively authorized by Congress, to the navigable capacity of any of the waters of the United States is hereby prohibited; and it shall not be lawful to build or commence the building of any wharf, pier, dolphin, boom, weir, breakwater, bulkhead, jetty, or other structures in any port, roadstead, haven, harbor, canal, navigable river, or other water of the United States, outside established harbor lines, or where no harbor lines have been established, except on plans recommended by the Chief of Engineers and authorized by the Secretary of War." An alternative solution that would avoid the regulatory issue is rotatable barge mounted spuds to allow for bridge clearance. Another is two point anchorage systems.

WRS manager Mike Duke, who represents Dry DREdge, estimates project completion under this option at 31.2 weeks. Dry DREdge estimate information can be found in Attachment B.

Table 2-1
Dry Dredging to Geotubes on Barges

Item #	Item	#	Unit	Unit Cost	Cost
1	Mobilization (B)	1	LS	$92,150	$92,150
2	Setup (B)	1	LS	$89,960	$89,960
3	Operation (B)	1	LS	$2,308,100	$2,308,100
4	Equipment (Purchased) (B)	1	LS	$107,780	$107,780
5	Geotubes (30 cy) (C)	1,870	EA	$1,219	$2,279,530
6	Demobilization (B)	1	LS	$135,250	$135,250
				TOTAL COST	$5,012,770
				COST PER CUBIC YARD	$89.34

*Note: Parenthesis "( )" indicates which Attachment section additional information on data can be found in.

2.2 Direct to Dewatering Facility

Pumping high solids content material directly to the dewatering facility using the Dry DREdge system will require the use of several booster pumps and intermediate material storage hoppers. This is accomplished by placing positive displacement pumps on barges every 2,000 feet along the return line. Each pump will take material from a holding hopper and pump it to the next holding hopper. This process repeats until the material reaches the dewatering facility. At the dewatering facility, the material will be placed directly into geo-tubes that are in a railcars or trucks for transportation to the disposal site. A portable hose connection would needed in this scenario to pump water out of the geo-tubes for treatment.

Pumping the material directly to the dewatering facility will require multiple pumps in line that result in lower production rates due to increased down time. Drawbacks of pumping the material back to the facility are increased monitoring requirements, increased opportunity for mechanical failure interrupting production, and an overall increase in required equipment and associated costs. These negative aspects are reflected in the estimated costs shown in the table below.

WRS manager Mike Duke, who represents Dry DREdge, estimates project completion under this option at 62.4 weeks. Dry DREdge estimate information can be found in Attachment B.

Table 2-2
Dry Dredging Direct to Dewatering Facility Estimate

Item #	Item	#	Unit	Unit Cost	Cost
1	Mobilization (B)	1	LS	$73,540	$73,540
2	Setup (B)	1	LS	$89,940	$89,940
3	Operations (B)	1	LS	$5,175,835	$5,175,835
4	Equipment (Purchased) (B)	1	LS	$133,440	$133,440
5	Geotubes (30 cy each = 1870 bags, $1,219 each) (C)	1,870	EA	$1,219	$2,279,530
6	Demobilization (B)	1	LS	$118,505	$118,505
				TOTAL COST	$7,870,790
				COST PER CUBIC YARD	$140.27

*Note: Parenthesis "( )" indicates which Attachment section additional information on data can be found in.

3.0 SCENARIO II - SLURRY RETURN

Scenario II will focus on a high volume slurry return system. Slurry return systems are more commonly used for cutterhead dredging activities, and the dewatering facility is already designed to handle this type of material being sent from the harbor dredging equipment. Material being excavated will be mixed with water to create a slurry with a range of 15 to 20 percent solids and then pumped to the dewatering facility. Material passing through the dewatering facility will not require any treatment in addition to that proposed as the normal process. The two main alternate configurations for this system are a single return line system and a dual pipe closed loop system as described below.

3.1 Single Pipe Slurry Return System

A single pipe slurry return system would utilize water from the harbor to convert excavated material to a slurry consistency for transportation back to the dewatering facility. Due to costs and flow rate problems associated with municipal water supplies, the local water source is considered to be New Bedford Harbor. Other special design considerations include anti-"fish trapping" provisions requiring intakes to be screened and have an approach velocity no greater than 1 ft/sec. At a pumping capacity of 4,000 gallons per minute, the result is a screen area approximately equal to 9 ft^2 or a 3.5-ft diameter intake screen. This design also adds considerable cost associated with treating a much larger volume of contaminated water.

Project completion under this option is estimated at 18.7 weeks based on excavation rates reported by RS Means that account for wet operations. Attachment A contains further information on rate estimates and time line estimates.

Table 3-1
Single Pipe Slurry Return System Estimate

Item #	Item	#	Unit	Unit Cost	Cost
1	Mobilization (A)	1	LS	$63,875.00	$63,875.00
2	10-inch Centrifugal Pumps (200 H.P., 4,000 gal/min) (A)	2	EA	$44,200.00	$88,400.00
3	10-inch HDPE Pipe (Purchased & Installed) (A)	5,000	FT	$16.67	$83,350.00
4	Excavation (wet) (1.5 C.Y.cap) (A)	18.7	Week	$3,792.00	$70,910.40
5	Slurry Mixer	1	LS	$20,000.00	$20,000.00
6	Demobilization (A)	1	LS	$95,812.50	$95,812.50
				TOTAL COST	$422,347.90
				COST PER CUBIC YARD	$7.53

*Note: Parenthesis "( )" indicates which Attachment section additional information on data can be found in.

3.2 Closed Loop System

The closed loop system will use the contaminated process water extracted from the processed dredge material at the dewatering facility to slurry the excavated material. Process water is returned to the excavation site via a 10-inch HDPE pipe and booster pump arrangement, used to slurry the excavated materials, and is then returned to the dewatering facility as slurry for processing. Although this system will require double the booster pumps and pipeline as the single pipe system, the amount of additional contaminated water to process is effectively zero.

Project completion under this option is estimated at 18.7 weeks based on excavation rates reported by RS Means that account for wet operations. Attachment A contains further information on rate estimates and time line estimates.

Table 3-2
Closed Loop Slurry Return System Estimate

Item #	Item	#	Unit	Unit Cost	Cost
1	Mobilization (A)	1	LS	$78,875.00	$78,875.00
2	10-inch Centrifugal Pumps (200 H.P., 4,000 gal/min) (A)	4	EA	$44,200.00	$176,800.00
3	10-inch HDPE Pipe Installed (A)	10,000	FT	$16.67	$166,700.00
4	Excavation (wet) (1.5 C.Y.cap)(A)	18.7	Week	$4,065.00	$76,015.50
5	Slurry Mixer	1	LS	$20,000.00	$20,000.00
6	Demobilization (A)	1	LS	$118,312.50	$118,312.50
				TOTAL COST	$636,703.00
				COST PER CUBIC YARD	$11.35

*Note: Parenthesis "( )" indicates which Attachment section additional information on data can be found in.

4.0 SCENARIO III – TRUCKING

Scenario III uses the same excavation equipment as Scenario I and II, but uses trucks to transport the excavated material back to the dewatering facility.

4.1 Dry DREdge

Excavated material can be pumped by the "Dry DREdge" system into sealed geotubes placed in the back of a dump truck or intermodal container on a truck. Access roads and decontamination areas must be constructed to allow truck access to the numerous excavation sites. Locations, lengths and costs of the access roads needed to reach the excavation locations can be found in Attachment E.

All truck transportation options will require the use of a local decontamination station comprised of a sealed concrete pad and two 1,000-gallon tanks. One tank provides clean wash water for decontamination activities and the other tank stores contaminated wastewater for subsequent treatment. The tabulation of costs for the decontamination station can be found in Attachment D. Figure 2 in Attachment D illustrates the layout of the stations for each access road.

Geo-tubes inside intermodal containers would be filled with sediment transported by the Dry DREdge system. Once filled, these containers would be trucked to the facility. For this scenario to be possible, a pump and hose hook-up would be necessary to suction off the entrained water for treatment. An overhead crane at the dewatering facility would also be an addition to the existing design to lift the geo-tubes out of the containers and place them in the railcars. The trucks would then return to the excavation site for reloading.

WRS manager Mike Duke, who represents Dry DREdge, estimates project completion under this option at 31.2 weeks. Dry DREdge estimate information can be found in Attachment B.

Table 4-1
Dry DREdge to Geotubes on Trucks Estimate

Item #	Item	#	Unit	Unit Cost	Cost
1	Mobilization (B)	1	LS	$20,420.00	$20,420.00
2	Setup (B)	1	LS	$23,980.00	$23,980.00
3	Operations (B)	1	LS	$2,879,765.00	$2,879,765.00
4	Equipment (Purchased) (B)	1	LS	$166,800.00	$166,800.00
5	Excavation (wet) (1.5 C.Y.cap) (A)	18.7	Week	$4,065.00	$76,015.50
6	Geotubes (30 cy each) (C)	1,870	EA	$1,219.00	$2,279,530.00
7	Decon Stations (D)	5	EA	$10,726.58	$53,632.90
8	2 Dump Trucks and Drivers (A) (Cost x2)	18.7	Week	$25,133.04	$469,987.85
9	Demobilization (B)	1	LS	$32,400.00	$32,400.00
				TOTAL COST	$6,002,531.25
				COST PER CUBIC YARD	$106.98

*Note: Parenthesis "( )" indicates which Attachment section additional information on data can be found in.

4.2 Direct Excavation to Trucks

Another option for trucking excavated material from the mudflats is direct placement into lined trucks. Marsh buggy excavators would fill marsh buggy dump trucks that would transport the sediment from the mudflats to the land-based dump truck located at the end of the access road. The dump truck would then transport the sediment to the dewatering facility. Two or more trucks would be recycled back and forth between the mudflats and the dewatering facility. The existing dewatering facility design would not be able to dewater the sediment through normal facility processes. A secondary dewatering process would have to be designed. This would mean that dual-dewatering designs would be needed and that is not practical.

Another negative aspect of this option is constantly moving multiple equipment around in the mudflats stirring up the contaminated sediments continuously. This may hinder the effects of the cleanup due to the continual stirring of the sediments into the water column at periods of high tide. Project completion under this option is estimated at 18.7 weeks based on excavation rates reported by RS Means that account for wet operations. Attachment A contains further information on rate estimates and time line estimates.

Table 4-2
Direct Excavation to Trucks

Item #	Item	#	Unit	Unit Cost	Cost
1	Mobilization (A)	1	LS	$31,250.00	$31,250.00
2	Excavator (wet material, 1.5 C.Y.cap) (A)	18.7	Week	$4,065.00	$76,015.50
3	Low Ground Pressure Excavator (A)	18.7	Week	$4,065.00	$76,015.50
4	Decon Stations (D)	5	EA	$10,726.58	$53,632.90
5	2 Over-the-road Dump Trucks and Drivers (A)	18.7	Week	$25,133.04	$469,987.85
6	2 Low Ground Pressure Dump Trucks (A)	18.7	Week	$25,133.04	$469,987.85
7	Demobilization (A)	1	LS	$46,875.00	$46,875.00
				TOTAL COST	$1,223,764.60
				COST PER CUBIC YARD	$21.81

*Note: Parenthesis "( )" indicates which Attachment section additional information on data can be found in.

5.0 VEGETATIVE GROWTH EXCAVATION

Large areas of the contaminated upland area sediment are covered with vegetation that cannot be processed with the equipment proposed for dewatering the sediment because the plants and root mat will clog up the presses. The contaminated material must be removed with conventional low ground pressure excavation and clearing equipment. The excavated material must then be placed directly into lined intermodal trucks for transportation to the dewatering facility. The intermodal containers would then be lifted off the trucks and placed on the railcars for transport. This would mean adding a crane to the existing dewatering facility building design. The volume of the vegetated wetlands excavation is estimated at 28,040 cubic yards.

The same access roads must be constructed to allow truck access to the vegetated areas as would be required for the truck transportation option discussed previously. Additionally, nine more sites must be accessed requiring nine more decontamination stations. All 14 decontamination stations are included in this estimate. Each decontamination station is comprised primarily of a sealed concrete pad and two 1,000-gallon tanks and connective plumbing as shown on Figure 2 in Attachment D. One tank provides clean wash water and the other tank stores contaminated wastewater for subsequent removal and treatment.

Project completion under this option is estimated at 9.4 weeks based on excavatión rates reported by RS Means that account for wet operations. Attachment A contains further information on rate estimates and time line estimates.

Table 5-1
InterModal Cars with Direct Fill Estimate

Item #	Item	#	Unit	Unit Cost	Cost
1	Mobilization (A)	1	LS	$31,250.00	$31,250.00
2	Excavator (wet material, 1.5 C.Y.cap) (A)	9.4	Week	$4,065.00	$38,211.00
3	Low Ground Pressure Excavator (A)	9.4	Week	$4,065.00	$38,211.00
4	Decon Stations (D)	14	EA	$10,726.58	$150,172.12
5	2 Over-the-road Dump Trucks and Drivers (A)	9.4	Week	$25,133.04	$236,250.58
6	2 Low Ground Pressure Dump Trucks (A)	9.4	Week	$25,133.04	$236,250.58
7	Demobilization (A)	1	LS	$46,875.00	$46,875.00
				TOTAL COST	$777,220.27
				COST PER CUBIC YARD	$27.72

*Note: Parenthesis "( )" indicates which Attachment section additional information on data can be found in.

6.0 OPTIONAL COST ADDITIONS

Optional cost items can be added to the systems above. Sheet pile walls as a barrier to the spread of contamination can be used for mudflat locations but are not considered necessary for excavation of upland vegetation. That work will normally be accomplished in the dry, and there is no substantial reason to be concerned about stirring up the contamination and redistributing it. A steel sheet pile barrier may be needed in some locations to prevent contamination stirred up during excavation from being redistributed to other areas.

6.1 Sheet Pile Barrier

As an add-on product to different types of excavation systems, barriers are an option to prevent the spread of contaminated sediments from areas being excavated to other areas of the harbor. When excavators move around on and excavate in the mudflats, the sediment will stir up in the water around the excavator. This stirring can suspend sediment in the water column, and tidal action will move the sediment to different parts of the harbor. This can cause contaminated sediments to travel to previously dredged subtidal areas and recently excavated areas. Therefore, there is an apparent need to prevent tidal action from moving the suspended sediments around.

A freestanding sheet pile wall can be used to stop tidal water from rushing into the excavation site by allowing only controlled flows. The unsealed connections will allow water to seep through in a much slower fashion, and weir areas could be included to ensure flows adequate to eliminate unacceptable differential head levels. By properly sizing the sheet pile thickness and embedment, a sheet pile wall can be designed to withstand the forces involved, including water and waves. Costs associated with the material, labor and installation for particular lengths of sheet piles used as barriers are shown below in Table 6-1.

Table 6-1
Sheet Pile Barrier Costs

#	Locations in Figure 10	Length (ft)	Height (ft)	Costs ($)
1	Robichaud Cove	2,274	10	$568,500
2	Beech Street Cove	495	10	$123,750
3	Veranda Avenue Cove	383	10	$95,750
4	Coffin Avenue Cove	1,279	10	$319,750
	TOTALS	4,431		$1,107,750
		COST PER SQUARE FOOT		$25

There are four very large areas that are slated for excavation. Longer periods of time are necessary to excavate these areas, thus resulting in additional potential for stirring up of the existing sediments. Smaller areas that are approximately 100 feet between the shoreline and MLLW are not included below because these areas are easier and more economical to be dredged or they will not require long periods to accomplish, thereby minimizing the potential for re-suspending and redistributing the contaminated sediments. Because the dredge will already be set up during dredging operations, these areas are small enough that, during high tide, the dredge will have the capability to reach these narrow areas. Figure 6-1 shows the various locations that have been preliminarily chosen for sheet pile barriers in this cost estimate, assuming a decision is made that the barriers are needed.

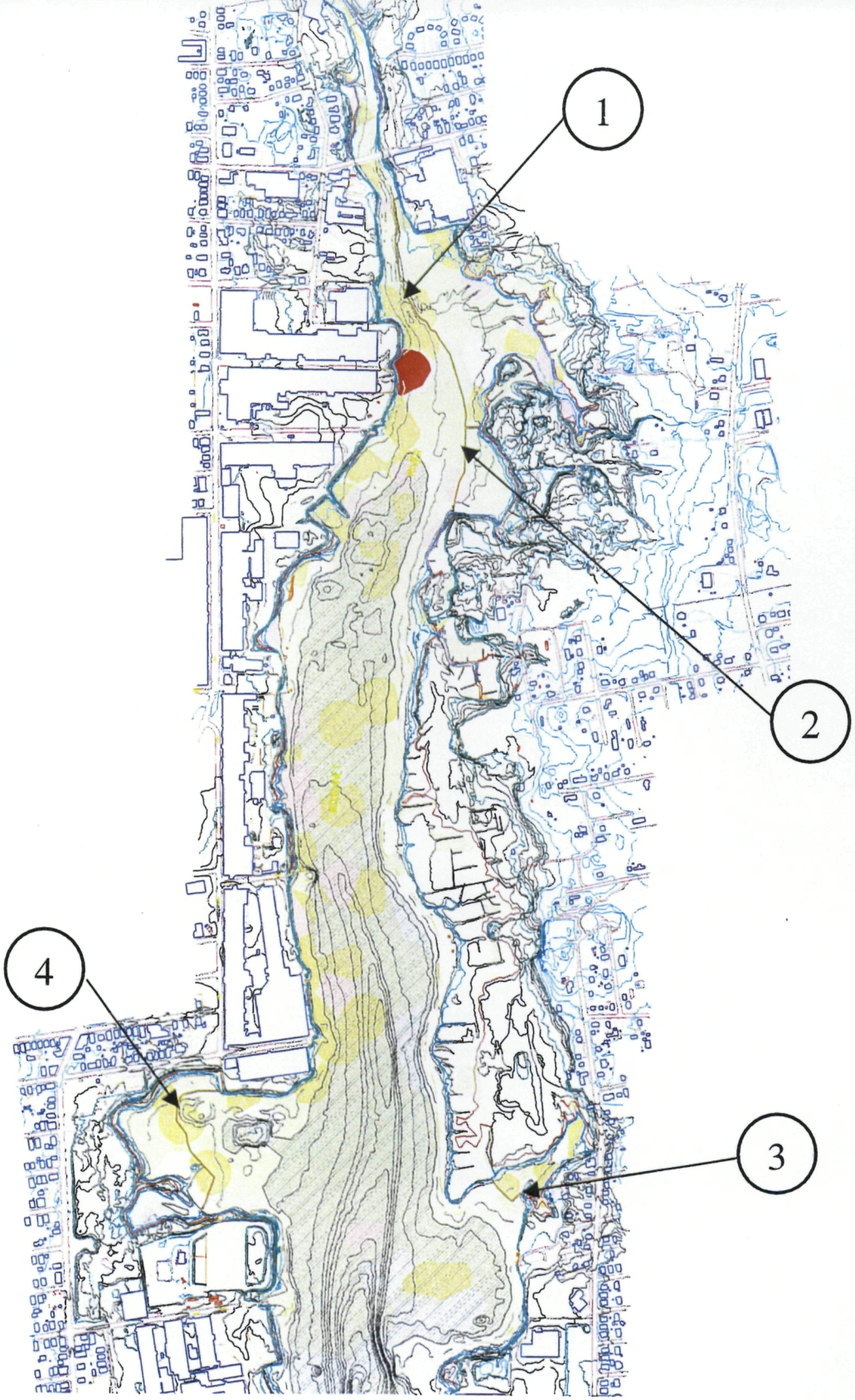


Figure 6-1 Sheet Pile Locations

7.0 CONCLUSIONS

Costs associated with each option have been tabulated below in Table 7-1.

Table 7-1
Total Per Cubic Yard Process Costs

Option	Cost Per Cubic Yard
Dry Dredging to Geo-bags on Barges	$89.34
Dry Dredging Direct to Dewatering Facility	$140.27
Single Pipe Slurry Return System	$7.53
Closed Loop Slurry Return System	$11.35
Dry Dredging to Geo-bags on Trucks	$106.98
Direct Excavation to Truck	$21.81
Vegetative Growth Excavation	$27.72

Of the options, all three Dry DREdge operations were found to be the most expensive at $89.34, $140.27, and $106.98 per cubic yard. This is due to additional costs from geotubes and bypassing the desanding and dewatering processes at the facilities. The Dry DREdge system can only be used for the mudflats, and this system includes geotubes into which the in-situ sediment is pumped. The geotubes carry an additional cost of $2,280,000 for the volumes calculated. Dry DREdge may be a viable option only if combined with the dredging operations. The Dry DREdge could pump to a hopper on a barge that is already transporting dredged material to the dewatering facility. Otherwise, using geo-tubes is costly and cumbersome.

The systems that use either a single pipe or closed loop pipe slurry return system have more reasonable estimated costs of $7.53 and $11.35 per cubic yard, respectively. These two systems will cause less impact to the environment than the direct excavation to truck, which is estimated to cost $21.81 per cubic yard. This is because direct excavation to truck encompasses the marsh buggy moving continuously in the mudflats to the truck carrying the excavated materials, which will stir up the sediments.

Given that desanding and dewatering facilities will be built for the dredging portion of the project, these two facilities offer a less expensive solution for transportation of the TSCA sediment. Therefore, a single pipe or closed loop pipe slurry return system reduces both costs of transportation from the excavation site to a shipping site and from a shipping site to a TSCA facility. Because the desanding facility will remove the sand from the slurry and the dewatering facility will remove the water, this also creates less tonnage of TSCA sediment to be transported, and costs are reduced.

The truck option does not have a dewatering solution and may become more expensive. This is only a viable option if the slurry system has broken down and excavation work must continue.

ATTACHMENT A

ATTACHMENT A
COST DATA

A. Centrifugal Pumps (10-inch): Cost for monthly rent and operational costs provided by Barbara Balboni of RS Means. Per month cost is $11,050 per unit.

B. Mobilization Costs: Mobilization costs will differ greatly depending on how much equipment is used and how far away its is. Dry DREdge provided mobilization costs for the systems using the positive displacement pumps. The single line, closed loop, and vegetative mat options are covered here.

1. Single Line Slurry System Mobilization Costs.

The system anticipated for the single line slurry system would include the following:

- Delivery of three 30'x 90' barges.
- Delivery of 5,000 feet of 10-inch HDPE pipe (installation cost is included in material cost).
- Delivery and setup of three booster pumps mounted on the barges.
- Delivery of one pusher barge with a captain and deckhand.
- Delivery of two low ground pressure vehicles (Marshbuggies), one being an excavator, one being a stage for a slurry mixer.

Single Pipe Slurry Mobilization Cost Estimate						
Item #	**Item**	**R.S. Means #**	**Qty.**	**Unit**	**Unit Cost**	**Total Cost**
1	3 - 30'x90' barge. Mobilization with a tugboat. Delivery distance of 100 miles.	02390 650 0300	300	Mile	$46.50	$13,950
2	Delivery of 5,000 feet of 10-inch HDPE pipe from a local supplier. Each truck load is 1,700 feet.		3	Truck Load	$3,000.00	$9,000
3	Delivery and setup of three 10-inch booster pumps. Includes attachment to barge.		3	Ea.	$1,000.00	$3,000
4	Delivery of one pusher barge with crew. Assumed to cost the same as barge delivery.	02390 650 0300	100	Mile	$46.50	$4,650
5	Delivery of two pieces of excavation equipment. Trucked 1,500 miles.		2	Truck Load	$10,000.00	$20,000
6	Mounting of slurry mixer on low ground pressure vehicle.		1	Ea.	$500.00	$500
					Sub-Total =	$51,100
					Contingency Cost (25%) =	$12,775
					Mobilization Total =	**$63,875**

2. Closed Loop Slurry System Mobilization Costs.

This system is identical to the single line system, except it requires feed water to be pumped from the dewatering station to the excavation site. The result is the doubling of most water transportation equipment requirements (i.e., 5,000 feet of HDPE becomes 10,000 feet of HDPE).

Closed Loop Slurry Mobilization Cost Estimate						
Item #	**Item**	**R.S. Means #**	**Qty.**	**Unit**	**Unit Cost**	**Total Cost**
1	3 - 30'x90' barge. Mobilization with a tugboat. Delivery distance of 100 miles.	02390 650 0300	300	Mile	$46.50	$13,950
2	Delivery of 10,000 feet of 10-inch HDPE pipe from a local supplier. Each truck load is 1,700 feet.		6	Truck Load	$3,000.00	$18,000
3	Delivery and setup of six 10-inch booster pumps. Includes attachment to barge.		6	EA	$1,000.00	$6,000
4	Delivery of one pusher barge with crew. Assumed to cost the same as barge delivery.	02390 650 0300	100	Mile	$46.50	$4,650
5	Delivery of two pieces of excavation equipment. Trucked 1,500 miles.		2	Truck Load	$10,000.00	$20,000
6	Mounting of slurry mixer on low ground pressure vehicle.		1	Ea.	$500.00	$500
					Sub-Total =	$63,100
					Contingency Cost (25%) =	$15,775
					Mobilization Total =	**$78,875**

3. Direct Excavation to Truck & Vegetative Mat Mobilization Costs.

The vegetative mat removal will require excavation and transportation of material to an area where upland equipment can operate. The upland site will have over-the-road trucks and another excavator. The over-the-road trucks are a general requirement and are not included in this estimate.

Direct to Truck & Vegetative Mat Excavation Mobilization Cost Estimate					
Item #	**Item**	**Qty.**	**Unit**	**Unit Cost**	**Total Cost**
1	Delivery of one piece of low ground pressure excavation equipment. Trucked 1,500 miles.	1	Truck Load	$10,000	$10,000
2	Delivery of one piece of upland excavation equipment. Trucked less than 500 miles.	1	Truck Load	$5,000	$5,000
3	Delivery of two pieces of low ground pressure bump body equipment. Trucked 1,500 miles.	2	Truck Load	$10,000	$20,000
				Sub-Total =	$25,000
				Contingency Cost (25%) =	$6,250
				Mobilization Total =	**$31,250**

C. Setup: Setup costs are only included for Dry DREdge cost estimates.

D. Demobilization: Demobilization costs are assumed as 1.5 times the mobilization costs. This estimate is used for all systems other than the Dry DREdge system, which WRS has provided.

E. Dry DREdge ™ Estimates: Cost estimates for Dry DREdge ™ dredging operations were provided by Michael Duke of WRS Infrastructure and Environment, Inc.

F. Excavation Volumes for Mud: Volumes used for total cubic yards (C.Y.) of material excavated, processed, and shipped and any other related action is based on 56,110 C.Y. in-situ volume. This value was calculated by the Design Department of Foster Wheeler Environmental Boca Office and is based on a phase II sediment contamination CAD layout of the project site where surface areas for different excavation depths where measured and multiplied for total in-situ C.Y. of material. This work was completed on August 31, 2001. Need to redo volumes

G. Excavation Volumes for Vegetation: Volumes used for total cubic yards (C.Y.) of material excavated, processed, and shipped and any other related action is based on 28,040 C.Y. in-situ volume. This value was calculated by the Design Department of Foster Wheeler Environmental Boca Office and is based on a phase II sediment contamination CAD layout of the project site where surface areas for different excavation depths where measured and multiplied for total in-situ C.Y. of material. This work was completed on August 31, 2001.

H. Vegetation Weight: Assumptions for vegetation weight are that it is made up of vegetation and root mat. A brake down calculation follows:

1. Vegetation (60%) – Density = 62 pcf
2. Root Mat (40%) – Density = 90 pcf

Conversion of vegetation volume from C.Y. to C.F. = $28{,}040cy \times (27cf/cy) = 757{,}080cf$

$$\text{Total Weight} = \frac{(757{,}080\text{cf} \times 60\% \times 62\text{pcf}) + (757{,}080\text{cf} \times 40\% \times 90\text{pcf})}{2000\text{lb/ton}} = 27{,}709tons$$

I. Geotubes: Geotubes cost estimate was provided by Dr. Jack Fowler of GEOTECH ASSOCIATES. Total product costs consider designs based on physical requirements, production, and material costs for T.C. Mirafi products.

J. Geotechnical Data: Preliminary geotechnical data was provided by Rich Otoski.

- In-place Density: 85 lb/ft^3
- In-place Solids by Weight: 43%
- In-place Coarse Material by Weight:20% of solids

K. Transportation Distances: Excavation areas are widely dispersed along the New Bedford Harbor area. The maximum distance between the dewatering facility and the furthest excavation area is approximately 10,000 feet. For calculation purposes, an average distance of 5,000 feet will be used.

L. Local Adjustment Factor: RS Means has a local adjustment factor for New Bedford Harbor. It is 107.2 percent.

M. HDPE 10-inch Pipe: HDPE 10-inch pipe with butt fusion joints supplied in 40 feet lengths costs 15.55 dollars for material and costs per linear foot. This cost includes all installation costs including welder, generator, and crew. This cost does not include delivery. With the added local adjustment factor of 107.2 percent, cost per linear foot is 16.67 dollars.

N. Excavator (Wet): RS Means value for excavation can be estimated per cubic yard or by rental rates based on a known time span. A production rate adjusted for wet operations was used to estimate the time of job completion, then rental rates were used to estimate the job cost.

The production rate is reported as 100 cubic yard per hour. Adjustments to this rate are covered under "Excavator Rates" and are reduced to 50 cubic yards per hour for wet operations. RS Means reports a rental rate that includes the cost of equipment, operation requirements such as fuel, and the appropriate crew. This estimated is based on one fifth of the weekly rental rate plus eight times the crew/support rate. RS Means reports this rate as $593.20 per day for a one and one-half cubic yard unit. Adjusting for a 10-hour workday and a 6-day workweek, we have:

$$\$2{,}190/Week \div 5 = \$438/DayforEquipment$$

$$\$593.20/Day - \$438/DayforEquipment = \$155.20/DayforCrew$$

$$\$155.20/DayforCrew \div 8Hours = \$19.40/HourforCrew$$

$$\$19.40/HourforCrew * 10Hours/Day + \$438/DayforEquipment = \$632/Day$$

$$\$632/Day * 6Days = \$3{,}792/Week$$

$$\$3{,}792/Week * 1.072(LocalAdjustmentFactor) = \$4{,}065/Week$$

Cost adjustments for wet operations are used to adjust the "time of completion" of the project; thus, rental rates based on time are already adjusted for lower production rates in wet areas.

O. Low Ground Pressure Excavator: Perry Autin of Marshbuggies Corp. has provided the following product information. Delivery cost for this unit from the manufacturing plant in Louisiana to New Bedford Harbor is approximately $10,000 one way. Rental cost could not be provided, but estimates based on regular excavation equipment can provide an accurate estimate. For the purpose of this estimate, "Low Ground Pressure Excavation" estimates will be based on the "Excavator (Wet)" values.

P. Timeline: Assumptions of timeline for excavation of vegetation and mudflat.

a) The workweek is assumed to be 60 hours long, 6 days a week.

b) Mudflats: $$56{,}110cy \times \frac{1hr}{50cy} \times \frac{1week}{60hrs} = 18.7weeks$$

$$18.7weeks \times \frac{6days}{1week} = 112days$$

c) Vegetation: $$28{,}040cy \times \frac{1hr}{50cy} \times \frac{1week}{60hrs} = 9.4weeks$$

$$9.4weeks \times \frac{6days}{1week} = 57days$$

Q. Dump Truck: 50 ton off highway dump truck costs were also taken from RS Means. RS Means reports a rental rate that includes the cost of equipment, operation requirements such as fuel, and the appropriate crew. This estimated is based on one fifth of the weekly rental rate plus eight times the crew/support rate. RS Means reports this rate as $1,466 per day for a 50-ton dump truck. Adjusting for a 10-hour workday and a 6-day workweek, we have:

$$\$5{,}300/Week \div 5 = \$1{,}060/DayforEquipment$$

$$\$1{,}775/Day - \$1{,}060/DayforEquipment = \$715/DayforCrew$$

$$\$715/DayforCrew \div 8Hours = \$89.38/HourforCrew$$

$$\$89.38/HourforCrew * 10Hours/Day + \$1{,}060/DayforEquipment = \$1{,}953.75/Day$$

$$\$1{,}953.75/Day * 6Days = \$11{,}722.50/Week$$

$$\$11{,}722.50/Week * 1.072(LocalAdjustmentFactor) = \$12{,}566.52/Week$$

R. <u>Low Ground Pressure Dump Truck:</u> Perry Autin of Marshbuggies Corp has provided the following product information. A low ground pressure track system has been successfully mounted with a dump body resulting in a vehicle that can traverse marshy areas at 2 to 4 MPH and transport approximately 10 cubic yards of material depending on the materials density. Delivery cost for this unit from the manufacturing plant in Louisiana to New Bedford Harbor is approximately $10,000 one way. Rental cost is approximately $1,200 a day plus crew and fuel. The over-the-road dump truck has a higher estimated rental cost and will be used as the rental estimate for the low ground pressure dump truck cost estimate.

Figure 1: Low Ground Pressure Dump Truck

ATTACHMENT B

ATTACHMENT B
DRY DREDGE OPERATIONS COST

Mike Duke of Dry DREdge™ provided the following cost estimate for the Dry DREdge operations.

WRS Dry DREdge Options
New Bedford Budgetary Cost Estimate Summary
September 14, 2001

Option 1 - Geotube Dewatering & Barge Transportation
Volume - 54,663 cubic yards
Production Rate - 30 cy/hr
Operations Duration - 30.4 weeks w/ 60 hr weeks

Task	Labor	Materials	Equipment	Subcontracts	Total
Mobilization	5,760	-	-	84,015	89,775
Setup	30,773	3,600	42,932	10,335	87,640
Purchased Equipment	-		105,000	-	105,000
Operations	1,139,572	72,884	689,412	346,705	2,248,573
Demobilization	21,147	-	21,465	89,153	131,765
Total	1,197,252	76,484	858,809	530,208	2,662,753

Option 2 - Pump via Boosters to Railcar Loading Area
Volume - 54,663 cubic yards
Production Rate - 15 cy/hr
Operations Duration - 60.7 weeks w/ 60 hr weeks

Task	Labor	Materials	Equipment	Subcontracts	Total
Mobilization	5,760	-	-	65,880	71,640
Setup	25,218	5,400	54,750	2,250	87,618
Purchased Equipment	-	-	130,000	-	130,000
Operations	1,904,297	218,652	2,176,397	743,012	5,042,358
Demobilization	18,369	2,700	27,375	67,005	115,449
Total	1,953,644	226,752	2,388,522	878,147	5,447,065

Option 3 - Pump to Truck Loading Station
Volume - 54,663 cubic yards
Production Rate - 50 cy/hr
Operations Duration - 18.2 weeks w/ 60 hr weeks

Task	Labor	Materials	Equipment	Subcontracts	Total
Mobilization					19,890
Setup					23,358
Purchased Equipment					162,500
Operations					2,805,500

The Dry DREdge estimate was provided prior to excavated volume calculations and was based on estimated volumes. The new mud flat volume is 56,110 cubic yards. The above spreadsheet has been modified to reflect the new volume and the results can be found below. The cost values have been increased by the ratio of the two volumes (56,110/54,663). These updated estimates were used in the cost estimate.

WRS Dry DREdge Options
New Bedford Budgetary Cost Estimate Summary
September 14, 2001

Option 1 - Geotube Dewatering & Barge Transportation
Volume - 54,663 cubic yards
Production Rate - 30 cy/hr
Operations Duration - 30.4 weeks w/ 60 hr weeks

For 56,110 CY
Operation Duration = 31.2 weeks

Task	Labor	Materials	Equipment	Subcontracts	Total	Total for 56,110 CY
Mobilization	5,760	-	-	84,015	89,775	$92,151.46
Setup	30,773	3,600	42,932	10,335	87,640	$89,959.94
Purchased Equipment	-		105,000	-	105,000	$107,779.49
Operations	1,139,572	72,884	689,412	346,705	2,248,573	$2,308,095.62
Demobilization	21,147	-	21,465	89,153	131,765	$135,252.99
Total	1,197,252	76,484	858,809	530,208	2,662,753	$2,733,239.50

Option 2 - Pump via Boosters to Railcar Loading Area
Volume - 54,663 cubic yards
Production Rate - 15 cy/hr
Operations Duration - 60.7 weeks w/ 60 hr weeks

For 56,110 CY
Operation Duration = 62.4 weeks

Task	Labor	Materials	Equipment	Subcontracts	Total	Total for 56,110 CY
Mobilization	5,760	-	-	65,880	71,640	$73,536.40
Setup	25,218	5,400	54,750	2,250	87,618	$89,937.36
Purchased Equipment	-	-	130,000	-	130,000	$133,441.27
Operations	1,904,297	218,652	2,176,397	743,012	5,042,358	$5,175,835.71
Demobilization	18,369	2,700	27,375	67,005	115,449	$118,505.08
Total	1,953,644	226,752	2,388,522	878,147	5,447,065	$5,591,255.82

Option 3 - Pump to Truck Loading Station
Volume - 54,663 cubic yards
Production Rate - 50 cy/hr
Operations Duration - 18.2 weeks w/ 60 hr weeks

For 56,110 CY
Operation Duration = 18.7 weeks

Task	Labor	Materials	Equipment	Subcontracts	Total	Total for 56,110 CY
Mobilization					19,890	$20,416.51
Setup					23,358	$23,976.32
Purchased Equipment					162,500	$166,801.58
Operations					2,805,500	$2,879,765.20
Demobilization					31,569	$32,404.67
Total					3,042,817	$3,123,364.28

ATTACHMENT C

ATTACHMENT C
GEOTUBES MATERIAL COST

The following Geotube cost estimate was provided by Dr. Jack Fowler of GEOTECH ASSOCIATES. Total product costs consider designs based on physical requirements, production, and material costs for T.C. Mirafi products.

Geotubes Vacuum Dewatering Project, New Bedford, MA

Dredged Material Geotechnical Properties

In Situ Volume cy	Specific Gravity	Satura-tion %	Percent Solids %	Moisture Content %	Void Ratio	Wet Bulk Density gr/cc	Wet Density pcf	Wet Density ton/cy	Dry Solids ton/cy	Bulking and/or Reduct Factor	Water Volume Change cy	Dewatered Soil Volume in Geotube cy	Dewatered Soil Weight in Geotubes ton
55,000	2.7	100	50	100	2.7	1.46	91.07	1.23	0.61	1	-	55,000	67,620
50 to 60 Solids	2.7	100	60	67	1.8	1.61	100.29	1.35	0.81	0.76	13,378	41,622	56,350
50 to 70 Solids	2.7	100	70	43	1.2	1.79	111.58	1.51	1.05	0.58	22,934	32,066	48,300
	2.7	100	20	400	10.8	1.14	71.39	0.96	0.19	3.19	(120,405)	Hydraulic Dredging Not Applicable	

20 ft Long Roll Off Containers

5x8x20 ft Roll Off Containers	Geotube Liner Length ft	Geotube Circum-ference ft	Geotube Fabric Area sy	Fill Height ft	Fill Width ft	Fill Height After Dewater ft	Volume Before Dewater cy per Container	Volume After Dewater cy per Container	Weight After Dewater # per Container	Weight After Dewater ton per Container	Geotubes Required
50 to 60 Solids	20	30	67	5	8	3.78	30	22.4	60,714	30.36	1,856
50 to 70 Solids	20	30	67	5	8	2.92	30	17.3	52,040	26.02	1,856

Vacuum Bag and Vacuum Cost

Geotube GT500 Fabric Cost/ln-ft	Geotube Non-Woven 16 oz liner per/ln-ft	Geotube 20 Mil PVC Liner per/ln-ft	Lifting Harness Cost per ln/ft	Geotube Cost per ln/ft & Lifting Harness per ln/ft	Cost of 25 ft long Geotube and Harness	Perforated PVC Pipe $2.00/ft for 22 ft	Total Cost Including Vacuum Pipe	Cost Based on 30 cy Geotube $/cy
$15.00	$ 10.00	$ 10.00	$ 12.00	$ 47.00	$1,175.00	$ 44.00	$1,219.00	$ 41.14

ATTACHMENT D

ATTACHMENT D
DECONTAMINATION STATION COST

Decontamination stations are required for each access road leading into the excavation work site areas. These stations provide wash down/decontamination capabilities to trucks and equipment traveling from the work site to public roads. Each station primarily consists of a concrete pad and two 1,000-gallon holding tanks and the hardware to connect them. The following figure indicates the basic station layout.

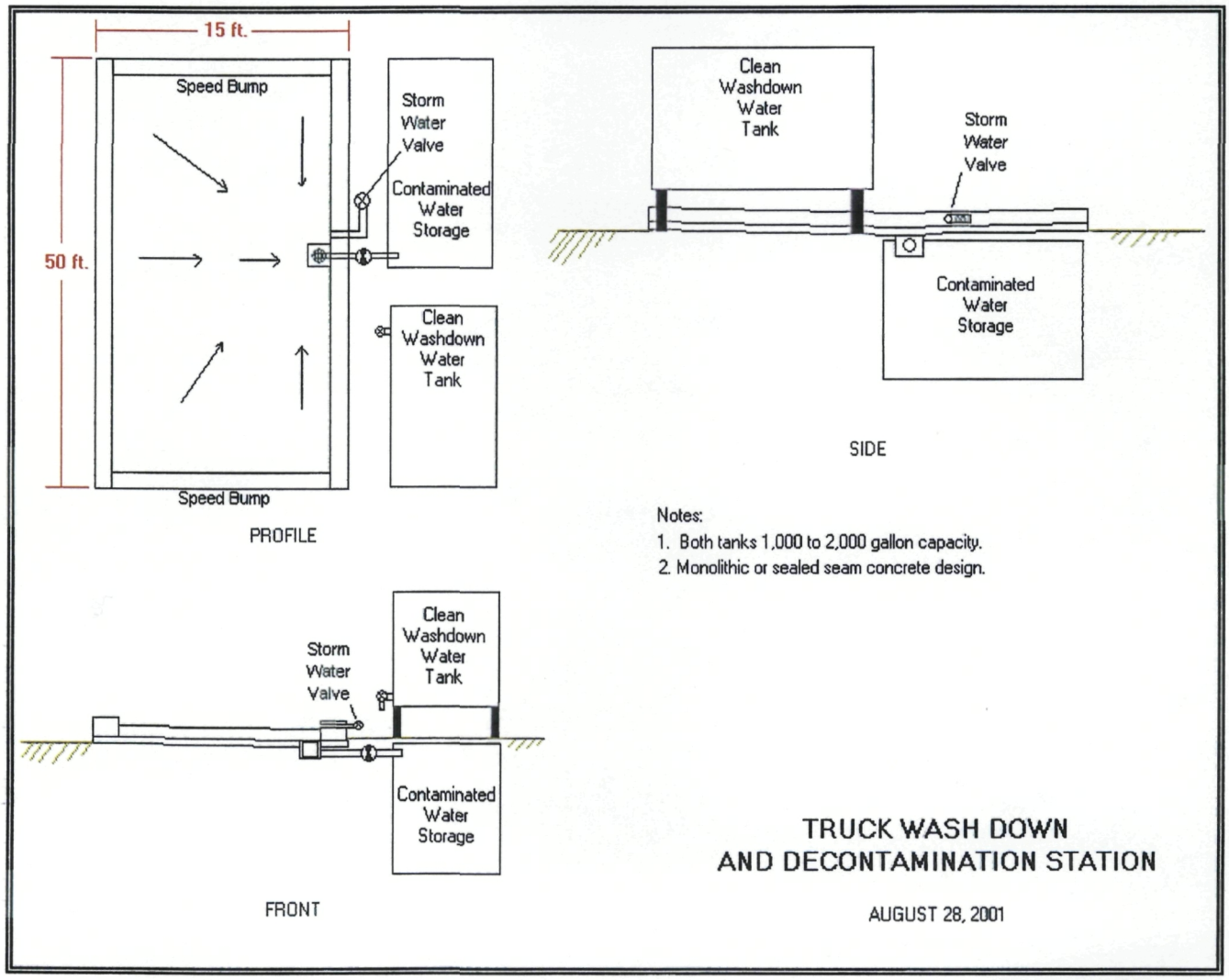


Figure 2: Decontamination Station Layout

The following is a cost estimate based on the previous layout design. Most of the cost data is based on values retrieved from "Heavy Construction Cost Data"(RS Means, 2001).

DECONTAMINATION STATION											
Equipment/Material	Call #	pg.	Unit	Quantity	Labor Hours per Unit	Total Labor Time	Material Cost per Unit	Labor & Equip. Cost per Unit	Material Cost	Labor Cost	Total Cost w/ Labor
Concrete Pad											
~Concrete (15' X 50' X 1' slab, troweled finish)	02750 100 0400	104	S.Y.	83.3	0.049	4.0817	$30.50	$2.28	$2,540.65	$189.92	$2,730.57
~~Subgrade 3/4" stone compacted 12"	02720 200 1513	103	C.Y.	27.78	0.046	1.27788	$24.50	$3.33	$680.61	$92.51	$773.12
~Re-Bar (2870ft of #3 @ .376 lb/ft)	03210 600 0600	152	TON	0.54	13.9	7.506	$525.00	$455.00	$283.50	$245.70	$529.20
~Formwork											
~~Edge Forms 12" (1*(15+15+50+50)=130 SF)	03110 445 3050	142	SFCA	130	0.074	9.62	$0.99	$2.03	$128.70	$263.90	$392.60
~~Curb Forms 6" (.5*(50+50)=50 SF)	03110 445 2150	142	SFCA	50	0.116	5.8	$0.61	$3.21	$30.50	$160.50	$191.00
~Grading for slab on grade.	02305 440 1100	49	S.Y.	83.3	0.015	1.2495	$0.00	$0.85	$0.00	$70.81	$70.81
Storage Tanks											
~Double Wall Steel Storage Tank (1,000 Gal.)	Tanks Direct		E.A.	1		0					$1,481.00
~~High level alarm for above tank.	Tanks Direct		E.A.	1		0					$637.00
~~Leak detection alarm for above tank.	Tanks Direct		E.A.	1		0					$839.00
~Above Ground PE Storage Tank (1,000 Gal.)	Tanks Direct		E.A.	1		0					$1,240.00
Plumbing											
~4in clean out drain (Cast in Concrete)	15155 160 0140	275	E.A.	1	1.3	1.3	$110.00	$46.00	$110.00	$46.00	$156.00
~Valves											
~~4in Iron Gate Valve (Flanged)	15110 200 2280	272	E.A.	1	5.3	5.3	$455.00	$165.00	$455.00	$165.00	$620.00
~~1 in PVC Ball Valve	15110 500 1250	273	E.A.	2	0.348	0.696	$34.00	$12.00	$68.00	$24.00	$92.00
~Piping											
~~4in PVC Pipe	15108 520 4480	265	L.F.	20	0.333	6.66	$4.74	$10.35	$94.80	$207.00	$301.80
~~4in PVC 90 Elbows (schedule 80)	15108 560 2190	267	E.A.	6	0.97	5.82	$19.15	$30.00	$114.90	$180.00	$294.90
~~1 in PVC Pipe	15108 520 5480	266	L.F.	30	0.174	5.22	$3.75	$6.00	$112.50	$180.00	$292.50
~~1 in PVC 90 Elbows (schedule 80)	15108 560 2140	267	E.A.	6	0.352	2.112	$2.03	$12.15	$12.18	$72.90	$85.08
Totals:					**Total Labor:**	56.64				**Total Cost:**	$10,726.58

Storage Tank Costs for Input into Decontamination Station Table

Tanks Direct *Aboveground and underground storage for water, petroleum, and chemical applications.*

"1000 GALLON DOUBLE WALL UL 142 CARBON STEEL SKID TANK
Diameter - 4 ft-0 in. , Length -10 ft-9 in.
10 Gauge Steel"

"1000 GALLON DOUBLE WALL UL 142 CARBON STEEL SKID TANK
Diameter - 4 ft-0 in. , Length -10 ft-9 in.
10 Gauge Steel
Primary Tank Includes (3)2 in & (1)6 in NPT Female Bungs
Secondary Tank Includes (1)6 in NPT Female Bungs
Secondary Tank Includes (1) 2 inch Interstitial Monitor Tube

Price: $ 1481

Aboveground and underground storage for water, petroleum, and chemical applications.

DUAL TANK ELECTRONIC LEAK DETECTION SYSTEM

No picture available

"DUAL TANK ELECTRONIC LEAK DETECTION SYSTEM
If purchased separately, freight will be calculated at time of order
Shipping amount to be determined at time of order processing"

Price: $ 839

Aboveground and underground storage for water, petroleum, and chemical applications.

DUAL TANK ELECTRONIC HIGH LEVEL ALARM SYSTEM

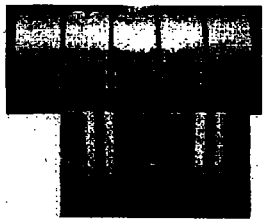
No picture available

"DUAL TANK ELECTRONIC HIGH LEVEL ALARM SYSTEM
If purchased separately, freight will be calculated at time of order
Shipping amount to be determined at time of order processing"

Price: $ 637

Aboveground and underground storage for water, petroleum, and chemical applications.

1000 GALLON LINEAR POLYETHYLENE HORIZONTAL TANK W/ INTEGRATED MOLDED LEG SUPPORTS



1000 GALLON LINEAR POLYETHYLENE HORIZONTAL TANK W/ INTEGRATED MOLDED LEG SUPPORTS

Dimensions:
-Length 154 in.
-Height 47 in
-Diameter 46 in
-Specific Gravity: 1.9

Price: $ 1240

ATTACHMENT E

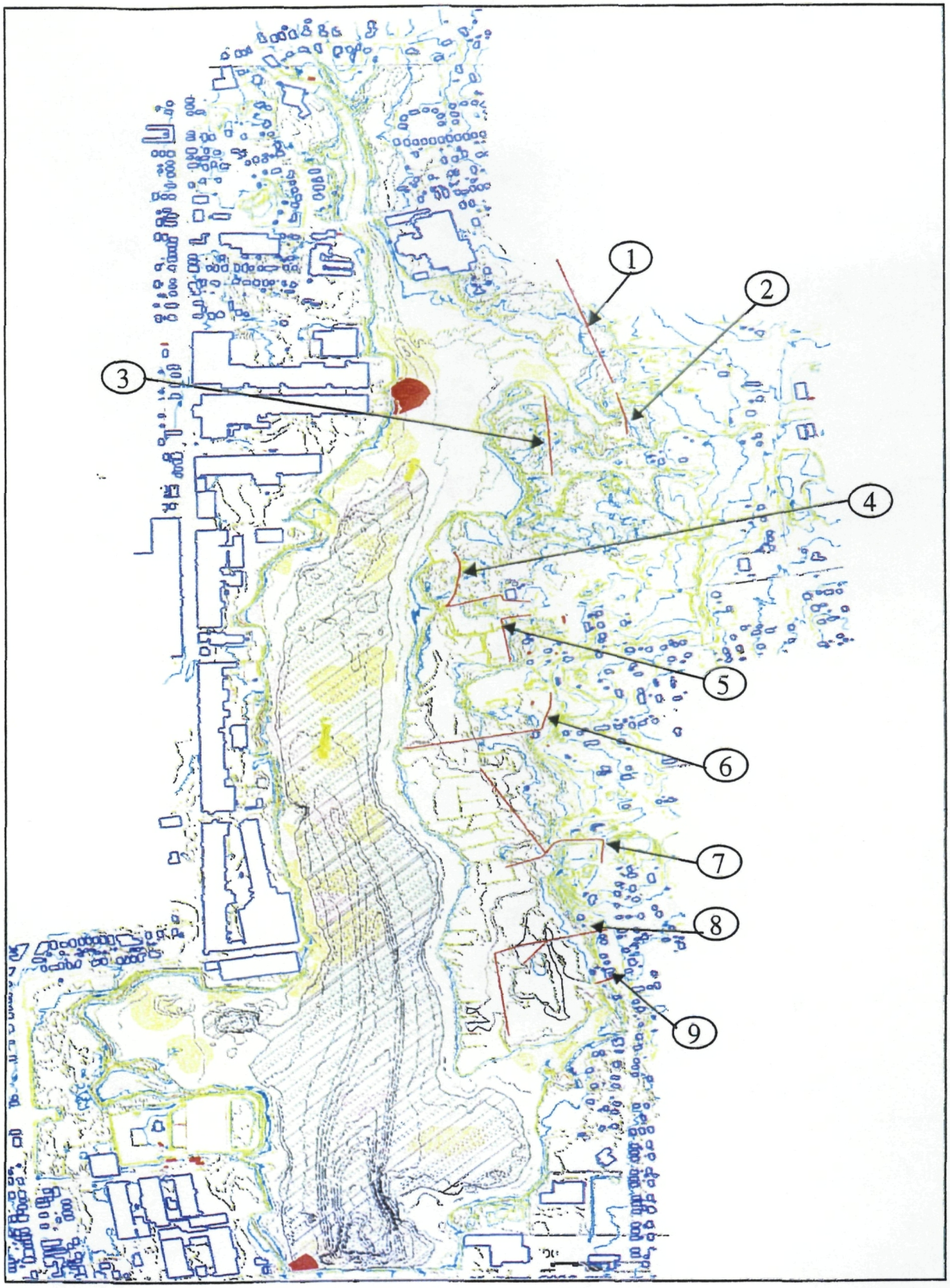
ATTACHMENT E
ACCESS ROAD COST

Access roads are necessary for reaching excavation sites for removal of vegetation and mudflats for the options in this report. Vegetation would be excavated and placed inside lined trucks. Mudflat sediment removal can utilize the geo-bag system and transport material also inside a truck. Another option is to direct fill mudflat sediment to a truck by means of an excavator. The access roads that are shown on the following page will be leased so that heavy machinery and construction crew can reach these inaccessible locations.

Several assumptions were made in the table below for width, depth and density of the material. Because the roads are temporary and will later be removed, the roads will be made of crushed limestone. If the access roads pass through marshy areas, then geotextiles might be necessary. The road dimensions will be 30 feet wide by one foot deep and lengths of each individual road are specified below. The numbers in the table correspond to the numbers in the drawing on the next page.

The cost of $32/ton includes delivery, spreading and compacting of crushed rock material of average grading. This is considered a conservative estimate and actual costs are expected to be less.

Access Roads				
	Length of Road (ft)	*Volume (cf)*	*Weight (tons)*	*$32 /ton*
1	1024	30,720	2,304	$73,728
2	335	10,050	754	$24,120
3	615	18,450	1,384	$44,280
4	973	29,190	2,189	$70,056
5	523	15,690	1,177	$37,656
6	1075	32,250	2,419	$77,400
7	1530	45,900	3,443	$110,160
8	2196	65,880	4,941	$158,112
9	140	4,200	315	$10,080
	8411	**252,330**	**18,925**	**$605,592**



ACCESS ROAD LOCATIONS

TRANSMITTAL OF SHOP DRAWINGS, EQUIPMENT DATA, MATERIAL SAMPLES, OR MANUFACTURER'S CERTIFICATES OF COMPLIANCE *(Read instructions on reverse side prior to initiating this form)*	DATE 6/12/03	TRANSMITTAL NO: 17.21.98-03-003

SECTION I - REQUEST FOR APPROVAL OF THE FOLLOWING ITEMS (This section will be initiated by the Contractor)

TO:	FROM:	CONTRACT NO:	CHECK ONE:
U.S. Army Corps of Engineers - New Bedford Resident Office 103 Sawyer Street New Bedford, MA 02746 Attention: Mr. Maurice Beaudoin	Foster Wheeler Environmental Corporation New Bedford Harbor Superfund Site Project Office 130 Sawyer Street New Bedford, MA 02746	DACW33-94-D-0002	— THIS IS A NEW TRANSMITTAL X THIS IS A RESUBMITTAL OF TRANSMITTAL 17.21.98-03-003

SPECIFICATION SECTION NO: (Cover only one section with each transmittal) NA

PROJECT TITLE AND LOCATION: New Bedford Harbor Superfund Site OU#1 and OU#2 Remedial Design and Remedial Action

ITEM NO. a.	DESCRIPTION OF ITEM SUBMITTED (Type, size, model number, etc.) b.	MFG. OR CONTR. CAT. CURVE DRAWING OR BROCHURE NO. (See instruction No. 8) c.	NO. OF COPIES d.	CONTRACT REFERENCE DOCUMENT SPEC. PARA. NO. e.	CONTRACT REFERENCE DOCUMENT DRAWING SHEET NO. f.	FOR CONTRACTOR USE CODE g.	VARIATION (See instruction No. 6) h.	FOR CE USE CODE i.
1	UPDATED PAGES FOR -FINAL EXCAVATION BASIS OF DESIGN /	na	1	na	na	FIO		
	DESIGN ANALYSIS REPORT							

REMARKS

FWENC Document #: 2003-017-0102

Distribution:

M. Beaudoin (2)	P. Craffey -CD	M. Otten	J. Scott
R. Simeone (4)	M. Palermo	L.Toroyan	NBH Site FILE
G Morin (1)	C. Jensen	R. Francisco	NBH Site FILE -QC PERSON
D. Dickerson (1)	G. Hartman	D. Beck	FWENC Boston file 15.12
J. Brown (1)	W. Elmeer		

I certify that the above submitted items have been reviewed in detail and correct and in strict conformance with the contract drawings and specifications except as otherwise stated.

Mark I Otte

NAME AND SIGNATURE OF CONTRACTOR

SECTION II - APPROVAL ACTION

ENCLOSURES RETURNED (List by Item No.)	NAME, TITLE AND SIGNATURE OF APPROVING AUTHORITY	DATE

MADEP's comments on
The Final Excavation Basis of Design/ Design Analysis
Report dated October 25, 2002

COMMENT	RESOLUTION
1. Page 3-1, Section 3.1.1, 5th paragraph, 1st sentence, number 3, last sentence "... as shown in Figure 1-2." - There is no Figure 1-2. Do you mean Figure 2-1?	Yes, text will be revised.
2. Page 3-5, Section 3.1.4, 1st paragraph, 6th sentence, "The existing surface and excavation design surface were subtracted from each other and the volumes were calculated by the software as shown in the North of Wood Street design package." - First, I do not understand how subtracting ("the existing surface and excavation design surface from each other") get to a volume. Do you mean one was subtracted from the other? Second, the "North of Wood Street design package" should have a reference.	Digital terrain models are defined in the computer programs by sets of points that have specific x, y and z coordinates. (For this project, the northing and easting are the x and y coordinates that locate the points on the site plan and the elevation is the z coordiante). Volume is calculated by sub-dividing the area of interest into thousands of small polygons, calculating the difference in surface elevations at the same x and y coordinates in each polygon, then using the surface area and elevation difference to calculate the volume in each polygon. Reference to North of Wood street documents will be deleted, since it is not necessary.
3. Page 3-5, Section 3.1.4, 2nd paragraph, 2nd sentence "...is given in Domain C." This seems to be the 1st place in the Design that the term "Domain" is used. A brief description of what a "Domain" means would be helpful.	The Domains are the same as used in the Data Interpretation Report. Additional text will be added to explain this.
4. Appendix A, Attachment B, page B-1 - Complete Option 3. Place cost for Demobilization and Total Cost in Option 3. The cost for Demobilization for Option 3 are on page B-3.	The costs shown on page B-1 were included only to document the sequence of work in going from cost data provided by a contractor to the costs used in the evaluation. The costs shown on page B-3 were used to make recommendations. Therefore, it is not necessary to revise page B-1.

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

FINAL
EXCAVATION BASIS OF DESIGN / DESIGN ANALYSIS REPORT
NEW BEDFORD HARBOR SUPERFUND SITE

New Bedford Harbor, Massachusetts

October 2002

Revision 2: June 2003

Prepared for

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

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

FINAL
EXCAVATION BASIS OF DESIGN / DESIGN ANALYSIS REPORT
NEW BEDFORD HARBOR SUPERFUND SITE
New Bedford Harbor, Massachusetts

October 2002

Revision 2: June 2003

Prepared for

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

Prepared by

Foster Wheeler Environmental Corporation
133 Federal Street
Boston, Massachusetts 02110

Revision	Date	Prepared By	Reviewed By	Approved By	Pages Affected
2	6/11/03	M. Otten, PE	R. Otoski, PE	G. Willant	Pg 3-1, Pgs 3-5 thru 3-6, Pg 3-8, Pg 4-4 Appendix A Cover sheet

REVISIONS

Revision No.	Revision Date	Page(s)	Revision
2	June 11, 2003	Window cover page	Replace
		Approval page	Add
		Revisions page	Add
		Page 3-1	Replace
		Pages 3-5 thru 3-6	Replace
		Page 3-8	Replace
		Page 4-4	Replace
		Appendix A Cover Sheet	Add

3.0 BASIS OF DESIGN AND DESIGN CRITERIA

3.1 Basis of Design

3.1.1 Sediment Management Units

The excavation and dredging work at New Bedford will be done over large areas with differing conditions over several years. In order to manage the design and construction of this large project, the excavation and dredge areas need to be subdivided into Management Units (MUs).

MUs will be used throughout the design, implementation and monitoring to evaluate and document remedial action progress, confirmatory sampling, and ultimately long-term environmental monitoring. The MUs will be used for items such as:

- Projecting annual remedial resource requirements;
- Improving accuracy of material balance calculations;
- Specifying sequence of removal;
- Providing bidders data on sediment types for each unit; and
- Monitoring remedial progress.

MUs will also be used as acceptance units for remediation Subcontractors and as measurement and payment units for Subcontractors. Sediment chemical and physical data for each unit may be compiled from the project database and GIS to provide unit-specific data. For example, within each unit the maximum, minimum, and mean of PCB concentrations, organic content, water content, and percent clay and sand may be calculated and made available to Contractors and Subcontractors in tabular and contour mapped form.

During sediment removal, water quality, air quality, PCB levels in the newly exposed sediment surface, and dredge accuracy could all be monitored and reported by excavation/dredge unit. Material balances will also be made for each management unit to support cost loading of the project schedule and to be used as an earned value tool during remediation.

Sediment MUs have been defined within the following areas of the Upper, Lower, and Outer Harbors:

1. Subtidal Areas: Harbor where mud line is below MLLW or elevation –1.44 feet NGVD.
2. Mudflat Areas: Intertidal areas above MLLW and below MHHW with no vegetation. This includes the non-vegetated channel of the Acushnet River north of Wood Street Bridge.
3. Vegetated Areas: Areas above MLLW covered with vegetation. This includes intertidal areas (i.e., where the ground surface is between MLLW and MHHW) and adjacent upland areas (i.e., where the ground surface is above MHHW). Note that the vegetation line approximately corresponds to elevation 1.0 feet NGVD. The actual edge of the vegetation has been surveyed and is shown in Figure 2-1.

Generally, sediments to be removed from below MLLW are defined as materials to be dredged, and sediments to be removed from above MLLW (typically the mud flat areas and the vegetated salt marshes) are defined as materials to be excavated. This is a convention adopted to clarify the planning and design of the project. It does not necessarily follow the usual definition of dredging, which is the "removal of more than one cubic yard of material from beneath the water."

The truck option does not have a dewatering solution and may become more expensive. This is only a viable option if the slurry system has broken down and excavation work must continue.

3.1.4 Excavation Volumes

The excavation design for North of Wood Street Bridge has already been completed, but an explanation of how it was done is pertinent to future design work for the rest of the harbor. Excavation volumes North of Wood Street Bridge were determined by a series of steps. Using the bathymetry and the topography surveys, a digital terrain model of the existing surface was created utilizing two dependent software called InRoads and MicroStation. A geostatistical analysis was done of the samples that were taken throughout the harbor, and this provided a Northing, Easting and elevation cut depth for use in the design. This information was used to create an excavation design surface. The excavation volume is the difference between the existing surface and the design surface. This would be the appropriate method to determine volumes for excavation management units in the future when design drawings are to be completed.

3.1.5 Sediment Clean-up Levels

Sediment clean-up levels have been discussed in the *Final Dredging Basis of Design / Design Analysis Report.* Volumes associated with the mudflat and vegetated areas have taken into consideration the various levels of clean-up that the ROD requires. In the Upper Harbor north of Coggeshall Street, sediments with PCB concentrations above 10 mg/kg (ppm) will be removed, while in the Lower Harbor and in the salt marshes, sediments with PCB concentrations above 50 ppm will be removed. Inter-tidal sediments in specific areas adjacent to homes or in areas prone to beach combing will be removed if PCB levels are above 1 and 25 ppm, respectively. The approximate locations of the areas to be excavated are shown in Figure 1-2.

3.1.6 Air Pollution Control

Air pollution control has been discussed in the *Final Dredging Basis of Design / Design Analysis Report.*

3.1.7 Noise Control

Engineering controls will be used during dredging operations to minimize noise emissions such that the activities do not cause or contribute to unnecessary or excessive noise emissions (310 CMR 7.10(1) and (2)). Such engineering controls may include modifying the equipment by having enclosures to reduce sound or having the equipment operated in a manner that minimizes sound. Use of supplemental or replacement mufflers or other sound-suppression devices on equipment must meet the manufacturer's specifications for the original device. Sound levels will be monitored near residential areas that could potentially be affected by the noise. The MA DAQC Policy 90-001 guideline for allowable sound emissions restricts new sources of noise to no more than 10 decibels above background. In the more remote areas, this may not be practical due to low background noise levels, and secondary criteria will be

needed. It is recommended that the following criteria be used for residential areas near the excavation sites:

- 7:00 A.M. to 11:00 P.M. 65 dB
- 11:00 P.M. to 7:00 A.M. 50 dB
- Maximum Impulse 80 dB

3.1.8 Site Access and Navigation

Roads and bridges in the area are regulated by the state. TERC Contractor will contact state and local government organizations to determine regulations for weight limits of roads and bridges. Transportation of heavy equipment and materials will be required to meet these regulations.

In order to comply with the Rivers and Harbors Act, the TERC Contractor will minimize impacts to navigation in New Bedford Harbor. The TERC Contractor will notify the Harbormaster before excavation activities begin and a "Notice to Mariners" will be issued. Flagging, lights, flashing lights, or buoys will be used to mark discharge piping and equipment to make it visible to Harbor vessel operators. All floating plants will be oriented to minimize impacts on navigation and water circulation in the Harbor to the extent possible.

3.1.9 Nighttime Navigation

No regulations limiting the use of lights for the excavation project have been found. Lights will be used as needed for safety, operational visibility, and visibility of equipment, piping, and cables during excavation under low light conditions. Adequate lighting is a safety concern for project personnel as well as for mariners who may be near the project area. Lighting will be directed away from residential areas when possible to prevent excess light pollution.

3.2 Design Criteria

The excavation design criteria were developed in accordance with the ARARs, ROD requirements, USACE Engineering Guidance, the work plan, the Excavation Process Cost Estimation in Section 3.0, and the Dredging and Excavation Technology Report. Results of additional studies described in Section 3.0 of the dredging BD/DA were also used to develop the design criteria, and conclusions are repeated below. The excavation design criteria are described in detail in the following sections and summarized in Table 3-3.

Design criteria for dredge/excavation management units have been discussed in the *Final Dredging Basis of Design / Design Analysis Report.*

Table 3-3- *Cont'd*
Summary of Excavation Design Criteria

Performance Standard	Design Objective	Design Criteria
Wetlands Protection		
• Massachusetts Wetlands Protection Regulations (310 CMR 10.00) contains the following performance standards: • Projects shall not alter the bottom topography in a manner that increases the potential for storm damage or erosion of nearshore areas. Project activities should attempt to avoid areas with eelgrass or widgeon grass and high densities of polychaetes, mollusks, or macrophytic algae (310 CMR 10.25)	• Minimize the period of loss of vegetative cover in the wetlands • EPA will review the proposed excavation program to evaluate the potential for erosion and storm damage. The TERC Contractor will design a protective measure if areas will be impacted.	• Schedule restoration to closely follow excavation of vegetated wetland areas • Schedule the restoration plantings to match periods of high growth rates for the involved plant species, when possible • Include results of EPA review
• Water-dependent projects on tidal flats should be designed and constructed to minimize adverse effects to marine fisheries and wildlife habitat caused by alterations in water circulation, distribution of sediment grain size or changes in water quality (310 CMR 10.27).	• Excavation activities will occur within tidal flats as needed to meet cleanup levels. The design will be coordinated with the appropriate federal and state agencies to minimize the impact of excavation/dredging on fish and wildlife habitats during remediation as much as is practical.	
• Massachusetts water quality standards must be met for dredging operations (310 CMR 10.27).	• The Contractor will treat all sediment dewatering supernatant prior to discharge. The treated supernatant will meet the current numerical AWQCs for cadmium, chromium and lead. The AWQCs for PCBs and copper will be met through the phased TMDL approach. If these limits cannot be met, the treated supernatant will be sent to the New Bedford POTW. • The Contractor will follow the approved sedimentation and erosion control plan during excavation to minimize sedimentation in New Bedford Harbor.	• See design criteria in the WTP Basis of Design Report
• Excavation should not destroy any portion or have an adverse effect on a salt marsh (310 CMR 10.32).	• The Contractor will replace the salt marshes (on the eastern shore) on a 1:1 ratio for functions and values.	• Restoration design is included in the Draft Restoration Basis of Design/Design Analysis Report (90%)
• If the excavation area underlies an anadromous or catadromous fish run, the project should not impede or obstruct the migration of fish, change the volume or rate or flow of water within the fish run or impair the capacity of the spawning or nursery habitat.	• The USACE will consult with the MADEP Division of Marine Fisheries and/or other appropriate entities regarding timing of work activities.	• The USEPA Region I have consulted with the US Dept. of Marine Fisheries. USEPA has told Foster Wheeler that project activities may occur throughout the year, and there is no constraint due to fish migration.

- Support Activities will include:
  - Movement of personnel from shore to barges and back – These activities would include crew shift changes, access by site superintendents, regulatory oversight, fueling operations, access by QC and field sampling personnel, and access by any other observers. This activity would typically be accomplished by a crew/supply boat.

  - Provisioning – The excavation equipment operating in the mudflats and grassed areas will require periodic fueling, topping up and changes to lubrication and engine fluids, provisioning of items such as drinking water, cleaning supplies, rags and other consumables, and service of a portable toilet. Most of these activities would be accomplished with a dedicated support/crew all-terrain vehicle. It is envisioned that fuel would be transferred from a tank truck at the end of an access road to the operating equipment in the field, and then pumped from the support equipment to the excavating equipment. Other items could be manually handed to the support equipment, or transferred to the equipment via a small crane. Should any spills occur, the area of contaminated sediment should be excavated and disposed of by either pipeline or by a lined intermodal truck.

  - Debris – Debris generated during excavation will need to be separated and transported to trucks for disposal. Debris will be considered contaminated and therefore kept separated and subject to special handling. It is envisioned that debris could be placed on a suitable decontamination pad at the end of an access road until a large enough quantity was accumulated to warrant loading it onto a truck and transporting it to the desanding facility. In the alternative, the debris can be decontaminated on shore at one of the decontamination pads where the wash water can be collected and treated. Once tested or delivered to the desanding facility, decontaminated debris can be disposed of in an approved location/landfill, or be recycled. Vegetation will be cut above the ground surface elevation and will be considered clean. Roots and vegetation mixed with sediment will be classified based on the sediment concentrations.

Optimally, shoreside facilities should provide safe and reliable all weather access for personnel transfers to the crew/supply boat, the ability to move consumables and miscellaneous equipment to and from the barges, and the ability to transfer potentially contaminated debris to a shore processing facility for decontamination.

In addition to the operations associated with the excavation process, the excavation subcontractor will require a secure laydown area for his equipment (excavators, pipe, floats, etc), space for at least one Conex or similar steel container for secure storage of tools and supplies, adequate space to set up an office/trailer; adequate space for parking for his staff and labor, and adequate space to maneuver trucks to handle debris and deliver supplies.

Desanding, water treatment plant, and dredging/excavation subcontractors will all be working at Area C simultaneously. Each specific scope of work will address access roads and staging areas for each subcontractor. Excavation areas, staging areas and access routes must avoid impact to known cultural resources to the extent practical. Therefore, work must be limited to those areas where cultural resource assessments have been completed. Cultural resources are an ongoing effort, and the final findings from the *Cultural Resources Report* will be included in the construction specifications and workplan. Figure 4-1 shows vegetated excavation areas, staging areas and access routes where cultural resources assessment are currently being performed. These areas may have to be revised in final design, depending on theresults of these assessments.

APPENDIX A

"The sole purpose of the "Excavation Process Cost Estimation Summary" in Appendix A is to evaluate excavation & transportation of mudflat and vegetated material to New Bedford Harbor facilities and not to evaluate treatment and disposal. This report does not reflect actual performance criteria for the project, and therefore, any values used in the report, such as pump capacity, excavation quantity, and labor hours, are only used for analysis of alternatives. This allows for a comparison analysis of excavation and transportation methods. For these reasons, the "Excavation Process Cost Estimation Summary" shall not be used for the final design."