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FOSTER WHEELER ENVIRONMENTAL CORPORATION

July 25, 2000
2000-17-0155
Response Required

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Mr. Robert Hunt
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Subject: USACE CONTRACT NO. DACW33-94-D-0002
TOTAL ENVIRONMENTAL RESTORATION CONTRACT (TERC)
TASK ORDER NO. 0017 – NEW BEDFORD SUPERFUND SITE OU #1
FINAL CDF-C ALTERNATIVES EVALUATION TECHNICAL MEMORANDUM

Dear Mr. Hunt:

Enclosed is the Final Technical Memorandum on Evaluation of Alternatives and Value Engineering Proposals for the CDF-C Offshore Containment Dike. As a result of the Alternative Evaluation and Value Engineering review, alternatives were identified that could provide potential cost savings of between $658,000 and $3,185,000. The current preferred alternative , Alternative 3, the Sheet Pile Wall with Exterior Half Dike could provide a potential cost savings of $900,000 with increased storage capacity. This preferred alternative is being evaluated further for feasibility and cost.

If there are any questions on the Technical Memorandum, please call Allen Ikalainen at (617) 457-8234.

Sincerely,

George M. Willant
Chief Project Manager

Enclosure: 2000-17-0156

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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

TECHNICAL MEMORANDUM
CONFINED DISPOSAL FACILITY C
OFFSHORE CONTAINMENT DIKE

ALTERNATIVE EVALUATION
AND
VALUE ENGINEERING
PROPOSAL EVALUATIONS

NEW BEDFORD HARBOR SUPERFUND SITE
New Bedford, Massachusetts
July 2000

Prepared for

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

2000-17-0156
7/21/00

USACE CONTRACT NO. DACW33-94-D-0002
TASK ORDER NO. 017
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OFFSHORE CONTAINMENT DIKE

ALTERNATIVE EVALUATION
AND
VALUE ENGINEERING PROPOSAL EVALUATIONS

NEW BEDFORD HARBOR SUPERFUND SITE
New Bedford, Massachusetts

July 2000

Prepared for

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

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TABLE OF CONTENTS

1.0 INTRODUCTION 1-1
- 1.1 Purpose 1-1
- 1.2 Background 1-3
- 1.3 Evaluation Approach 1-3

2.0 CDF SITE DESCRIPTION AND GEOTECHNICAL CONDITIONS 2-1

3.0 CDF C DIKE ALTERNATIVES 3-1
- 3.1 Earth Dike Alternative (Basic Alternative 1A) 3-1
  - Description of Earth Dike Alternative 3-4
  - Evaluation of Earth Dike Alternative 3-5
- 3.2 Earth Dike With Sediment Displacement (Basic Alternative 1B) 3-5
  - Description of Earth Dike With Sediment Displacement 3-7
  - Evaluation of Earth Dike With Sediment Displacement 3-7
- 3.3 Earth Dike Dredge And Replace Inside Sheet Piles (Basic Alternative 1C) 3-8
  - Description of the Earth Dike with Dredging and Fill Replacement Inside Sheet Pile Walls 3-8
  - Evaluation of the Earth Dike with Dredging and Fill Replacement Inside Sheet Pile Walls 3-10
- 3.4 Pile Supported Concrete Wall (Basic Alternative 2) 3-11
  - Description of Pile Supported Concrete Wall 3-11
  - Evaluation of Pile Supported Concrete Wall 3-13
- 3.5 Sheet Pile Wall With Batter Piles (Basic Alternative 3) 3-13
  - Description of Sheet Pile Wall 3-13
  - Evaluation of Sheet Pile Wall 3-15
- 3.6 CDF Interior Excavation (Basic Alternative 4) 3-16
  - Excavation To Bedrock 3-16
  - Partial Excavation 3-16

4.0 VALUE ENGINEERING PROPOSALS 4-1
- 4.1 Earth Dike Alternative (Basic Alt 1) Proposals 4-2
  - Earth Dike With Vinyl Sheet Pile (VE Proposal 90, 5 6, 7) 4-2
  - Earth Dike With Steep Side Slopes (VE Proposals 44, 45) 4-2
- 4.2 Earth Dike Dredge And Replace Alternative (Basic Alt 1B) Proposals (VE Proposal 39) 4-2
- 4.3 Earth Dike Dredge And Replace Within Sheet Piles Alternative (Basic Alt 1C) Proposals 4-6
  - Place Fill Within Sloped Excavation (VE Proposals 38, 41, 42) 4-6
  - Earth Dike Dredge and Replace Within Sheet Pile Walls Along Centerline (VE Proposal 41) 4-8
- 4.4 Pile Supported Concrete Wall Alternative Proposals 4-10
- 4.5 Sheet Pile Wall Alternative (Basic Alt 3) Proposals 4-10
  - Sheet Pile Wall with Pipe Piles (VE Proposal 40) 4-10
  - Sheet Pile Wall with Exterior Half Dike (VE Proposal 52, 4, 38) 4-13
  - Earth Dike Alternative with Sheet Pile in Upper Dike (VE Proposal 90) 4-16
- 4.6 General VE Proposals 4-16
  - Fill Earth Dike CDF as Dike is Built Above Water Level (VE Proposals 46, 50) 4-17

5.0 EVALUATION OF REVISED ALTERNATIVES 5-1
- 5.1 Introduction 5-1
- 5.2 Revised Alternatives 5-1

TABLE OF CONTENTS *(Continued)*

5.3 Discussion 5-1
Preferred Alternative 5-2

6.0 ALTERNATIVE EVALUATION AND VALUE ENGINEERING TEAM STUDY – SUMMARY OF PROPOSALS 6-1

7.0 REFERENCES 7-1

APPENDICES

APPENDIX A CDF-C Design Criteria Outline
APPENDIX B Alternatives Construction Cost Estimates
APPENDIX C Value Engineering Construction Cost Estimates
APPENDIX D Value Engineering Workshop Notes

LIST OF TABLES

Table 3-1 Earth Dike Features 3-4
Table 3-2 Earth Dike With Sediment Displacement Features 3-5
Table 3-3 Earth Dike With Fill Inside Sheet Pile Walls Features 3-10
Table 3-4 Pipe Supported Concrete Retaining Wall Features 3-11
Table 3-5 Sheet Pile Wall With Batter Piles Features 3-15
Table 3-6 Alternative Evaluation Summary 3-17
Table 4-1 CDF C Dike VE Proposals 4-1
Table 4-2 Earth Dike With Vinyl Sheet Pile 4-6
Table 4-3 Earth Dike With Steep Side Slopes4-8 4-8
Table 4-4 Earth Dike With Dredge And Replace On Geotextile (VE Proposal 39) 4-10
Table 4-5 Earth Dike And Place Fill Within Sloped Excavation (VE Proposal 42, 38) 4-12
Table 4-6 Earth Dike Dredge and Replace Within Sheet Pile Walls (VE Proposal 41) 4-12
Table 4-7 Pile Supported Concrete Wall (VE Proposal 72) 4-13
Table 4-8 Sheet Pile Wall With Pipe Piles (VE Proposal 40) 4-13
Table 4-9 Sheet Pile Wall With Exterior Half Dike (VE Proposal 52, 4, 38) 4-15
Table 4-10 VE Proposal 51 4-17
Table 4-11 VE Proposal 37, 47 4-17
Table 4-12 CDF With Earth Dike and Filling As Dike Is Built (VE Proposals 46,50) 4-18
Table 5-1 Alternative and Value Engineering Proposal Summary 5-4
Table 6-1 Confined Disposal Facility C Off Shore Containment Dike 6-1

TABLE OF CONTENTS *(Continued)*

LIST OF FIGURES

Figure 1-1 General Site Plan 1-2
Figure 3-1 Earth Dike 3-2
Figure 3-2 Earth Dike With Sediment Displacement 3-6
Figure 3-3 Earth Dike With Fill Inside Sheet Pile Walls 3-9
Figure 3-4 Pile Supported Concrete Retaining Wall 3-12
Figure 3-5 Sheet Pile Wall With Batter Piles 3-14
Figure 4-1 Earth Dike With Vinyl Sheet Pile 4-3
Figure 4-2 Earth Dike With Steep Side Slopes 4-4
Figure 4-3 Earth Dike With Dredge And Replace On Geotextile 4-5
Figure 4-4 Earth Dike and Place Fill Within Sloped Excavation 4-7
Figure 4-5 Earth Dike Dredge And Replace Within Sheet Pile Walls Along Centerline 4-9
Figure 4-6 Sheet Pile Wall With Pipe Piles 4-11
Figure 4-7 Sheet Pile Wall With Exterior Half Dike 4-14

1.0 INTRODUCTION

Foster Wheeler Environmental Corporation (Foster Wheeler) has prepared this Technical Memorandum to evaluate alternatives for the offshore perimeter dike at Confined Disposal Facility (CDF) C. CDF C design is part of the Remedial Design (RD) of Operable Unit #1 (OU #1), Upper and Lower Harbor, New Bedford Harbor Superfund Site, New Bedford, Massachusetts. This work is being performed under Task Order No. 17 of the U.S. Army Corps of Engineers (USACE) New England Total Environmental Restoration Contract (NETERC) No. DACW33-94-D-0002.

CDF C, one of four proposed CDFs included within the OU #1 RD, is proposed to be located along the western shoreline of Upper New Bedford Harbor. CDF C is planned to be located from the existing USACE Sawyer Street facility south to about 250 feet north of the Coggeshall Street Bridge.

As envisioned, contaminated sediment will be contained by an earthen dike. The eastern arm of the dike will be constructed in the Upper Harbor generally parallel to the existing shoreline, approximately 250 to 300 feet offshore. The dike will include north and south arms that will form an enclosed dike. Alternative dike alignments for the southern portion of the offshore dike were evaluated in the Technical Memorandum titled "Evaluation of Alternative CSO and CDF Alignments for Confined Disposal Facility C (Foster Wheeler, 1999). The current proposed dike location is shown on Figure 1-1.

1.1 Purpose

The purpose of this Technical Memorandum is to describe and evaluate alternatives for offshore perimeter dike configurations. As part of the design work, Foster Wheeler completed an extensive geotechnical boring program and performed slope stability and bearing capacity calculations for the dike. These preliminary calculations indicate that due to the very low shear strength and high compressibility of the existing sediments, an earth dike built using a continuous filling method will displace underlying soft sediments to a major extent. In order to build the dike while consolidating the underlying sediments, it would have to be built in multiple stages with extended waiting periods between each stage.

Briefings on the preliminary dike design for CDF C were held with USACE and EPA Region 1 on January 26, 2000. Information presented by Foster Wheeler on the preliminary design indicated that the earth dike on geotextile would need to be built in 6-7 lifts. After placement, each stage would require several to many months to settle, resulting in a several year construction period for the dike. From this it was concluded that Foster Wheeler should evaluate the feasibility of alternative concepts for the CDF earth dike. The first alternatives to be considered were displacement of the silt and clay sediments by rapid placement of dike fill, and removal of the silt and clay sediments prior to placement of the dike fill. During a follow-on meeting on February 7, 2000 and a conference call on February 10, 2000 with USACE, it was decided to evaluate two new types of walls. One would be a concrete retaining wall built on a concrete slab supported by concrete pilings, and one would be a steel sheet pile wall supported by vertical steel piles and batter piles.

The perimeter confinement dike must meet a number of objectives defined in the Operable Unit #1 Record of Decision (September 1998) and the USACE Scope of Work (October 1998) and Engineering Guidance for the Remedial Design of OU #1 (November 1998). These objectives are described in the attached document (Appendix A) Task Order No. 17, Operable Unit #1, Confined Disposal Facility C, Design Criteria Outline, New Bedford Harbor Superfund Site (Foster Wheeler, March 2000). The overall objective is to provide reliable long-term containment of contaminated sediment. In addition, the dike must:

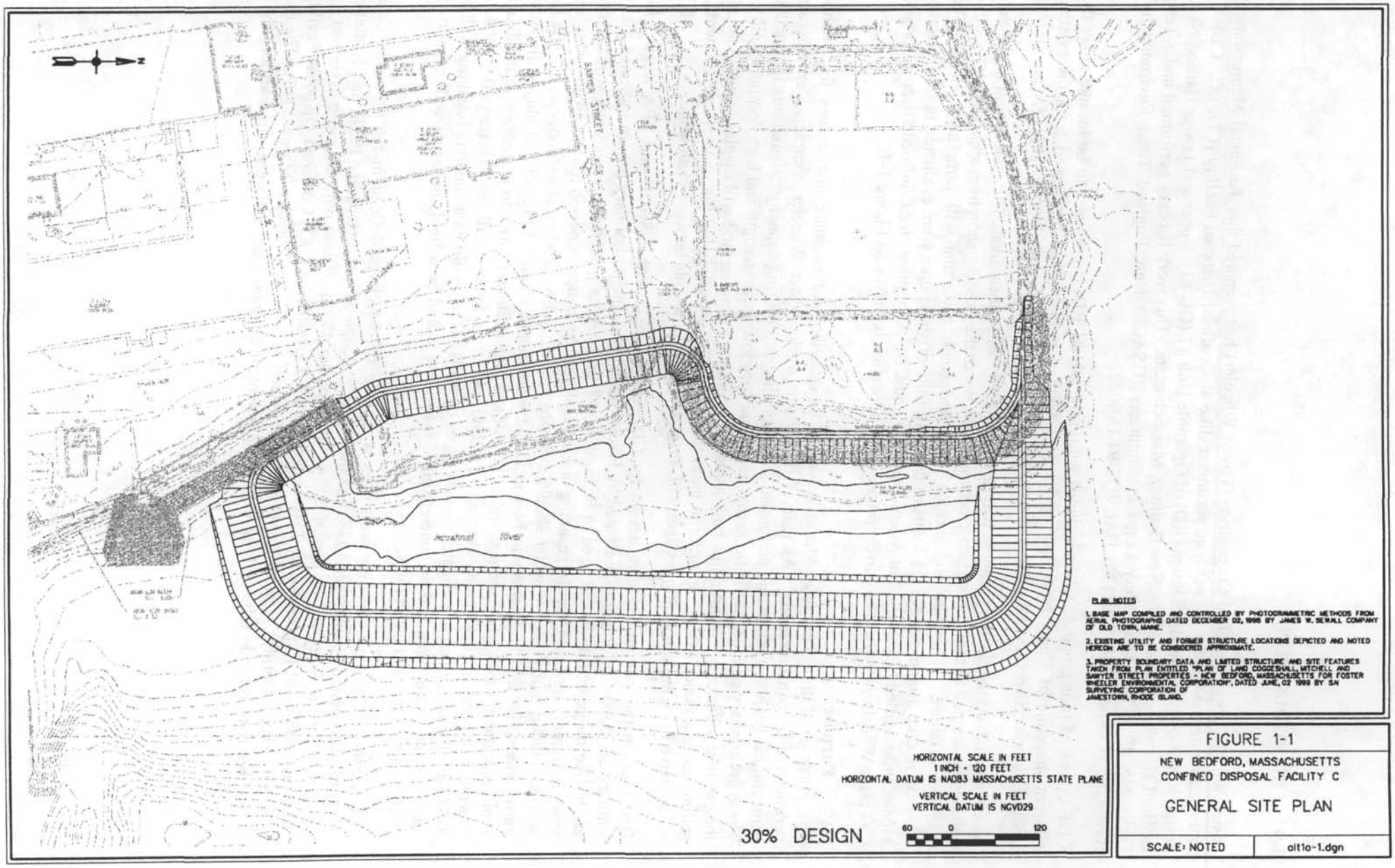


FIGURE 1-1

NEW BEDFORD, MASSACHUSETTS
CONFINED DISPOSAL FACILITY C

GENERAL SITE PLAN

SCALE: NOTED	oit1a-1.dgn

1. Provide contaminated sediment storage capacity.
2. Support a side wall liner, contaminated sediment, final cap, and temporary surcharge fill.
3. Be stable in the event of storm surges, waves, and floods with a 100-year recurrence interval.
4. Contain contaminated sediment. In the event of a large earthquake (with probability of recurrence of 10 percent in 250 years), CDF C must not allow release of contaminated sediment to the Upper Harbor. Dike deformation and loss of cover soil would be acceptable.
5. Prevent contaminant transport. The interior side walls of the dike must have a low-permeability liner to prevent contaminant transport through the permeable walls of the dike.
6. Maintain surface water quality within acceptable standards during dike construction.

Specific features of the dike design are:

1. Final top elevation must be 10.7 feet NGVD.
2. Long-term static slope stability factor of safety of 1.5, or greater.
3. Long-term static bearing capacity factor of safety of 3.0, or greater.
4. Short-term static slope stability factor of safety of 1.3, or greater. (see note 1).
5. Short-term bearing capacity factor of safety of 1.5, or greater (see note 1).
6. Dike construction duration should be consistent with the overall project schedule.
7. Estimated dike construction cost should be consistent with current project budget.

Note (1) The short-term factors of safety for dike construction depend on several site-specific variables including differing subsurface conditions, quantity and quality of subsurface data, potential impacts from unexpected movements, understanding advantages and disadvantages of higher risk construction, and risks acceptable to all involved parties.

1.2 Background

The Record of Decision (ROD) for OU #1, describes the perimeter dike as ... "shoreline confined disposal facilities ...sidewalls will be lined with a synthetic impermeable material...once the CDFs have been filled with sediment an interim cap will be installed... it is anticipated that approximately three years of sediment consolidation will be required before final capping". The USACE Draft Engineering Guidance for Scope of Work, dated 14 October 1998, for Remedial Design of New Bedford Harbor Superfund Site OU #1 included the following: "Safe and economical sections for CDFs A, B and C shall be designed in accordance with the lessons learned and experience gained from the design, construction and use of the of the Pilot Study CDF".

An offshore earth dike was constructed as part of the Pilot Study work at the site. The top of the dike is approximately elevation 11 to 13 feet NGVD. The pre-construction mudline was approximately elevation –1 to –4 feet NGVD. At the previous dike location, the subgrade sediment was very soft organic silt that was typically 10 to 15 feet thick. Construction of this dike resulted in the formation of a displaced "mud wave" and required a greater volume of imported fill than expected. The as-built conditions are documented in the Pilot Study report (USACE, 1990).

1.3 Evaluation Approach

This technical memorandum evaluates the Basic Dike Alternatives and also evaluates Value Engineering (VE) proposals. Most of the VE proposals apply to only certain alternatives, which complicates the comparisons of both alternatives and VE proposals. Therefore, the evaluation approach used in this Technical Memorandum consists of three steps:

1. In Section 3.0, the Basic Alternatives are described and construction costs are shown for each alternative. The Basic Alternatives were defined in meetings between Foster Wheeler and the USACE, and have not been changed.

2. In Section 4.0, VE proposals are applied to Basic Alternatives. In this section, each alternative is the "baseline" for comparison of specific VE proposals. The results of this section are a set of Revised Alternatives.
3. In Section 5.0, the Revised Alternatives (revised with the optimum VE proposals) are compared to each other, and the preferred alternative is identified.

2.0 CDF SITE DESCRIPTION AND GEOTECHNICAL CONDITIONS

The subsurface conditions at the proposed CDF are shown in the Geotechnical data report for CDF C (Foster Wheeler, 2000 in preparation). The subsurface conditions under the centerline of the offshore dike alignment are summarized below:

1. The surface sediments observed are very soft, organic silt (classified as OH). The organic silt varies from 6 to 10 feet thick along the east-west southern section (south leg) to 6 to 14 feet thick along the east-west northern section (north leg) and from 4 to 12 feet thick along the north-south section.
2. A layer of peat roughly 2 to 3 feet thick was observed in borings near Stations 7+00 to 10+00.
3. Interbedded sands (predominantly classified as SM or SP) were observed below the organic silt and are on the order of 30 to 40 feet thick. The sand is generally medium dense or dense. There are some limited zones with loose sand (SPT blow counts less than 10 blows per foot).
4. Glacial till or rock was observed below the sand.

For all the alternatives included in this Technical Memorandum, the existing mudline elevation is assumed to be -4 feet. The very soft organic silt is assumed to be present from elevation –4 to –14 feet and sand is assumed to extend to elevation –40 feet, or deeper. The alternative cross-sections are based on constructing a dike from a mudline elevation of -4 feet to 11 feet NGVD (after settlement). For pile-supported alternatives, the top of wall would be elevation 11 feet.

The centerline length of the offshore portion of the dike is about 1,360 feet. This extends from the shoreline on the south leg to the existing berm on the north leg. This length does not include the upland dike on the southwest side of CDF C.

Mean Low Water (MLW) elevation is -1.3 feet, Mean High Wide (MHW) elevation is 2.4 feet, and the Mean Tide is approximately elevation -0.5 feet NGVD. Therefore, the water depth ranges from approximately 3 feet to 6 feet between mean low and mean high tide.

3.0 CDF C DIKE ALTERNATIVES

This section presents the descriptions, construction costs, construction schedules and evaluations of Basic Alternatives for the perimeter dike at CDF C. These are the same alternatives that Foster Wheeler and the USACE agreed to consider before the Value Engineering Workshops. The alternatives are:

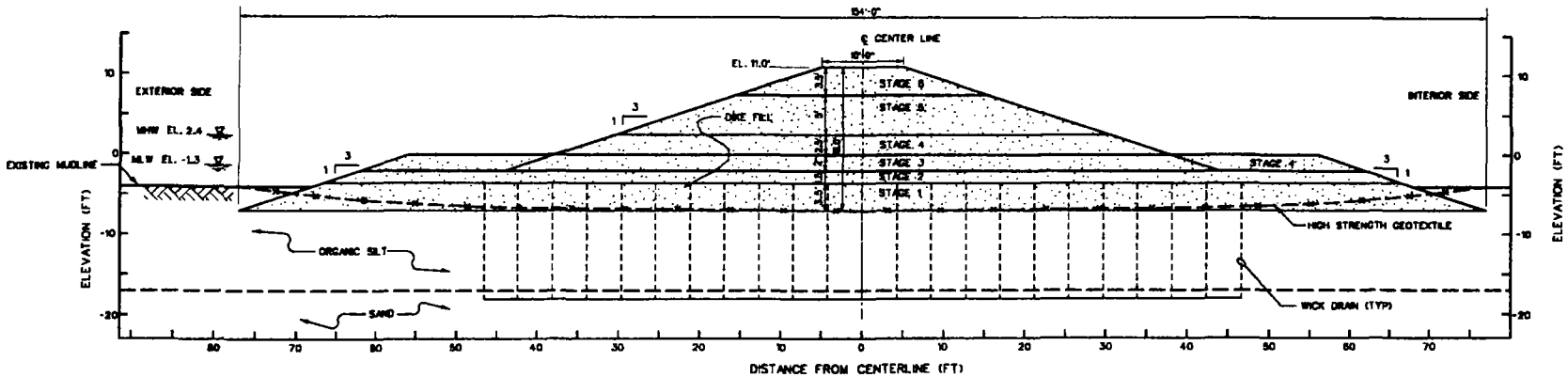
- Earth Dike Alternative (Figure 3-1). This is the concept used in the 30 percent design submittal. It is based on constructing a geotextile-reinforced dike directly over very soft, contaminated sediment. (Basic Alternative 1A)
- Earth Dike with Sediment Displacement. This concept would be built by intentional displacement of very soft sediment. (Basic Alternative 1B)
- Earth Dike with Sediment Replacement. Built by first removing very soft sediment and replacing it with imported fill. (Basic Alternative 1C)
- Pile-Supported Reinforced Concrete Wall. (Basic Alternative 2)
- Steel Sheet Pile Wall with Batter Piles. (Basic Alternative 3)
- Construct CDF with Deep Excavated Interior. (Basic Alternative 4)

3.1 Earth Dike Alternative (Basic Alternative 1A)

The selected remedy in the ROD and Foster Wheeler's Scope of Work is based on using earth dikes for perimeter containment at CDF C. The ROD does not give specific design and construction details for the dike. As part of the design process, earth dike alternatives are being considered as described in this Technical Memorandum.

Based on findings of the geotechnical analysis and experience during the Pilot Study, very soft organic silt would be displaced laterally if continuous filling dike construction methods were used (i.e. "mud wave"). However, silt gains shear strength as it consolidates under the weight of fill or surcharge loads. A dike could be safely constructed by placing relatively thin layers of imported fill on geotextile fabric, waiting for consolidation strength gain, then placing the next layer. In order to increase dike stability and to accelerate construction time, high-strength geotextile would be placed near the bottom of the dike, wick drains would be installed through the geotextile and through the organic silt and additional fill would be placed at the toe of the slope. This process would continue until the dike was completed. Construction would need to be performed using floating marine equipment, a significant cost factor as compared to land based construction. However, once the dike is completed to above high tide elevation, the upper portion could be built using conventional land based earth moving methods.

The Earth Dike Alternative would require special construction: (a) placing geotextile in shallow water depths, (b) placing relatively thin, uniform fill on the geotextile over very soft sediment in shallow water, and (c) possibly installing wick drains from shallow-draft barges. Foster Wheeler evaluated the feasibility and practical aspects of this special construction by interviewing construction personnel with actual experience performing the work and by researching published papers on design and construction of dikes over very soft sediment. The work required to implement this alternative has been successfully completed on projects along the Atlantic Coast.



LEGEND

- EXISTING SEDIMENT PROFILE
- PROPOSED SEDIMENT PROFILE
- GEOTEXTILE
- WICK DRAINS (TYP)

HORIZONTAL SCALE 1"=15'-0"

7.5 0 15 30 45 FEET

VERTICAL SCALE 1"=15'-0"

FIGURE 3-1

NEW BEDFORD, MASSACHUSETTS
CONFINED DISPOSAL FACILITY C

EARTH DIKE

SCALE: NOTED | ALT1A.DGN

For example, geotextile fabric was placed under water on the Wilmington Harbor South Project (Uibel, 1987), the New Bedford Pilot Study (Corps, 1990), and the LaGuardia Airport Overrun Area (Sandiford, 2000). One of the first applications of this technology in the United States was the Wilmington Harbor South Project, which was designed by the Philadelphia District USACE. For this project, perimeter embankments were required to contain dredged sediment from the Delaware River Federal Navigation Channel. Geotextile reinforcement was used for the Pilot Study perimeter dikes at the Sawyer Street site. In addition, wick drains were installed at the Wilmington and New Bedford projects.

Relatively thin layers of sand have been placed under water as caps over contaminated sediment. There are several methods available. Foster Wheeler and its subsidiary, Hartman Consulting Corporation, have designed sand cap projects that have been completed and are currently designing other projects. Two methods that may be applicable to CDF C are described in the following paragraphs.

- Clamshell Placement. This method uses a crane and clamshell bucket to carefully place fill material. Material is usually delivered to the site on barges, then the clamshell is used to pick up material from the barge and lower it to near the sediment surface.
- Conveyor Placement. This method uses barge-mounted conveyors to deliver and spread fill material over the sediment surface. Material is placed into a hopper and discharged onto conveyors, which are moved continuously to provide uniform placement.
- Other methods may be applicable where water depths are adequate to permit the particular piece of equipment. Methods which have been successfully used include the following:
- Tremie Tube. In this method, material is usually delivered to the site on barges, then fed into a hopper by loader or conveyor. From the hopper, the material is discharged into a tremie tube, which is a vertical pipe that confines the fill as it moves down onto the sediment surface.
- Hydraulic Washing. In this method, fill material is washed off flat-deck barges using high-pressure water hoses. The mixture of sand and water flows off the side of the barge and settles onto the sediment surface.
- Pipeline with Diffuser. This is a hydraulic method where the fill material is mixed with water, then pumped through a hydraulic pipeline and into a vertical discharge pipe. A diffuser is usually placed on the end of the discharge pipe, so that the slurry flows out in a horizontal direction, then settles onto the sediment surface.

A layer of rock rip rap would be placed on the outside of the dike to provide protection against wave erosion. For cost estimating purposes, it is assumed that the rock would have a nominal thickness of 2 feet and be made from 6 inch to 8 inch size rock. The rip rap will be placed as the dike is constructed to limit erosion by tide and waves during construction. There will also be a key trench filled with rock at the outside toe to prevent scour under the rip rap.

The features, benefits, and disadvantages of this Alternative are described below and presented in Table 3-1. The estimated construction cost and cost per cubic yard of disposal capacity are shown in Tables 3-6 and 5-1.

Table 3-1
Earth Dike Features (Basic Alt 1A)

Key Elements	Install wick drains in organic clay. Place high-strength geotextile. Place dike fill in multiple stages over undisturbed sediment. Install inside impermeable liner.
Major Quantities	8,400 wick drains approximately 15 feet long. 204,000 square feet of geotextile. 69,000 cubic yards dike fill. 130,000 square feet geomembrane liner.
Construction Issues	Very soft organic silt can not support dike without time-dependent shear strength gain. Must build dike in stages and wait for consolidation settlement and corresponding shear strength gain. Need to place geotextile under water. Consolidation would be faster if wick drains are placed under water. Need to place dike fill in relatively thin, uniform layers.
Schedule Impacts	With wick drains, estimate 16-18 months from start of construction until placement of final dike fill up to design elevation of 11 feet NGVD. It is possible to start disposal of contaminated dredged material with dike partially completed.
Disposal Capacity Impacts	Approximate disposal volume is 71,000 cubic yards.
Benefits	No corrosive structural material in dike. No disturbance of existing contaminated sediment under dike. Relatively low cost.
Disadvantages	With the estimated time from start of construction to completion, there could be overall project schedule impacts and construction issues.

Description of Earth Dike Alternative

For CDF C, wick drains would be installed as early in the project as feasible. Wick drains are installed by lifting steel lances and drains with cranes, pushing the lance and drains into the ground, then extracting the lance. For the offshore dike, the cranes mounted on shallow-draft barges and moved with small tugboats or amphibious barges would be used.

Preliminary design calculations indicate that an earth dike with side slopes of 3 horizontal to 1 vertical (3H:1V, or 18 degrees) would have to be built in 6 stages. In order to provide time for the organic silt to consolidate and gain shear strength, waiting periods of several months would be required between each stage. Therefore, the total construction duration would be in excess of one year.

The organic silt would settle approximately 3 feet. Therefore, the dike layout is based on a total fill height of up to elevation 14 feet, so that the elevation of the top of the dike would be elevation 11 feet NGVD at the end of settlement.

The estimated disposal capacity is approximately 71,000 cubic yards. This estimate is based on placing contaminated sediment over the existing mudline up to an elevation of 7 feet NGVD.

The geotextile reinforcement would be most effective if placed near the base of the dike. This also means that the geotextile would have to be placed under water. Underwater geotextile placement has been done for a number of projects as noted in Section 3.1.

The next step would be to place imported sand and gravel fill for the dike construction. Even with the geotextile reinforcement, the dike would have to be built in multiple stages.

As soon as the dike is built up to above the elevation of contaminated sediment disposal, an inside geomembrane liner would be installed. The upslope side of the liner would be held in place with an anchor trench excavated into the dike. The downslope side would be terminated in the organic silt with low permeability.

Evaluation of Earth Dike Alternative

Based on the bearing capacity, slope stability, and settlement rate calculations completed at this time, the dike construction time is estimated to be 16-18 months with wick drains and 42 months without drains. Depending on the overall project schedule this would delay placement of dredged contaminated sediment for a considerable period of time.

The main benefits of this alternative are (a) relatively low cost, (b) minimum disturbance to existing contaminated sediment, (c) minimum impact to short-term water quality, (d) capacity of 71,000 cubic yards, and (e) no corrosive structural materials used in the dike. Since the organic silt gains shear strength with consolidation, the stability increases with time. Therefore, this alternative will provide reliable long-term containment of the contaminated sediment.

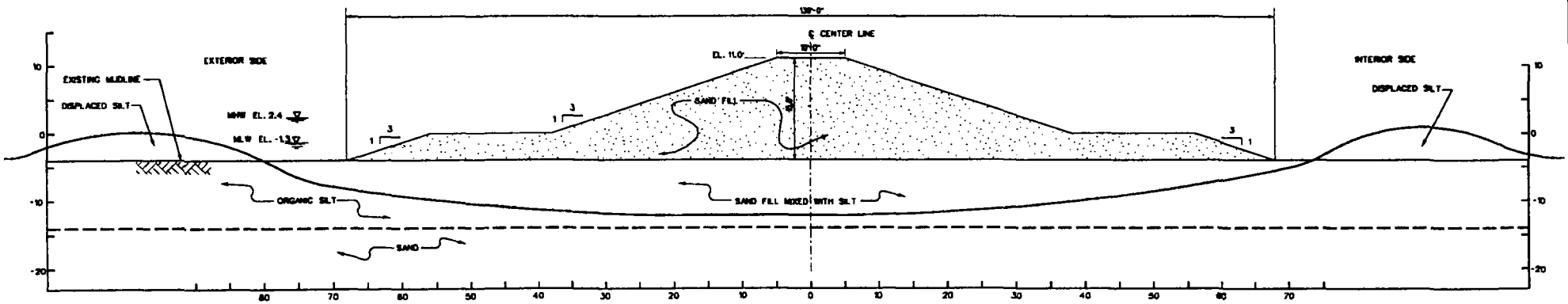
3.2 Earth Dike With Sediment Displacement (Basic Alternative 1B)

In this alternative, an earth dike would be built by intentionally displacing laterally the very soft organic silt. The purpose of this technique would be to decrease the thickness of very soft sediment under the dike by replacing organic silt with imported granular fill. By removing and displacing the silt, the dike would be more stable and, once constructed, settle less as compared to the configuration in the Earth Dike Alternative. A typical cross-section is shown in Figure 3-2. The features, benefits, and disadvantages are described below and presented in Table 3-2. The estimated construction cost and cost per cubic yard of disposal capacity are shown in Table 3-6.

Table 3-2

Earth Dike With Sediment Displacement Features (Basic Alt 1B)

Key Elements	Dredge near-surface contaminated sediment. Place dike fill by pushing from each end, which would cause existing sediment to be displaced laterally. Place dike fill in one or two stages. Install inside impermeable liner.
Major Quantities	72,000 cubic yards dike fill. 81,000 square feet geomembrane liner. 10,000 cubic yards contaminated dredging and disposal.
Construction Issues	Dike fill would displace an unknown quantity of existing sediment. There would be a variable thickness of fill in the dike, which introduces uncertainty in long-term stability. Displacement would result in re-suspension of sediment, which would result in surface water quality impacts.
Schedule Impacts	Would allow rapid dike construction (if not interrupted by water quality impacts).
Disposal Capacity Impacts	Approximate disposal volume is 55,000 cubic yards.
Benefits	No corrosive structural material in dike. Relatively rapid construction time. Relatively low cost.
Disadvantages	Water-quality impacts associated with dredging the footprint and the creation of the mudwave, uncertain long-term stability, loss of disposal capacity.



LEGEND

- - - - EXISTING SEDIMENT PROFILE

——— PROPOSED SEDIMENT PROFILE

FIGURE 3-2

NEW BEDFORD, MASSACHUSETTS
CONFINED DISPOSAL FACILITY C

EARTH DIKE
WITH SEDIMENT DISPLACEMENT

SCALE: NOTED	ALT1B-3.DGN

Description of Earth Dike With Sediment Displacement

The first step would be to dredge the near-surface contaminated sediment under the dike and along the outside edge of the dike. The thickness of the contaminated sediment is about 3 feet on the south end of CDF C and 1 foot on the north end. The purpose of removing contaminated sediment first is to eliminate release of contaminated sediment into the water during construction and to prevent mixing of contaminated near-surface sediment with deeper native sediment.

Dike fill would commence at each end by dumping fill and placement with bulldozers or other conventional land based earthwork equipment. The granular fill would be a mixture of cobbles, gravel, and sand sized particles. As the fill was placed, it would sink below the mudline and displace the existing sediment. The sequence of placement is important, so that the direction of displacement is controlled.

The first lift would bring the dike above the high tide elevation. This means that the first lift would go below elevation –4 feet and up to about elevation 4 to 5 feet NGVD. It is assumed that the fill would displace the existing sediment at depths of approximately 5 to 8 feet, which means that the total initial lift thickness would be on the order of 15 feet, or more.

With a design slope of 3H:1V, the dike would need to be 118 feet wide at elevation –4 feet and 64 feet wide at elevation 5. The full width of the dike could be built at one time, or it could be built in 2 or 3 longitudinal sections (i.e. parallel finger-shaped sections). If the outside finger were built first, then subsequent filling for the inside fingers would displace most of the sediment in towards the confined disposal facility. On the other hand, if the inside finger were built first, then most of the sediment would be displaced towards the outside of the CDF.

After the dike was constructed, due to the pre-excavation of the contaminated surface layer displaced sediment outside the dike would be left in place, and contaminated sediment displaced to the inside the dike would also be left in place. As with the Earth Dike Alternative, a geomembrane liner would be installed on the inside of the dike.

Evaluation of Earth Dike With Sediment Displacement

Construction of the dike could be done with conventional land-based construction equipment and the dike could be constructed relatively rapidly. Even though more material would be required to construct the dike than for the Earth Dike Alternative, the advantage of avoiding using expensive floating marine equipment would help reduce the cost of this alternative and the more rapid schedule would benefit the project.

The cost saving achieved by using conventional methods would be offset by the added cost of dredging and disposal of contaminated sediment. The cost of this alternative is uncertain because the volume of fill required can not be accurately predicted. The unknown fill volume also impacts the long-term reliability of this alternative.

One of the critical elements of long-term reliability is slope stability of the CDF with a temporary surcharge placed above the top of the dike. The lowest factor of safety would occur immediately after placement of the final cover and a surcharge fill on the cover. A potential surface of sliding would extend from the ground surface inside the dike, through the soft, unconsolidated dredged fill, and through the soft native silt under the dike. As with the Earth Dike Alternative (Basic Alternative 1A), organic silt left under the dike fill would consolidate and gain strength with time. Also the factor of safety would increase after any surcharge is removed.

With the displacement alternative, it is impossible to quantify the shear strength of the mixture of imported fill and native silt under the dike. The subgrade below the dike will contain some zones of continuous imported fill and some zones of native silt or native silt mixed with imported fill with

relatively lower strength than the uniform imported fill placed above this layer. When gravel or sand-sized particles are placed into soft silt or clay, the result is gravel with soft, low-strength material between the particles. In this situation, the gravel particles are not interlocked and do not provide the strength of typical gravel fill. The silt acts as a "lubricant" between the particles, so that the overall shear strength is controlled by the silt strength.

For final design of a displacement alternative, the slope stability would have to be analyzed for two cases: (a) assuming the dike subgrade strength was equal to the native silt (which is the same as the Earth Dike Alternative or (b) assuming the dike subgrade was loose sand. With this condition, it may be necessary to add an outside toe buttress to the dike, similar to the buttress shown in the Earth Dike section. With this design approach, the long-term stability would be similar to the Earth Dike Alternative.

There will be short-term water quality impacts during dike construction. As the dike fill is placed and existing sediment is displaced, a portion of the sediment will be re-suspended into the surface water.

The capacity of the disposal facility would be reduced by the volume of displaced sediment. Both the volume of sediment displaced towards the inside and the volume of contaminated sediment dredged would reduce the capacity. The volume of contaminated sediment dredged prior to dike construction is approximately 10,000 cubic yards. For this evaluation, it is assumed that the displacement volume would be on the order of 10,000 cubic yards. The reduction in volume would be partially offset by an increase of about 5,400 cubic yard from eliminating the interior toe buttress. Therefore, the disposal capacity would be approximately 55,000 cubic yards, although the actual volume could be considerably less, but will not be known until construction.

The main benefits of this alternative are (a) relatively low cost, (b) rapid construction, and (c) no corrosive structural materials used in the dike.

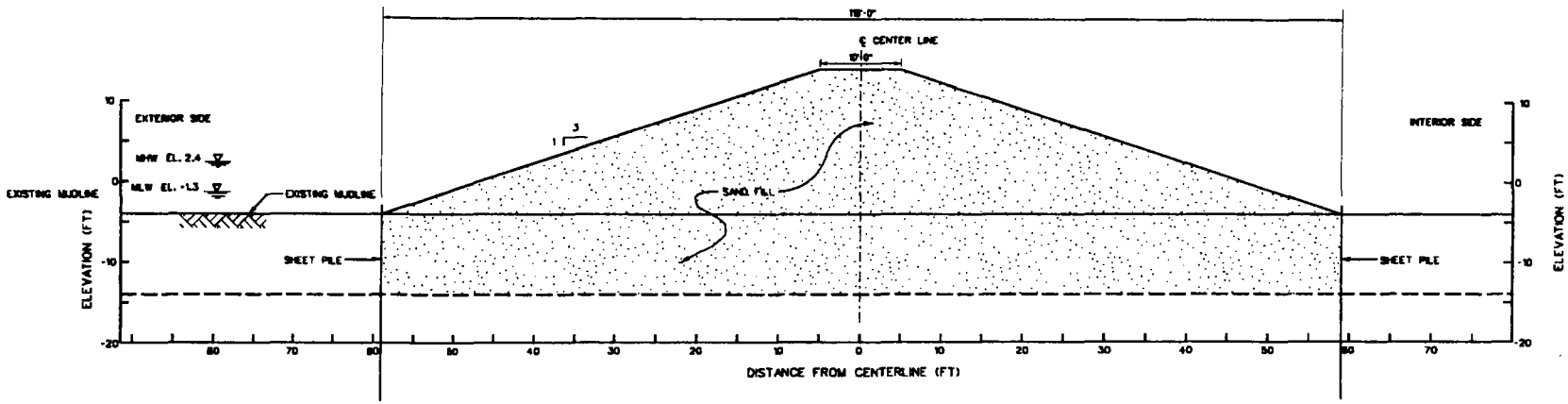
3.3 Earth Dike Dredge And Replace Inside Sheet Piles (Basic Alternative 1C)

In this alternative, the very soft existing organic silt would be dredged and replaced with imported gravel and sand fill. Steel sheet piles would be installed along the toe of the proposed dike, both on the outside and inside. The purpose of the sheet piles would be to reduce the volume of dredging and fill by temporarily retaining sediment, and to control release of sediment into the Upper Harbor. A typical cross-section is shown in Figure 3-3. The features, benefits, and disadvantages of this alternative are described below and presented in Table 3-3. The estimated construction cost and cost per cubic yard of disposal capacity are shown in Table 3-6.

Description of the Earth Dike with Dredging and Fill Replacement Inside Sheet Pile Walls

The first step would be to drive steel sheet piles along the entire length of dike. Floating marine equipment is envisioned as the means to drive the sheeting. The top of the piles would extend above mean high tide to about elevation 5 feet NGVD. The construction cost estimate is based on preliminary calculations that indicate that PZ-27 pile section 40 feet long would be used.

The next step would be to dredge contaminated silt between the sheeting and to place the contaminated material into a temporary holding area. This volume would fit in CDF Cell #1, which was used to hold and dewater sediment removed during "Hot Spot" dredging. Deeper sediment dredged down to the sand layer would have low contamination levels and may be suitable for other uses such as post clean-up habitat enhancement in the Upper Harbor, beneficial use, or disposal In the Lower Harbor if determined to be sufficiently uncontaminated for these purposes. No specific solution has been developed for disposal of the excess material. For purposes of this evaluation, it is assumed it would be disposed off site in a non-TSCA landfill.



LEGEND

- - - - - EXISTING SEDIMENT PROFILE

——— PROPOSED SEDIMENT PROFILE

HORIZONTAL SCALE 1"=15'-0"

7.5 0 15 30 45 FEET

VERTICAL SCALE 1"=15'-0"

FIGURE 3-3

NEW BEDFORD, MASSACHUSETTS
CONFINED DISPOSAL FACILITY C

EARTH DIKE WITH FILL
INSIDE SHEET PILE WALLS

SCALE: NOTED | ALT1C-4.DGN

Table 3-3

Earth Dike With Fill Inside Sheet Pile Walls Features (Basic Alt 1C)

Key Elements	Install steel sheet pile at inside and outside toe of dike. Dredge contaminated sediment between piles and place in disposal site. Portion of the deeper dredge sediment may be suitable for beneficial use or open water disposal. Place imported fill between sheets and build dike. Outside steel sheets may be removed. Install inside impermeable liner.
Major Quantities	59,000 square feet temporary sheeting and 50,000 square feet permanent sheeting. 10,000 cubic yards contaminated sediment dredging. 33,000 cubic yards silt/clay dredging. 82,000 cubic yard dike fill. 81,000 square feet geomembrane liner.
Construction Issues	Need to install vertical impermeable liner beside inside sheet pile wall. Connection between inside sheet pile and geomembrane liner.
Schedule Impacts	Would allow rapid dike construction.
Disposal Capacity Impacts	Approximate disposal volume is 69,000 cubic yards.
Benefits	No corrosive structural material in dike. Relatively rapid construction time.
Disadvantages	Relatively high cost. Questions of disposal options for excavated silt/clay.

Imported gravel and sand fill would be delivered to the site and used to fill inside the steel sheet piles. Once the fill was placed up to elevation 5 feet, then traditional upland earthwork equipment would be used to place the balance of fill. After filling was complete, the outside sheet piles could be removed.

Without the low-permeability silt under the dike, there would be an increased potential for migration of contaminated groundwater from the CDF to the surface water. Therefore, leaving the inside sheet piling in place, or installing a vinyl sheet pile wall to act as a low-permeability barrier would be beneficial. For cost estimating, it is assumed that vinyl sheet would be driven from elevation 11 feet to elevation –19 feet (30 foot long sheets).

As with the other Earth Dike Alternatives (Basic Alternatives 1A and 1B) , a geomembrane liner would be installed on the inside of the earth dike. The geomembrane would extend from an elevation above the top of contaminated sediment down to the barrier wall. The membrane would need to be connected to the barrier wall, but will have flexibility to allow for differential settlement between the dike and the sheet pile.

Evaluation of the Earth Dike with Dredging and Fill Replacement Inside Sheet Pile Walls

This alternative could be constructed using traditional marine construction methods. Once the sheet piling was in place, the organic silt could be removed with a small clamshell dredge for disposal in the existing Cell #1. The dredged material could be transported by either pipeline or small haul barge.

This alternative would allow rapid dike construction. The outside sheet piles would not be required for long-term stability, so this alternative would provide reliable long-term containment.

The disadvantage of this alternative is the higher cost in comparison to the other Earth Dike Alternatives (basic Alternative 1A and 1B). Storage capacity would be reduced by the volume of contaminated sediment dredged from between the sheet piles, but would be increased by the elimination of the inside buttress. Options for disposal of silt/clay excavated after contaminated sediment removal are limited. Contamination levels of this excavated sediment are not predictable. The disposal capacity is approximately 69,000 cubic yards.

The main benefits of this alternative are (a) minimum impact to short-term water quality, (b) rapid construction, and (c) no permanent corrosive structural materials used in the dike.

3.4 Pile Supported Concrete Wall (Basic Alternative 2)

The Pile Supported Concrete Wall containment system would be a reinforced concrete wall rather than an earth dike. The retaining wall would have to be supported by piling driven into the dense sand. A typical cross-section is shown in Figure 3-4. The features, benefits, and disadvantages of the Pile Supported Concrete Wall are described below and presented in Table 3-4. The estimated construction cost and cost per cubic yard of disposal capacity are shown in Table 3-6.

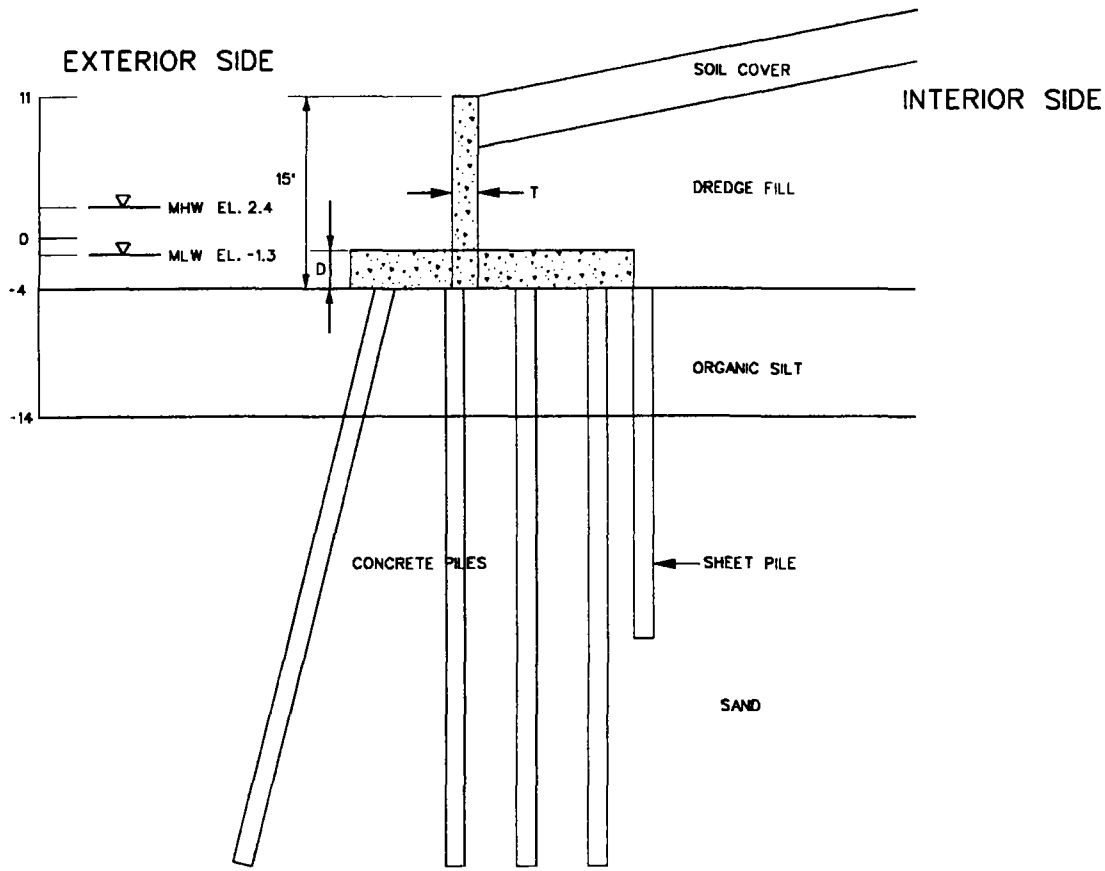
Description of Pile Supported Concrete Wall

The first step in this alternative would be to drive pre-cast concrete piling and temporary steel sheet pile. After the piles were in place, the area inside the sheet piles would be dewatered to lower the water level down to the existing mudline (about elevation –4 feet NGVD).

Table 3-4

Pile Supported Concrete Retaining Wall Features (Basic Alt 2)

Key Elements	Install temporary steel sheet pile on inside and outside. Drive concrete piling. Dewater inside sheets to expose top of piles. Form and pour pile cap and grade beam. Form and pour retaining wall. Install impermeable liner on wall, grade beam and onto native sediment. Remove temporary sheet piles.
Major Quantities	109,000 square feet temporary sheeting 1,020 concrete piles approximately 50 feet long. 30,000 square feet pile-supported slab and grade beam forms. 41,000 square feet wall forms. 4,800 cubic yards reinforced concrete. 48,000 square feet geomembrane liner.
Construction Issues	Need for pile-supported slab and grade beam forms, since organic clay would not carry weight of fluid concrete. Need to treat all water pumped from inside sheets for temporary dewatering.
Schedule Impacts	Would allow continuous wall construction.
Disposal Capacity Impacts	Approximate disposal volume is 100,000 cubic yards.
Benefits	Increased disposal volume over earth dike.
Disadvantages	High cost. Structure rather than earthen dike habitat. Need to fill potential voids under pile-supported concrete. Long-term degradation of the concrete.



PILE SUPPORTED CONCRETE RETAINING WALL

SCALE 1"=10'-0"

FIGURE 3-4

NEW BEDFORD, MASSACHUSETTS
CONFINED DISPOSAL FACILITY C

PILE SUPPORTED
CONCRETE RETAINING WALL

SCALE: NOTED | alt2-5.dgn

The next step would be to build forms for the pile cap and grade beam between the concrete piles. Due to the low shear strength of the organic silt, the bottom forms would have to be supported by the piles and not the sediment. For cost estimating, it is assumed that timber or steel beams would be attached to the tops of the piles, then concrete forms supported by the beams. Alternatively, to avoid formwork, precast sections could be investigated for feasibility in lieu of cast-in-place techniques. After the pile cap and grade beam was placed, the vertical portion of the retaining wall would be formed and poured.

A low-permeability barrier would be required on the inside of the retaining wall. A geomembrane would be attached near the top of the wall and would extend down the wall, across the inside of the grade beam and onto the native low-permeability sediment. Since the existing sediment would remain in place below the concrete grade beam, no additional barriers would be required below the concrete.

Evaluation of Pile Supported Concrete Wall

The Pile Supported Concrete Wall would be constructed using marine construction methods. Both the concrete piles and sheet pile would be constructed with barge-mounted pile driving cranes. The limited water depths would restrict the size of the barges and workboats.

Assuming the wall is placed along the centerline alignment of the earthen dike alternatives, the disposal capacity would be increased by the difference between the interior volume of the berm. The disposal volume would be increased by approximately 30,000 cubic yards, to a total of approximately 100,000 cy. If the wall were moved east to near the toe of the proposed earth berm (approximately 50 feet), then the disposal capacity would increase 15,000 cy for a total of 115,000 cy.

Disadvantages of this alternative are the high cost and time to complete construction . There would be a potential that voids could occur under the pile-supported concrete cap and grade beam and require filling. Another disadvantage would be the need to treat water pumped out from between the sheet piles during construction. It is assumed that this water would require treatment before being discharged back into the Upper Harbor.

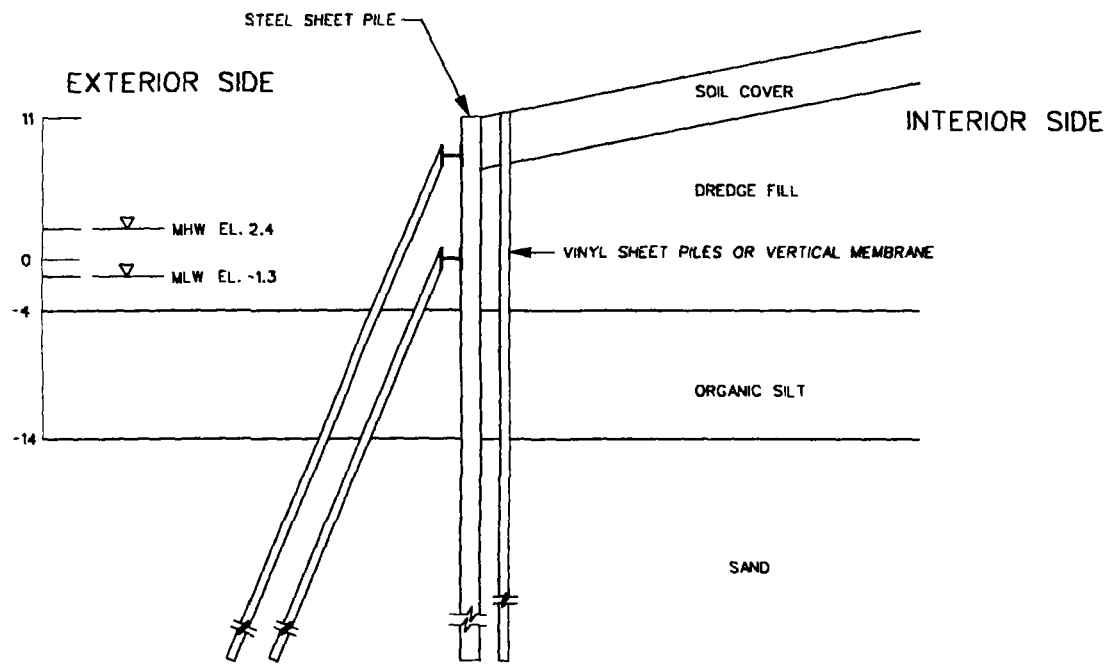
The main benefits of this alternative are minimum impact to short-term water quality and the increased storage capacity.

3.5 Sheet Pile Wall With Batter Piles (Basic Alternative 3)

In this alternative, the perimeter containment system would be a steel sheet pile wall rather than an earth dike. Standard sheet pile sections manufactured in the U.S. would not have sufficient strength to support the lateral pressure from contaminated sediment and capping material placed in the CDF. Alternative heavy-duty sections are available from foreign sources, and may be able to withstand the estimated loads. For this discussion, additional support would have to be provided by steel batter piles. A typical cross-section is shown in Figure 3-5. The features, benefits, and disadvantages of the Sheet Pile Wall are described below and presented in Table 3-5. The estimated construction cost and cost per cubic yard of disposal capacity are shown in Table 3-6.

Description of Sheet Pile Wall

The steel piles would have to support 15 feet of dredged fill and final cover above the existing soft organic silt. The existing silt does not have sufficient shear strength to provide passive soil support for the sheet piles. Therefore, the sheet piles must be designed to support a total of 25 feet of low strength material over medium dense native sands. The largest Z-shaped sheet pile made (40 pounds per square foot) with high-strength steel (50,000 pounds per square inch yield stress) has less bending capacity than needed for a vertical wall.



SHEET PILE WALL WITH BATTER PILES

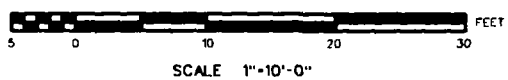


FIGURE 3-5

NEW BEDFORD, MASSACHUSETTS
CONFINED DISPOSAL FACILITY C

SHEET PILE WALL
WITH BATTER PILES

SCALE: NOTED	qlt3-6.dgn

Table 3-5

Sheet Pile Wall With Batter Piles Features (Basic Alt 3)

Key Elements	Drive batter piles. Drive vertical piles. Dive steel sheet pile and install steel whalers. Install impermeable liner along inside sheet pile wall.
Major Quantities	Not estimated due to lack of availability in the U.S.
Construction Issues	Need for structural connection between batter piles, vertical piles, whalers and steel sheet piles.
Schedule Impacts	Would be the most rapid construction system of all alternatives.
Disposal Capacity Impacts	Capacity would be increased by the difference between dike volume and steel structure volume inside centerline.
Benefits	Relatively rapid construction time
Disadvantages	High cost. Corrosion potential of structural steel in tidal zone.

In order to provide support for the sheet piles, additional lateral support would have to be provided. This is usually done with steel rods anchored to tiebacks in firm soils or to concrete deadmen. Design and installation with steel rod anchors behind the wall is not feasible for this site, due to the thickness of very soft sediment. Lateral support could be provided by steel batter piles installed either inside of or outside of the sheet piles.

The first step in this alternative would be to drive steel batter piles. The next steps would be to install horizontal steel whalers (beams) between the batter piles, which would provide lateral support to the vertical sheet piles. The whalers would also serve as guides to drive the sheet piles.

An impermeable liner would be required on the inside of the retaining wall. The steel sheet piles may provide this requirement, or vinyl sheet piles may need to be driven along the wall to provide better containment.

Evaluation of Sheet Pile Wall

The Steel Sheet Pile Wall could be constructed using traditional marine construction methods. Each of the different types of piles would be constructed with barge-mounted equipment. The limited water depths would restrict the size of the barges and workboats.

Disadvantages of this alternative are high cost and the potential for corrosion of steel exposed to saltwater. Structural analysis of the required sheeting indicates sizes of sufficient strength are not manufactured in the U.S. Based on experience with pile installations, it is estimated that the piles would be installed within one foot of the design location. For batter piles, both the angle and location would vary along the alignment.

The main benefits of this alternative are (a) minimum impact to short-term water quality, and (b) rapid construction. Storage capacity would be increased by the volume of the earth dikes inside the alignment centerline.

This alternative is eliminated from further analysis due to the required sizes not being available in the U.S. and the corrosion concerns.

3.6 CDF Interior Excavation (Basic Alternative 4)

Foster Wheeler has performed an assessment of the feasibility of deepening the interior of CDF C prior to placing contaminated dredged material. The purpose of deepening would be to increase the disposal capacity.

Excavation To Bedrock

In this alternative, all sediment and underlying sands inside the perimeter dikes would be removed down to the depth of bedrock. The depth to bedrock is approximately 50 feet below the existing mudline elevation. As envisioned the width available for excavation is about 200 feet between the existing shoreline and the centerline of the offshore dike.

A temporary slope in the native sediment is assumed to be 3 horizontal to 1 vertical, which means that a cut 50 feet deep would take 150 feet horizontal. Given the site plan, there is not adequate width to make a dredge slope down to bedrock.

Use of vertical shoring to gain added capacity was evaluated. If the excavation were done under water to reduce hydrostatic pressure, a braced wall would be required to support a 50-foot high wall. The wall would have to rest on top of bedrock because it is not possible to drive piles into rock. Internal cross-bracing would have to be installed underwater, which is not feasible.

It is recommended that this alternative be eliminated due to the complex structure needed to support the walls of the deep CDF and the complexities of creating an impermeable bottom on bedrock.

Partial Excavation

A variation of deepening would be to perform a partial excavation into the native sediments to increase disposal capacity. For this evaluation, it was assumed that slopes of 3 horizontal to 1 vertical would be stable. With these slopes, the mudline could be dredged to approximately elevation –10 feet NGVD. This would increase the disposal capacity by approximately 25,000 cubic yards.

Dredging to elevation –10 feet would remove all the existing organic silt in the southern and northern portion of CDF C. The ROD required that silt provide a low-permeability barrier on the bottom of the CDF C. It is assumed that at least 2 feet of organic silt would have to be left in the bottom of the site. This requirement would significantly reduce the potential added disposal capacity. In addition, the surface sediment in CDF C is contaminated. It is assumed that the contaminated sediment would have to be placed into a temporary holding cell, then placed into CDF C, which would further reduce the net increase in disposal capacity.

Given the constraints described above, the net increase in disposal would be on the order of 10,000 to 15,000 cubic yards. In order to achieve this increase, the near-surface contaminated sediment would have to be dredged, placed in temporary upland storage, then placed back into CDF C.

This alternative is eliminated from further analysis due to the small amount of increased capacity that would be obtained and the rehandling of contaminated sediment.

Table 3-6
Alternative Evaluation Summary

	Baseline – Earth embankment (Basic Alt 1A)	**Fill and Displace Subgrade Sediment (Basic Alt 1B)**	**Dredge and Replace Inside Sheet Piles (Basic Alt 1C)**	**Pile Supported Concrete Wall (Basic Alt 2)**	**Vertical Structural Steel Wall (Basic Alt 3)**
Key Elements	Install wick drains in organic clay. Place high-strength geotextile. Place dike fill in multiple stages. Install inside impermeable liner.	Dredge near-surface contaminated sediment. Place dike fill by pushing from each end to displace sediment laterally. Install inside impermeable liner.	Install steel sheet pile. Dredge contaminated sediment, then replace soft silt. Place imported dike fill. Install impermeable liner..	Install temporary steel sheet pile. Drive concrete piling. Dewater to top of piles. Install pile cap. Build retaining wall. Install impermeable liner.	Drive batter piles. Drive vertical piles. Dive steel sheet pile and install steel whalers. Install impermeable liner along inside sheet pile wall.
Construction Issues	Must build dike in stages Need to place geotextile under water. Need to place dike fill in relatively thin, uniform layers.	Uncertain long-term stability. Displacement would re-suspend sediment, which would impact surface water quality and potentially shutting down CDF construction.	Need to install vertical impermeable liner beside inside sheet pile wall. Connection between inside sheet pile and geomembrane liner.	Pile-supported slab and grade beam forms. Need to treat all water pumped from inside sheets for temporary dewatering. Need to install impermeable liner.	Structural connection between batter piles, vertical piles, whalers and steel sheet piles. Need to install impermeable liner.
Schedule Impacts	With wick drains, estimate 16-18 months to build dike.	Water quality impacts could stop construction.	None.	Estimate 18 to 24 months to build wall.	None
Disposal Capacity Impacts	Approximate disposal capacity is 71,000 cubic yards.	Approximate capacity 55,000 cy	Approximate capacity 69,000 cy	Approximate capacity 115,000 cy with wall along toe of earth berm.	Approximate capacity 115,000 cy with wall along toe of earth berm.
Benefits	Reliable long-term containment. Contaminated sediment not disturbed under dike. Relatively low cost.	Reliable long-term containment. Relatively rapid construction time. Relatively low cost.	Reliable long-term containment. Relatively rapid construction time.	Conventional construction. Increased disposal capacity.	Conventional construction. Increased disposal capacity.
Disadvantages	Schedule impacts and construction issues.	Water-quality impacts. Reduction of disposal capacity.	Relatively high cost. Cost of offsite disposal	High cost. Long-term degradation of concrete.	High cost. Lack of required sheeting in U.S. Corrosion of structural steel in tidal zone.
Construction Cost	$ 8,709,000.	$ 5,524,442.	$12,666,877.	$ 10,471,711.	Not estimated
Cost / disposal volume.	$ 122.	$ 100.	$ 184.	$ 91.	NA

4.0 VALUE ENGINEERING PROPOSALS

A Value Engineering (VE) Workshop was held on April 11, 2000 in Concord, MA at the office of the USACE. During the workshop, a "speculation list" of all ideas for CDF construction was made. After making the list, the first step in the evaluation process was to screen the ideas. The speculation list with the results of the initial screening is in Appendix D.

The next step was to identify which ideas applied to which component of the facilities. Several of the ideas apply to CDF D, CDF cover design, dredged material handling, or to site-wide aspects of the New Bedford Superfund site. This Technical Memorandum addresses only those ideas that apply to the perimeter dike at CDF C.

The ideas are formed into Value Engineering Proposals (VE proposals) and evaluated against the Basic Alternatives. In this section, each of the five Basic Alternatives is considered as a separate "baseline" for initial evaluation of VE proposals. Table 4-1 lists the numbers and short titles of all VE proposals that apply to each alternative.

Table 4-1
CDF C Dike VE Proposals

Alternative	VE Proposal No.	Description
Earth Dike (Basic Alt 1A)	5, 6, 7 90, 7 46, 50 44, 45 (BD)	Vinyl sheet pile on top and less dike fill. Vinyl sheet piles on top 4 ft. Place contaminated sediment as dike is raised. Steepen side slopes and steepen interior slope.
Earth Dike With Sediment Displacement (Basic Alt 1B)	39 43 (BD)	Add geotextile. Build with mud wave construction.
Earth Dike Dredge and Replace Within Sheet Piles (Basic Alt 1C)	38, 41, 42	Dredge base slope and fill with sand, move steel sheet, eliminate steel sheets and dredge slope under dike.
Pile Supported Concrete Wall (Basic Alt 2)	72 (BD)	Modify to increase life cycle benefits (add thickness for longer design life)
Sheet Pile Wall With Batter Piles (Basic Alt 3)	40 36 52, 4 61 70 (BD) 48 (BD)	Use pile / sheet pile combination without batter piles. Use vertical sheet pile with ½ dike on outside. Use ½ dike on outside. Use "excess" dredged material for outside dike. Use steel sheet pile with batter piles. Use cathodic protection to increase design life.
General	51 (BD)	Use dredged material for part of dike.
Shoreline	37, 47	Delete liner along existing dikes.

Many of the ideas listed during the VE workshop express similar concepts. In these cases, the ideas have been combined into one VE proposal. For example, ideas 6, 7, and 90 are about using sheet pile to make the dike higher. Therefore, ideas 6,7 and 90 have been combined into one VE proposal, which is to use vinyl sheet pile to build the top portion of the dike from elevation 7 to 11 feet NGVD.

Idea 5 is to make the dike higher to increase disposal capacity. As with all the ideas expressed during the VE workshop, no details were discussed. This idea is not evaluated in this Technical Memorandum because it is outside the scope of perimeter dike alternatives. For common comparison of alternatives, the

top of the dike during construction is elevation 11 feet NGVD. Consideration of changes in design elevation for the dike will be made during design of the interim and final covers for CDF C.

In order to evaluate the VE proposals, additional conceptual details and conceptual engineering analysis were required. This section describes the proposals in more detail than given in the VE Workshop and describes the analyses that were done to assist in the assessment of the proposals. It is not practicable to perform design level calculations for each VE proposal within a reasonable period of time. Therefore, the cost estimates shown are order of magnitude estimates that are valid for comparisons. During final design of the selected alternative, some variations should be expected.

4.1 Earth Dike Alternative (Basic Alt 1) Proposals

In this section, VE proposals that apply to the Earth Dike design concept are evaluated.

Earth Dike With Vinyl Sheet Pile (VE Proposal 90, 5 6, 7)

In this proposal, an earth dike would be built up to elevation 7 feet NGVD and then vinyl sheet piles would be installed to raise the dike elevation to 11 feet NGVD. Dredged material and discharge water would reach to elevation 7 to 9 feet with two feet of freeboard from elevation 9 to 11 feet. After completion of placing contaminated sediment, it is assumed that a temporary surcharge fill would be placed from elevation 7 to 11 feet.

Conceptual design calculations were done to estimate the depth of penetration of the sheet pile and the size of piles required. The sheet piles would need to be driven approximately 8 feet below the ground surface and 4 feet above the ground, for a total length of 12 feet. The piles would be driven with land-based equipment working from the top of the earth dike. The tips of the piles would be several feet above the geotextile at the base of the dike and would not be driven through the geotextile. Figure 4-1 shows a typical cross-section of the dike and the proposal evaluation is shown in Table 4-2.

Further evaluation of this proposal is recommended. This is the revised alternative that will be used in the alternative comparison in this Technical Memorandum. The use of vinyl sheet pile reduces the volume of imported fill required and would require one less stage to construct.

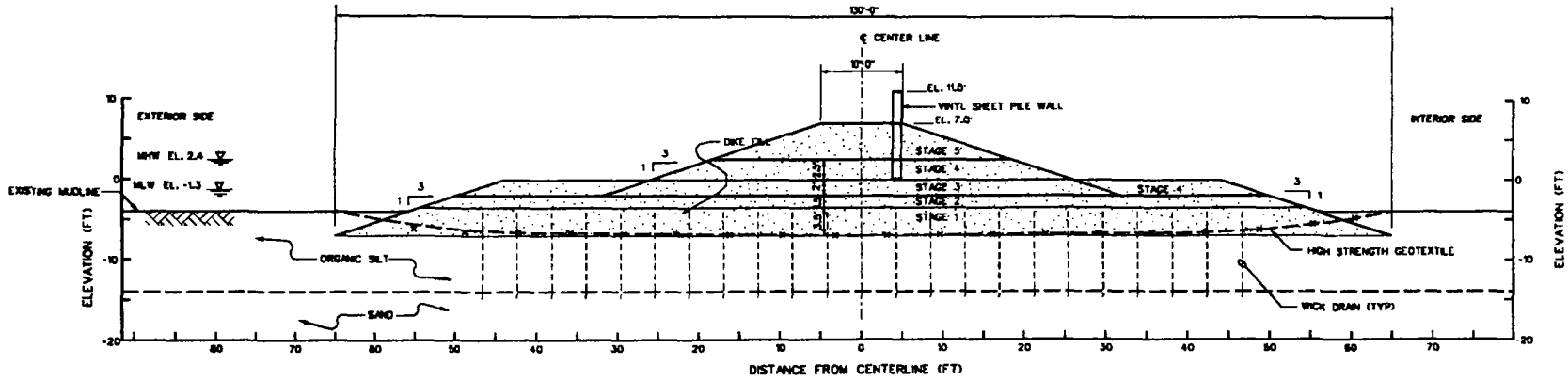
Earth Dike With Steep Side Slopes (VE Proposals 44, 45)

In this proposal, the exterior and interior slopes of the earth dike would be made steeper than 3 horizontal to 1 vertical. This proposal would reduce the volume of imported fill and would increase the disposal capacity. Figure 4-2 shows a typical cross-section of the dike and the proposal evaluation is shown in Table 4-3.

The slope stability of the dike would be reduced. Therefore, in order to implement this proposal, more detailed stability analyses would be required. It is recommended that this proposal be implemented during final design of the preferred alternative. At that time, the slopes will be made as steep as possible.

4.2 Earth Dike Dredge And Replace Alternative (Basic Alt 1B) Proposals (VE Proposal 39)

VE proposal 39 is the only idea that applies only to the Earth Dike Dredge and Replace Alternative. This proposal is to place a geotextile over the existing sediment before placing imported fill. The purpose of this would be to keep the imported fill separate from the existing sediment. Figure 4-3 shows a typical cross-section of the dike and the proposal evaluation is shown in Table 4-4.



LEGEND

- EXISTING SEDIMENT PROFILE
- PROPOSED SEDIMENT PROFILE
- GEOTEXTILE FABRIC
- WICK DRAINS (TYP)

HORIZONTAL SCALE 1"=15'-0"

7.5 0 15 30 45 FEET

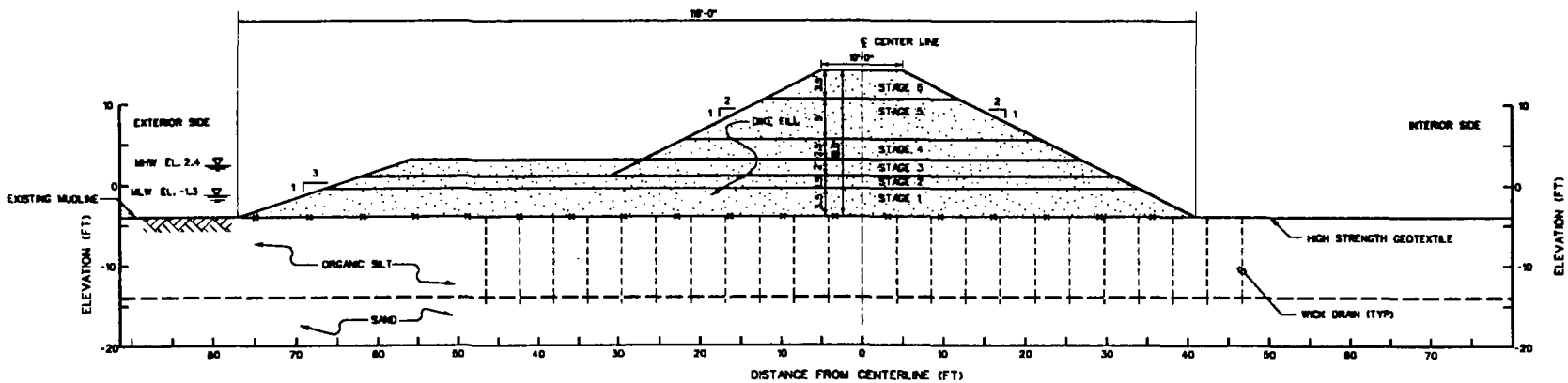
VERTICAL SCALE 1"=15'-0"

FIGURE 4-1

NEW BEDFORD, MASSACHUSETTS
CONFINED DISPOSAL FACILITY C

EARTH DIKE
WITH VINYL SHEET PILE

SCALE: NOTED	ALT4A.DGN



LEGEND

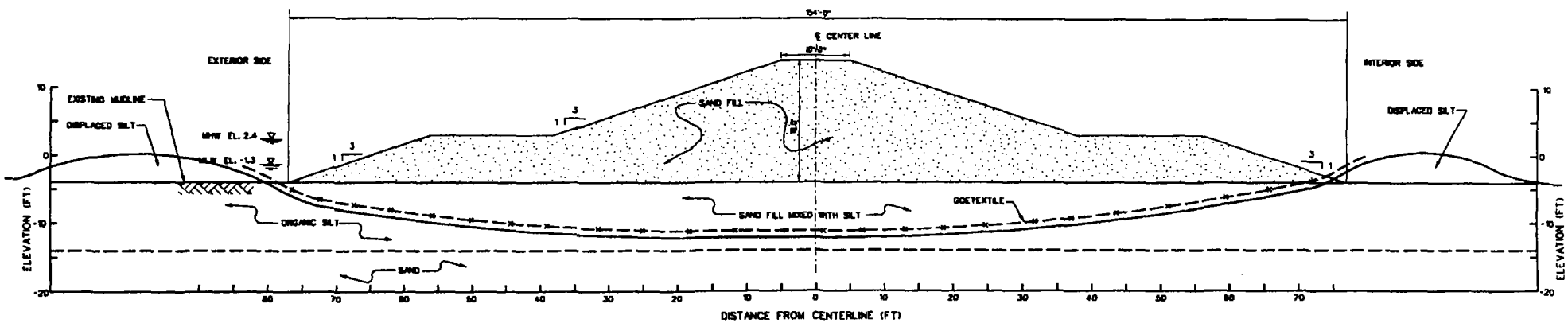
- EXISTING SEDIMENT PROFILE
- PROPOSED SEDIMENT PROFILE
- GEOTEXTILE
- WICK DRAINS (TYP)

HORIZONTAL SCALE 1"=15'-0"

7.5 0 15 30 45 FEET

VERTICAL SCALE 1"=15'-0"

FIGURE 4-2	
NEW BEDFORD, MASSACHUSETTS CONFINED DISPOSAL FACILITY C EARTH DIKE WITH STEEP SIDE SLOPES	
SCALE: NOTED	ALT4B.DGN



LEGEND

- EXISTING SEDIMENT PROFILE
- PROPOSED SEDIMENT PROFILE
- GEOTEXTILE FABRIC

HORIZONTAL SCALE 1"=15'-0"

7.5 0 15 30 45 FEET

VERTICAL SCALE 1"=15'-0"

FIGURE 4-3

NEW BEDFORD, MASSACHUSETTS
CONFINED DISPOSAL FACILITY C

EARTH DIKE WITH DREDGE AND REPLACE ON GEOTEXTILE

SCALE: NOTED	ALT4C.DGN

Table 4-2
Earth Dike With Vinyl Sheet Pile (Basic Alt 1A)

EARTH DIKE (Basic Alt 1A)	Build dike with 3H:1V side slopes on outside and outside. Build 20 foot wide toe buttresses on inside and outside.
VE PROPOSAL NO.90, 5, 6, 7	Install vinyl sheet piles on top 4 feet of dike, so that height of earth fill is reduced by 4 feet. For VE evaluation use sheet piles to provide 2 feet of freeboard and 2 feet of water ponding depth during placement of contaminated sediment. After completion of sediment placement, vinyl sheet pile would support temporary surcharge fill. Top of permanent earth fill to elevation 7 feet and top of sheet pile to elevation 11 feet (after allowing for dike settlement. Based on pile analysis, vinyl sheets would be driven 8 feet into the dike fill. They would not penetrate geotextile at base of dike.
ADVANTAGES	The volume of fill required to build the berm would be reduced by approximately 20,000 cubic yards. The storage volume would be increased by 11,000 cy. Construction time would be reduced since Stage 6 dike placement would not be required.
DISADVANTAGES	None
CHANGE IN COSTS	Construction cost would be reduced, based on reduction in imported fill volume and addition of sheet pile cost. With increased disposal volume, unit cost per cubic yard of storage capacity would be reduced.
CONDITIONS	None.
RECOMMENDATION	Apply to Earth Dike Alternative.

Displacement of the existing sediment with imported fill would have to be done one area at a time. As a result, there will be significant differential movement between adjacent areas of the dike, which will likely result in tearing and failure of the geotextile.

It is recommended that this proposal be eliminated from further evaluation. Although the geotextile would provide some material separation, this would not add to the stability of the dike, and there would be little benefit for the added cost.

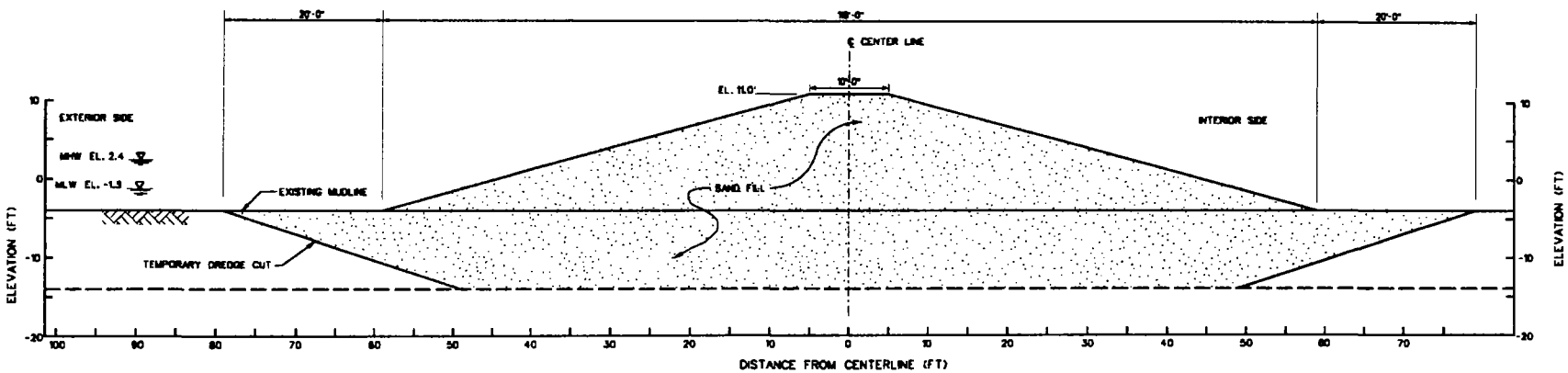
4.3 Earth Dike Dredge And Replace Within Sheet Piles Alternative (Basic Alt 1C) Proposals

This section describes and evaluates VE proposals that apply to the Earth Dike Dredge and Replace within Sheet Pile Alternative.

Place Fill Within Sloped Excavation (VE Proposals 38, 41, 42)

This proposal would eliminate the temporary steel sheet pile on both the inside and outside toes of the dike. The existing very soft sediment under the dike would be removed by dredging with a temporary slope on the inside and outside. Based on experience with similar sediments, it is assumed that the sediment would be stable with a slope of 3H:1V or less. Figure 4-4 shows a typical cross-section of the dike and the proposal evaluation is shown in Table 4-5.

Slope stability of the dike with interim cover and surcharge fill was evaluated using the program UTEXAS3. The results indicated that the dike would be stable provided that the top slope of the sand fill was 20 feet outside the toe of the dike.



LEGEND

- - - - EXISTING SEDIMENT PROFILE

——— PROPOSED SEDIMENT PROFILE

HORIZONTAL SCALE 1"=15'-0"

7.5 0 15 30 45 FEET

VERTICAL SCALE 1"=15'-0"

FIGURE 4-4

NEW BEDFORD, MASSACHUSETTS
CONFINED DISPOSAL FACILITY C

EARTH DIKE AND PLACE FILL WITHIN SLOPED EXCAVATION

SCALE: NOTED	ALT4D.DGN

Table 4-3
Earth Dike With Steep Side Slopes (Basic Alt 1A; VE Proposals 44, 45)

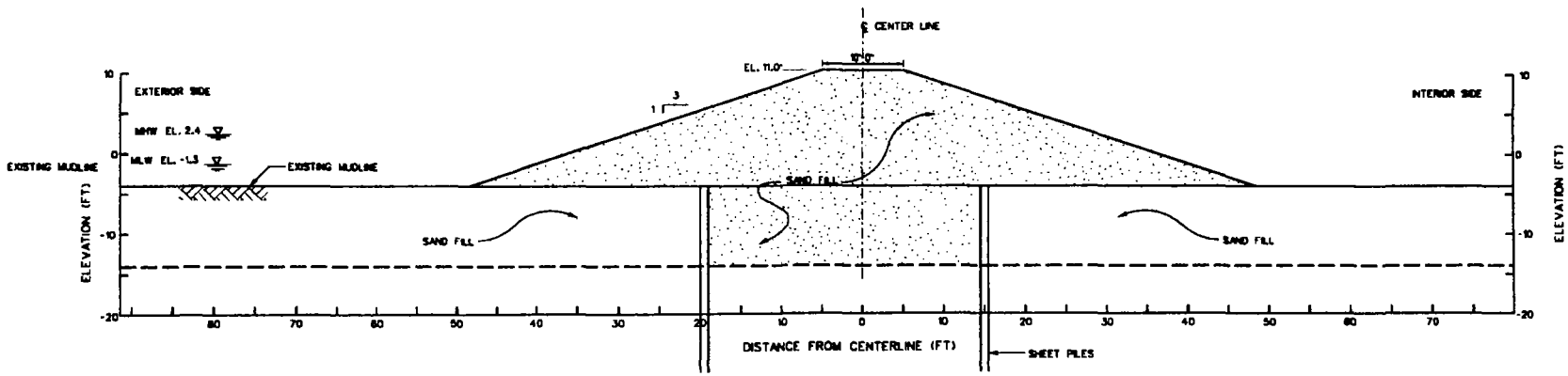
EARTH DIKE (Basic Alt 1A) WITH STEEPER SIDE SLOPES	Build dike with 3H:1V side slopes on inside and outside. Build 20 foot wide toe buttresses on inside and outside.
VE PROPOSAL NO. 44 and 45	Eliminate inside toe buttress and make inside slopes steeper. For VE evaluation, assume that inside slope would be stable at 2H:1V.
ADVANTAGES	The volume of fill required to build the dike would be reduced by approximately 15,000 cubic yards. The storage volume would be increased by 15, 000 cy.
DISADVANTAGES	Would be more difficult to place inside geomembrane liners on dike slope. May require higher strength geomembrane. Dike would be less stable prior to placing contaminated sediment.
CHANGE IN COSTS	Construction cost would be less, based on reduction in dike fill cost, and an increase in geomembrane cost. With increased disposal volume, unit cost per cubic yard of storage capacity would be reduced.
CONDITIONS	Depending on rate of dike construction, may require placing contaminated sediment on inside slope before dike is built to full height to keep dike stable (this is VE Proposals 46 and 50)
RECOMMENDATION	Evaluate further during final design.

The sheet pile is an expensive item in the cost for Basic Alternative 1C and would not be required for this proposal. The savings in sheet pile costs are much greater than the cost for additional dredging outside the toe of the dike. This is the revised alternative that will be used in the alternative comparison in this Technical Memorandum.

Earth Dike Dredge and Replace Within Sheet Pile Walls Along Centerline (VE Proposal 41)

In this proposal, the temporary sheet piles would be moved towards the center of the dike. This would reduce costs by reducing the volume of imported fill required. Evaluation of this proposal was performed. Figure 4-5 shows a typical cross-section of the dike and the proposal evaluation is shown in Table 4-6.

Slope stability was evaluated with the program UTEXAS3. The outside portion of the dike is not stable with this configuration. Therefore, it is recommended that this proposal be eliminated.



LEGEND

- - - - EXISTING SEDIMENT PROFILE

——— PROPOSED SEDIMENT PROFILE

HORIZONTAL SCALE 1"=15'-0"

7.5 0 15 30 45 FEET

7.5 0 15 30 45

VERTICAL SCALE 1"=15'-0"

FIGURE 4-5

NEW BEDFORD, MASSACHUSETTS
CONFINED DISPOSAL FACILITY C

EARTH DIKE DREDGE AND REPLACE WITHIN SHEET PILE WALLS ALONG CENTERLINE

SCALE: NOTED	ALT4E.DGN

Table 4-4
Earth Dike With Dredge And Replace On Geotextile
(Basic Alt 1B; VE Proposal 39)

EARTH DIKE (Basic Alt 1A) WITH DREDGE AND REPLACE ON GEOTEXTILE	Build dike with 3H:1V side slopes on outside and outside. Build 20 foot wide toe buttresses on outside.
VE PROPOSAL NO. 39	Install geotextile over native sediment before starting dike construction by displacement method.
ADVANTAGES	Geotextile would provide a separation fabric to reduce mixing of imported fill with organic silty sediment.
DISADVANTAGES	Geotextile would undergo large deformation and stresses during filling and would likely tear. Therefore, adding the geotextile would change dike design and would not provide any quantifiable benefits.
CHANGE IN COSTS	Construction cost would be increased, based on addition of geotextile. With increased cost, unit cost per cubic yard of storage capacity would be increased.
CONDITIONS	None.
RECOMMENDATION	Eliminate

4.4 Pile Supported Concrete Wall Alternative Proposals

The only proposal that applies to the Concrete Retaining Wall is VE Proposal No. 72, which is to make the concrete thicker to increase long-term reliability. The concrete in the wall face is the most susceptible to deterioration over time from the effects of exposure to saltwater. For cost estimating purposes, it is assumed that the wall would be increased in thickness from 24 to 30 inches. This would allow more concrete cover over the internal reinforcing steel, which may make this alternative more reliable. Should this alternative be carried forward into design, other means may be more suitable to increase longevity, such as specialized admixtures which prevent chloride attack on the reinforcement.

The proposal evaluation is shown in Table 4-7. Further evaluation of this proposal is recommended. This is the revised alternative that will be used in the alternative comparison in this Technical Memorandum.

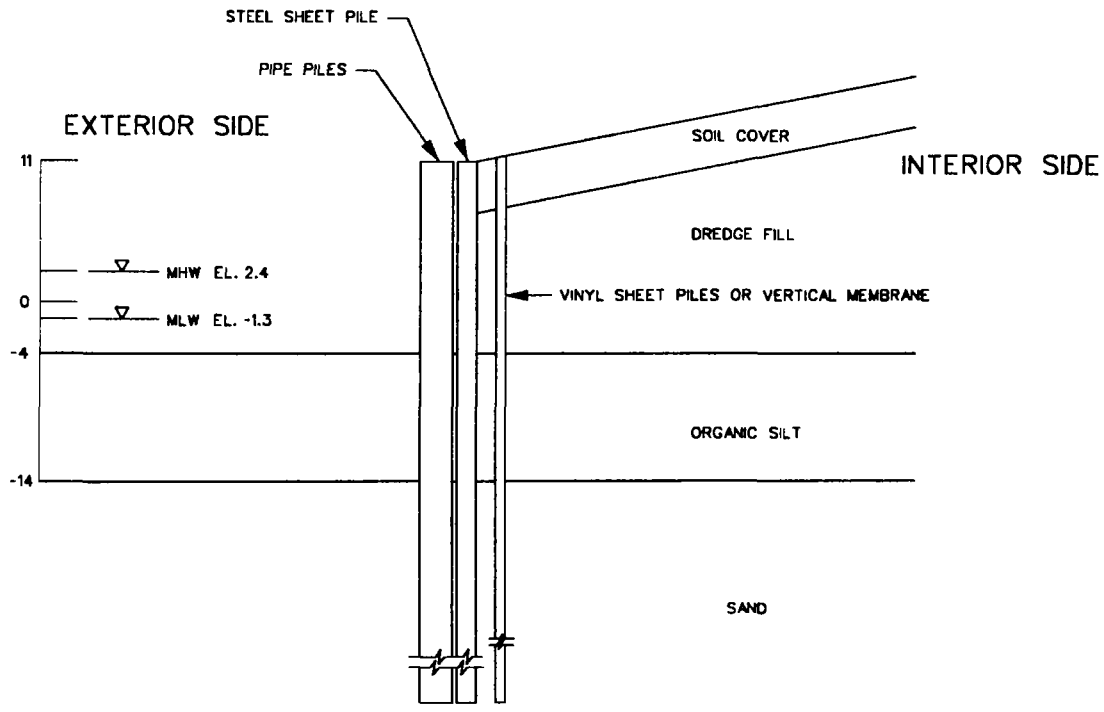
4.5 Sheet Pile Wall Alternative (Basic Alt 3) Proposals

This section describes the proposals that apply to the Steel Sheet Pile Wall with Batter Piles.

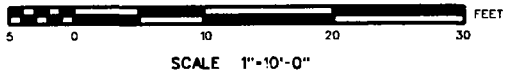
Sheet Pile Wall with Pipe Piles (VE Proposal 40)

In VE proposal 40, the batter piles and horizontal whalers would be eliminated by using vertical pipe piles attached to vertical steel sheet piles. The pipe piles would be filled with concrete, which would provide a structural wall system with high bending moment capacity. Figure 4-6 shows a typical cross-section of the dike and the proposal evaluation is shown in Table 4-8.

It is theoretically possible to fabricate wall sections with the strength needed to support the contaminated dredged material. However, there is only one company that has designed and manufactured these systems.



SHEET PILE WALL WITH PIPE PILES



SCALE 1"=10'-0"

FIGURE 4-6

NEW BEDFORD, MASSACHUSETTS
CONFINED DISPOSAL FACILITY C

SHEET PILE WALL
WITH PIPE PILES

SCALE: NOTED	ALT4F.DGN

Table 4-5
Earth Dike And Place Fill Within Sloped Excavation
(Basic Alt 1C; VE Proposals 42, 38)

EARTH DIKE (Basic Alt 1C) DREDGE AND REPLACE WITHIN SHEET PILE WALLS	Build dike with 3H:1V side slopes on outside and outside. Build 20 foot wide toe buttresses on inside and outside.
VE PROPOSAL NO. 42, 38	Eliminate steel sheet pile at inside and outside toe of dike. Dredge out existing very soft silt starting from 20 feet out from the outside toe of the dike. Assume that the very soft sediment will be stable with a temporary dredged slope of 3H:1V.
ADVANTAGES	Reduction in cost and construction time.
DISADVANTAGES	None.
CHANGE IN COSTS	Construction cost would be less, based on elimination of 109,000 square feet of sheet pile. With decreased cost, unit cost per cubic yard of storage capacity would be reduced.
CONDITIONS	Need disposal site for sediment below cleanup level.
RECOMMENDATION	Evaluate further. This is the revised alternative that will be used in the summary Technical Memorandum evaluation.

Table 4-6
Earth Dike Dredge and Replace Within Sheet Pile Walls Along Centerline
(Basic Alt 1C; VE Proposal 41)

EARTH DIKE (Basic Alt 1C)	Build dike with 3H:1V side slopes on inside and outside. Build 20 foot wide toe buttresses on inside and outside.
VE PROPOSAL NO. 41	Move steel sheet pile in towards center of dike
ADVANTAGES	Reduce volume of dredging and imported fill
DISADVANTAGES	Dike slope stability would be decreased since there would be more very soft silt left in place under the inside and outside toes. Foster Wheeler evaluated dike stability using the UTEXAS3 program and the dike would not be stable.
CHANGE IN COSTS	Not evaluated.
CONDITIONS	Dike not stable.
RECOMMENDATION	Eliminate.

The structural wall would need to support low strength dredged material from elevation –4 to 7 feet, with weight of an interim cover from elevation 7 to 11 feet and a surcharge fill up to elevation 15 feet. During dredged material placement, there would be water inside the CDF up to elevation 9 feet. The existing sediment from elevation –4 to –14 feet is very low strength organic silt that provides essentially no soil resistance. From a structural standpoint, the wall would have to be strong enough to support 21 feet of low strength sediment covered with 8 feet of interim cover and surcharge fill.

Vertical retaining walls without bracing or tiebacks are typically limited in height to about 15 feet. In this case, the wall would be nearly 30 feet high and would have to retain hydrostatic pressure from ponded water.

Table 4-7
Pile Supported Concrete Wall (Basic Alt 2; VE Proposal 72)

PILE SUPPORTED CONCRETE WALL (Basic Alt 2)	Construct reinforced concrete wall with minimum thickness needed for structural support.
VE PROPOSAL NO.72	Increase thickness of concrete wall to increase long-term reliability. For cost estimating, assume that the wall is 6 inches thicker.
ADVANTAGES	May provide longer design life for containment of contaminated sediments by increasing thickness of concrete cover over the reinforcing steel on the outside face of the wall.
DISADVANTAGES	None.
CHANGE IN COSTS	Construction cost would be higher, based on increase in concrete volume With increased cost, unit cost per cubic yard of storage capacity would be increased.
CONDITIONS	None.
RECOMMENDATION	Evaluate Further. This is revised Alternative 2.

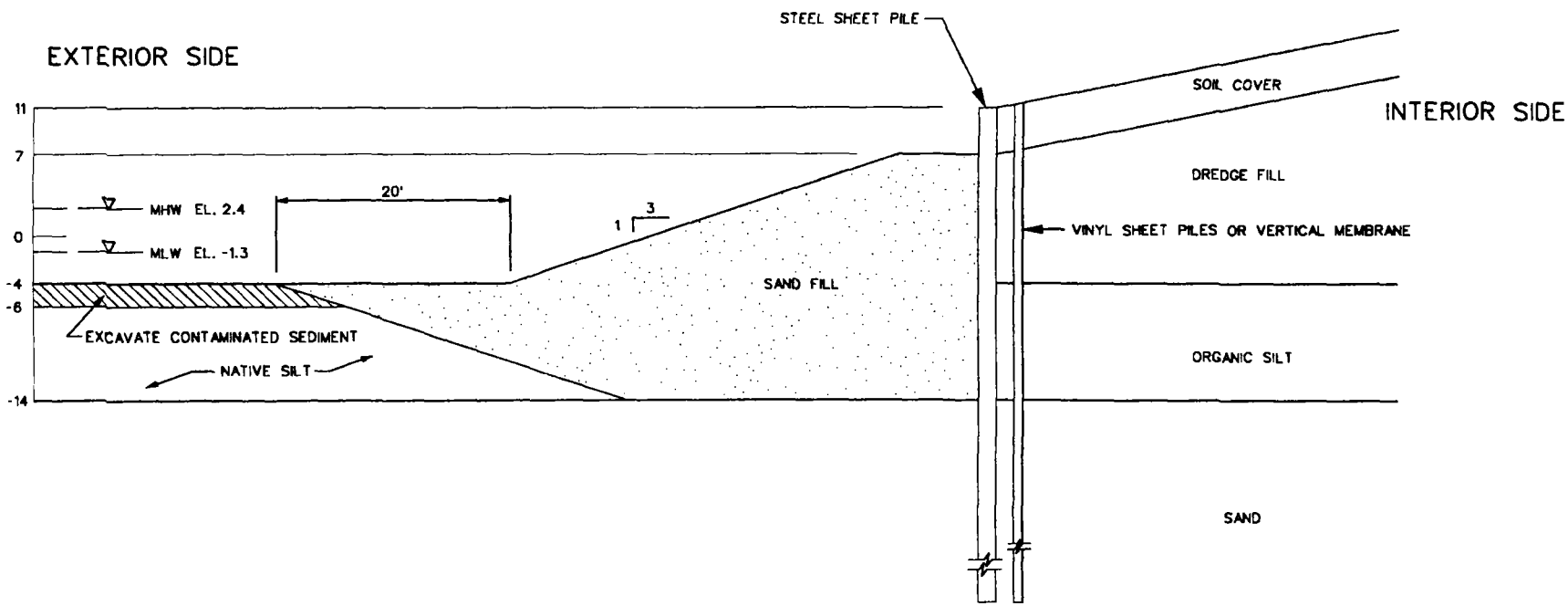
Table 4-8
Sheet Pile Wall With Pipe Piles (Basic Alt 3; VE Proposal 40)

SHEET PILE WALL WITH BATTER PILES (Basic Alt 3)	Use batter piles and horizontal whalers to support steel sheet pile.
VE PROPOSAL NO. 40	Delete batter piles and use combination pipe piles and sheet piles for vertical wall.
ADVANTAGES	Less complicated field construction because pile piles and steel sheet pile are shop fabricated. This eliminates need for field connections between horizontal whalers, batter piles and vertical sheet piles.
DISADVANTAGES	Structural steel wall would have to support very low strength sediment from elevation –14 to 11 feet (25 feet high). This requires extraordinary high wall strength. Long-term reliability limited by corrosion of steel. Even with corrosion protection, corroded steel may require replacement periodically.
CHANGE IN COSTS	Not possible to estimate.
CONDITIONS	Not feasible due to very high bending stresses.
RECOMMENDATION	Eliminate.

It is recommended that this proposal be eliminated. There would be a high cost to build the wall and there would be long-term corrosion of the structural steel exposed to seawater.

Sheet Pile Wall with Exterior Half Dike (VE Proposal 52, 4, 38)

In the VE proposal, the batter piles and horizontal whaler would be replaced with an earth dike on the outside of vertical steel sheet piles. This is referred to as the half dike idea. The method for constructing the earth dike was not specified in the VE workshop. The dike could be built directly over the existing sediments (as in the baseline design), or could be built by first removing the very soft sediment as in Alternative 1C revised with VE proposal 42. Figure 4-7 shows a typical cross-section of the dike and the proposal evaluation is shown in Table 4-9.



SHEET PILE WALL WITH EXTERIOR HALF DIKE

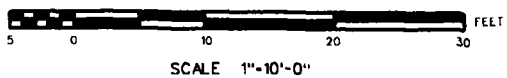


FIGURE 4-7

NEW BEDFORD, MASSACHUSETTS
CONFINED DISPOSAL FACILITY C

SHEET PILE WALL
WITH EXTERIOR HALF DIKE

SCALE: NOTED | ALT4G.DGN

Table 4-9
Sheet Pile Wall With Exterior Half Dike (Basic Alt 3; VE Proposal 52, 4, 38)

SHEET PILE WALL WITH BATTER PILES (Basic Alt 3)	Use batter piles and horizontal whalers to support steel sheet pile.
VE PROPOSAL NO. 52, 4, 38	Delete batter piles and horizontal whalers. Construct earth berm with imported fill on outside of vertical steel sheet pile. Include vertical vinyl sheet piles to provide low-permeability barrier. Note: Method of placing earth dike not specified in VE. For VE evaluation, assume existing very soft clay on outside would be excavated and replaced, using the same section as shown for VE Proposal 42 on Alternative 1C. (another option would be to build Earth Dike on exterior). After installing sheet pile, dredged outside contaminated surface sediment and place inside CDF C. Dredge deeper outside sediment and place inside along sheet pile. Place imported fill along outside of sheet pile.
ADVANTAGES	Outside berm provides reliable long-term support and eliminates corrosion concerns. Berm could be built with standard construction methods. Avoids re-handling of surface contaminated sediment, since it can be placed directly into the CDF, rather than in a temporary upland cell. Allows start of production dredging once all sheets and side wall liner are in place.
DISADVANTAGES	May not be possible to build outside berm full height due to limited sheet pile strength and inside support. If so, would need to place dredged material on inside of sheets to provide support.
CHANGE IN COSTS	Construction cost would be less, based on elimination of whalers and batter piles and addition of outside dike. With reduced cost, unit cost per cubic yard of storage capacity would be reduced.
CONDITIONS	Same as disadvantages.
RECOMMENDATION	Evaluate further.

The slope stability of this proposal was analyzed using the computer program UTEXAS3 for the option with the dike built as in the baseline design. As described in the baseline, the rate of building the outside dike and the rate of placement of the contaminated dredged material would be limited by the rate of strength gain of the native sediment. The earthen portion would have to be built in stages and the interim cover and temporary surcharge could not be placed until sediment has consolidated and gained shear strength.

A unique advantage of this alternative would be that once the sheeting has been installed, contaminated sediments could partially fill the CDF even before the exterior half dike has been fully constructed, allowing the earliest start of production dredging of all the alternatives.

For evaluation of this proposal, it is assumed that the sequence of construction would be as follows:

- Install vertical sheet pile along the dike centerline.
- Install impermeable liner on the inside of the sheet piles.

- Dredge near-surface contaminated sediment outside the sheet piles and place sediment directly inside the sheet pile (unlike other alternatives, the sediment would not have to be placed into a temporary upland disposal area).
- Starting from both ends, dredge low-strength organic sediment below cleanup levels along the outside of the sheets. Sediment would be disposed off-site or by another means.
- Place imported fill along the outside of the sheet piles.
- Continue placing contaminated sediment inside the sheet piles concurrent with dike construction.

Further evaluation of this proposal is recommended with the earth dike built to elevation 7 feet and the top of the sheet pile at elevation 11 feet, which is VE proposal 90. This is the revised alternative that will be used in the alternative comparison in this Technical Memorandum. The presence of the outside berm eliminates corrosion concerns with the steel. Once filling and consolidation of the fill has occurred, the dredged material will be stable without considering the strength of the piles above the elevation of the existing sediment. Therefore, if the steel deteriorates, the CDF will be stable and provide reliable long-term containment. In reality, steel will corrode very slowly when buried in soil.

Earth Dike Alternative with Sheet Pile in Upper Dike (VE Proposal 90)

VE proposal 90 is the concept of using vertical sheet pile for the temporary portion of the dike from elevation 7 to 11 feet, and is described above under the Earth Dike alternative. This proposal would be used with the half dike proposal, so that the half dike would be built with earth up to elevation 7 feet. The steel sheet pile would serve as the temporary dike from elevation 7 to 11 feet.

This proposal has been evaluated further along with the Sheet Pile Wall with Half Dike Alternative.

4.6 General VE Proposals

There are two groups of VE proposals that apply to the design of CDF C and are not specific to any dike alternative. The first is VE proposal 51, which is the concept of using dredged materials to build a portion of the dikes. The proposal evaluation is shown in Table 4-10.

It is recommended that VE proposal 51 be eliminated for CDF C. The dike for CDF C would be the first construction task implemented and there would be no specialized dredging equipment suitable for handling contaminated sediment on site when the dike construction is started. Therefore, a separate mobilization would be required to provide dredged material. The dike needs to be constructed from sand and gravel type material, while the native sediments in the Upper Harbor are predominately fine-grained material which is not suitable for dike construction.

VE proposals 37 and 47 are the concept of eliminating an impermeable liner between the existing debris cell dike and the new portion of CDF C. The proposal evaluation is shown in Table 4-11.

It is recommended that VE proposal 37, 47 be eliminated from further consideration. Without the impermeable side wall liner, there would be a potential high permeability soil providing a pathway for upland groundwater to flow into CDF C. This would increase the potential for long-term migration of contaminated leachate out of CDF C.

Table 4-10
VE Proposal 51

GENERAL	Build dike with imported material.
VE PROPOSAL NO. 51	Use dredge materials to build part of dikes
ADVANTAGES	Reduce construction costs
DISADVANTAGES	Requires proper types of material to make dike stable and would need to coordinate dike schedule with dredging schedule. Would require dredge equipment to be mobilized and operating at the site at the same time or before dike construction.
CHANGE IN COSTS	Not evaluated.
CONDITIONS	None.
RECOMMENDATION	Eliminate. Granular dredged material not available when needed for CDF C dike and would require early mobilization of dredging equipment to the site.

Table 4-11
VE Proposal 37, 47

GENERAL	Place impermeable geomembrane liner on existing dike in northwest portion of CDF C.
VE PROPOSAL NO. 37, 47	Delete geomembrane liner on west portion of CDF C.
ADVANTAGES	Reduction in construction cost.
DISADVANTAGES	Provide potential drainage path for upland groundwater into CDF C.
CHANGE IN COSTS	Not evaluated.
CONDITIONS	None.
RECOMMENDATION	Eliminate. This would increase potential for long-term migration of upland groundwater into contaminated sediment.

Fill Earth Dike CDF as Dike is Built Above Water Level (VE Proposals 46, 50)

In this proposal, contaminated dredged material would be placed on the inside of the dike concurrent with dike construction. This would allow dredging to start before all of the time has elapsed to complete the dike in stages. With this proposal, it would be possible to eliminate the inside toe buttress, which would decrease the cost of the dike and increase disposal capacity by approximately 5,000 cy.

The liner must be placed on the inside of the dike prior to placing contaminated sediment. In order to implement this proposal, it would be necessary to construct the liner in at least two stages. After the lower stages were constructed, placement of contaminated sediment could start. The proposal evaluation is shown in Table 4-12.

The decision to use this alternative depends on the schedule of the overall project, which is not known at this time. Therefore, it is recommended that flexibility be designed into the CDF C dike. The design could be done to show two-stage liner installation, so that it would be possible to implement this proposal, if it helped reduce the overall project schedule. The liner could be installed in one stage, if two-stage installation were not necessary.

Table 4-12
CDF With Earth Dike And Filling As Dike Is Built (VE Proposals 46, 50)

GENERAL (All Alternatives)	Build dike with 3H:1V side slopes on outside and outside. Build 20 foot wide toe buttresses on inside and outside.
VE PROPOSAL NO. 46 and 50	Place contaminated sediment on inside of dike concurrent with dike construction, rather than waiting until dike is built to design elevation of 11 feet.
ADVANTAGES	Allows earlier start of contaminated sediment dredging, which reduces overall project schedule and costs.
DISADVANTAGES	Requires 2-stage placement of inside impermeable liner and addition of horizontal seam along length of dike.
CHANGE IN COSTS	Additional costs for 2 stage liner placement. Reduction in cost if used with VE Proposal 45 to eliminate inside dike buttress and steepen inside slope. Potential savings in overall project due to lower inflation effects and reduced management costs with shorter overall schedule.
CONDITIONS	Requires coordination with dredging schedule and other CDF construction
RECOMMENDATION	Implement during final design. Design dike to give project management team flexibility with the option to start placing contaminated sediment before dike is built to final height. Show design for 2-stage impermeable liner installation and give minimum dike elevation needed before starting dredging.

5.0 EVALUATION OF REVISED ALTERNATIVES

5.1 Introduction

This section evaluates the Basic Alternatives as modified by the recommended Value Engineering proposals from Chapter 4. The set of proposals carried forward are hereinafter referred to as Revised Alternatives. The result of this evaluation is the selection of a preferred alternative.

5.2 Revised Alternatives

The Revised Alternatives are:

Earth Dike With Vinyl Sheet Pile (Revised Alt 1A Figure 4-1)

Basic Alt 1A revised to incorporate the VE recommendation to lower dike fill elevation to +7.0 MLW and restore overall structural top elevation to +11.0 MLW by placing vinyl sheet pile in dike.

Earth Dike With Sediment Displacement (Revised Alt 1B Figure 3-2)

No VE recommendations were deemed appropriate for incorporation in this Alternative. For uniformity, this alternative will be called "Revised Alt 1B"

Earth Dike and Place Fill Within Sloped Excavation (Revised Alt 1C Figure 4-4)

Basic Alt 1C revised to incorporate the VE recommendation to delete the use of sheet piling to retain soft sediments outside dike foundation.

Pile Supported Concrete Retaining Wall (Revised Alt 2 Figure 3-4)

Basic Alt 2 revised to incorporate the VE recommendation to increase the thickness of the concrete stem wall to insure required longevity.

Sheet Pile Wall With Exterior Half Dike (Revised Alt 3 Figure 4-7)

Basic Alt 3 revised to incorporate the VE recommendations to replace batter pile with a half dike, and to lower dike fill elevation to +7 MLW with steel piling providing the required structural top elevation of +11.0.

Revised Alt 4 Will not be created since Basic Alt 4 (deepening inside the CDF) was eliminated.

5.3 Discussion

All of the Revised Alternatives brought forward to this point meet the basic objectives stated in Section 1.1. To determine preferred alternatives, alternatives are compared using other evaluation and design criteria. These are: (a) construction cost per cubic yard of disposal capacity; (b) construction schedule; (c) long term reliability; (d) short term environmental impacts; and (e) constructability. Of these criteria, construction cost and constructability have uncertainties which can be reduced during final design. However, these cannot be completely eliminated due to the nature of the site.

Earth Dike With Vinyl Sheet Pile (Revised Alt 1A Figure 4-1)

This alternative reduces the imported material volume versus Earth Dike With Sediment Displacement or Earth Dike and Place Fill Within Sloped Excavation and adds the cost of the vinyl sheet piles. Since the fill is imported in lifts and must consolidate between each lift, this alternative has a long construction schedule. There is uncertainty in the construction time because the actual consolidation time between placing fill stages can be estimated during design but not actually determined until settlement monitoring during construction. There is a greater difficulty in construction, since marine equipment must be used.

Earth Dike With Sediment Displacement (Revised Alt 1B Figure 3-2)

This alternative requires no consolidation delays. Thus this alternative will, along with Sheet Pile Wall With Exterior Half Dike, have the shortest construction schedule. While the footprint of the dike is similar to Earth Dike With Vinyl Sheet Pile, the disposal capacity is reduced by the displacement of soft material (mud wave) to the inside of the dike and the disposal of contaminated pre-dredge material expected to be on the outside. Constructability is simpler, as land-based equipment can be used.

Earth Dike and Place Fill Within Sloped Excavation (Revised Alt 1C Figure 4-4)

This alternative requires no delay for consolidation, and will have a slightly longer construction period to perform the excavation prior to fill placement. While the footprint of the dike is similar to the Earth Dike alternative, the disposal capacity is reduced by placing excavated contaminated sediment inside the dike. Constructability is mixed, as marine equipment will be required for the excavation, while land-based equipment can be used to place the fill.

Pile Supported Concrete Retaining Wall (Revised Alt 2 Figure 3-4)

This alternative requires no delay for consolidation, but because of the specialized system of cast-in-place caps and walls, and the requirement that a cofferdam be constructed and dewatered, it is anticipated to have the longest construction period. Since this is a structural solution which has a small footprint, this alternative has the maximum potential capacity. Special construction techniques will be required, including the use of marine equipment, and the installation of a temporary cofferdam. These will drive up the costs of this. This alternative has much lower long-term reliability due to the degradation of concrete exposed to seawater. Even with the use of special additives in the concrete and expoxy coatings on the reinforcing steel, the wall will degrade and require periodic maintenance and future replacement.

Sheet Pile Wall With Exterior Half Dike (Revised Alt 3 Figure 4-7)

This alternative does not have waiting times for subsurface sediment consolidation for dike support, and the construction period is more controllable than the Earth Dike. As a partial structural solution, the footprint for this alternative will be about half that for the other earth dike alternatives, with the result this alternative has a comparably high capacity. Construction of the sheet pile wall will require marine equipment; however, the fill can be accomplished with land-based equipment. Further, once the sheet piling is in place, this alternative will allow disposal of contaminated material from alongside the dike as well as from a production dredge in the harbor, and thus will allow the earliest start of production dredging of all the alternatives. While more expensive than the Earth Dike With Vinyl Sheet Pile alternative, this alternative has one of the lower unit cost per cubic yard of disposal capacity. An uncertainty in the cost is the disposal of silt/clay excavated beneath the dike.

Table 5-1 summarizes the Baseline and five Revised Alternatives, their benefits, disadvantages, constraints, capacity, schedule, cost, and cost per yard disposed.

Preferred Alternative

The Earth Dike With Vinyl Sheet Pile has lower cost, capacity and construction time than the Baseline Earth Dike alternative. Therefore, the Earth Dike With Vinyl Sheet Pile is the revised baseline. The other revised alternatives are compared to the Revised Baseline for selection of the preferred alternative. This is also called Revised Alternative 1A and a cross-section is shown on Figure 4-1.

The Earth Dike with Sediment Displacement (Revised Alt. 1B) is not recommended. This alternative has the lowest disposal capacity and the highest short-term water quality impact. There is uncertainty in the actual disposal capacity since the volume of sediment displaced will not be known until construction. There will be unknown conditions in the mixture of imported sand and native organic silt below the dike, which makes the actual long-term stability and reliability uncertain.

The Earth Dike and Place Fill Within Slope Excavation (Revised Alt. 1C) is not recommended. This alternative has high total cost and the highest unit cost per cubic yard of disposal capacity. A major component of cost is off-site disposal of native organic silt with PCB concentration less than cleanup levels. For this evaluation, it is assumed that this material would be taken to an off-site solid waste landfill.

The Pile Supported Concrete Wall Retaining Wall (Revised Alt. 2) is not recommended. This alternative has the longest construction schedule and the highest cost. The duration and cost are impacted by the difficulty of constructing the pile cap and lower portion of the retaining wall below low tide elevation.

This alternative has the lowest long-term reliability due to concrete and internal reinforcing steel degradation.

Sheet Pile Wall With Exterior Half Dike (Alternative 3 shown on Figure 4-7) is the preferred alternative. This alternative offers a more controllable construction period, eliminates the need for temporary upland storage of contaminated dredged material, and offers the earliest start of production dredging in the upper harbor of all the alternatives considered. This alternative can be constructed with conventional marine and upland construction methods, although as with all alternatives special shallow-draft marine barges will be required. This alternative can also provide one of the highest disposal capacities.

Although total cost is higher than the Revised Baseline alternative, the unit cost per cubic yard of disposal can be one of the lowest depending on the disposal of the excavated silt/clay. The cost shown in Table 5-1 is based on the assumption that approximately 30,000 cubic yards of native sediment with PCB concentrations less than the cleanup level would be taken to an off-site solid waste landfill for disposal. Should the material need to be disposed off-site in a TSCA landfill, the cost would increase substantially. This is a major element of the cost, that would be significantly lower if this sediment can be kept within the CERCLA site. The native silt has high water content and low strength, so would not be suitable for dike construction. However, this sediment could be used for interim cover over contaminated sediment or potentially could be placed over the outside portion of the dikes for benthic habitat restoration.

The preferred alternative provides reliable long-term containment of contaminated dredged material because the steel sheet pile is not needed for long-term stability. In other words, even if the sheet pile corrodes and has no strength, the dredged material will be contained by the earth dike.

The sheet pile must be designed to resist different lateral loads during different stages of construction. It is not feasible to analyze all loading cases during the conceptual engineering work done for this evaluation of alternatives and Value Engineering Proposals. As stated above, no sheet pile strength would be needed in the long-term condition. Three temporary cases are (1) after dredging native organic silt on the outside of the sheet piles so that the sheet pile must support the inside silt, (2) after placement of the exterior dike with no dredged material on the inside of the sheets, and (3) after placement of interim cover and 5 feet of temporary fill to surcharge the dredged material for consolidation settlement. Foster Wheeler completed preliminary analysis of cases (1) and (3). Our analysis indicated that heavy US-made "Z-shaped" sheet piles will provide sufficient strength (i.e. bending moment capacity). Based on analyses to date, all contaminated dredged material could be placed without waiting periods. It may be necessary to wait for some consolidation strength gain before placing the final cover and/or temporary surcharge. It may be necessary to place dredged material on the inside of the sheet piles before completing the upper portion of the exterior dike. This would have to be done after the impermeable side wall liner is in place. This side wall liner for this alternative has not been analyzed for this concept. This will not impact the overall project schedule because the upper portion of the dike will be constructed with conventional upland earth work equipment.

Table 5-1.
Alternative and Value Engineering Proposal Summary

	Baseline – Earth Dike (Fig. 3-1)	Revised Baseline – Earth Dike With Vinyl Sheet Pile (Fig. 4-1 Alt 1A)	Earth Dike with Sediment Displacement (Fig. 3-2 Alt.1B)	Earth Dike and Place Fill Within Sloped Excavation (Fig. 4-4 Revised Alt. 1C)	Revised Pile Supported Concrete Retaining Wall (Fig. 3-4 Alt. 2)	Sheet Pile Wall With Exterior Half Dike (Fig. 4-7 Alt. 3)
Value Engineering Proposal Applied	NA	Vinyl sheet pile on top 4 feet.	None.	Eliminate sheet pile.	Thicken concrete.	Replace batter piles with half dike.
Features	Geotextile Wick drains Multiple stage dike placement.	Geotextile Wick drains Multiple stage dike placement. Vinyl sheets.	Pre-dredge contaminated sediment. Fill from land to displace very soft silt.	Pre-dredge contaminated sediment. Replace very soft silt with fill.	Temporary sheet pile. Pile-supported, reinforced concrete slab, grade beam and wall.	Sheet pile. Dredge contaminated sediment. Replace very soft silt. Fill outside dike.
Benefits	No disturbance to contaminated sediments under dike. Reliable long-term containment.	Same as Baseline.	Conventional construction from land. Reliable long-term containment.	Conventional construction with floating equipment. Reliable long-term containment.	No disturbance to contaminated sediments under wall.	Drive sheet piles first, allows early start. Contaminated sediment can be placed directly into CDF. Conventional construction with floating equipment. Reliable long-term containment
Disadvantages	Special construction to place geotextile and initial lifts of dike fill.	Same as Baseline.	Short-term water quality impacts. Not possible to predict displacement volume. Unknown conditions under dike after filling.	More short-term water quality impacts than Baseline.	Degradation of concrete. Special construction to build slab and grade beam over very soft sediments below water level.	Limited differential fill height along sheet pile. Need to place fill inside concurrent with dike placement (or add batter piles).
Constraints	Consolidation time between fill stages.	Same as Baseline.	Requires conservative stability design due to unknown conditions.	Need to find place for dredged sediment with chemical concentrations below cleanup levels.	Need to treat water pumped out to build grade beam.	Need to find place for dredged sediment with chemical concentrations below cleanup levels
Disposal Capacity	71,000 cy	75,000 cy and possibly up to 113,000 cy	55,000 cy	69,000 cy	115,000 cy	100,000 cy (disposal dependent)
Construction Schedule	16-18 months	14 months	10 months	10 months	28 months	10 months
Construction Cost	$ 8,709,000	$ 8,050,770	$ 5,867,047	$ 12,440,000.	$ 13,497,709	$ 11,339,000
Cost / disposal volume.	$ 122.	$ 107 or less	$ 107.	$ 180.	$ 117.	$ 113 +/-

6.0 ALTERNATIVE EVALUATION AND VALUE ENGINEERING TEAM STUDY – SUMMARY OF PROPOSALS

6.1

Six design concepts and 17 VE proposals for CDF alternatives or ways to improve the CDF design for CDF C were evaluated in this Technical Memorandum. Of the alternatives evaluated four were shown to provide potential cost savings of $650,000 to $3,200,000 in construction cost and $31 per c.y. to $9 per c.y. savings in cost for sediment disposal. The preferred alternative, the sheet pile wall with exterior half dike could result in $900,000 in savings for the increased capacity and lower cost per cubic yard of storage.

These alternatives and the savings are summarized in Table 6-1.

Table 6-1
Confined Disposal Facility C Off Shore Containment Dike

Alternative Evaluation And Value Engineering Team Study

Summary of Proposals

Proposal Designation	Description	Potential Cost Savings
Baseline Alternative 1A	Earth Embankment Capacity = 71,000 c.y.	Baseline Construction Cost = $8,709,000 Cost per c.y. for Disposal = $122
Alternative 1B	Fill and Displace Subgrade Sediment Capacity = 55,000 c.y.	Construction Cost = $5,524,000 Potential Savings = $3,185,000 Cost per c.y. for Disposal = $100
Revised Baseline Alternative 1A	Earth Embankment With Vinyl Sheet Pile Capacity = 75,000 c.y.	Construction Cost = $8,050,770 Potential Savings = $658,230 Cost per c.y. for Disposal = $107
Alternative 2	Pile Supported Concrete Wall Capacity = 115,000 c.y.	Construction Cost = $10,471,711 Cost per c.y. for Disposal = $91
Alternative 3	Sheet Pile Wall With Exterior Half Dike Capacity = 100,000 c.y.	Construction Cost = $11,339,000 Cost per c.y. for Disposal = $113 Savings for Increased Capacity = $900,000

7.0 REFERENCES

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APPENDIX A
CDF-C
DESIGN CRITERIA OUTLINE

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

TASK ORDER NO. 017, OPERABLE UNIT #1
CONFINED DISPOSAL FACILITY C
DESIGN CRITERIA OUTLINE
NEW BEDFORD HARBOR SUPERFUND SITE
New Bedford, Massachusetts

May 2000

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

2000-17-0158
07/10/00

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Revision	Date	Prepared By	Approved By	Pages Affected
0	7/10/2000	A. Ikalainen, P.E. Project Engineer	G. Willant Project Manager	All

2000-17-0158
07/10/00

USACE CONTRACT NO. DACW 33-94-D-002
T.O. NO. 17, OPERABLE UNIT #1
CONFINED DISPOSAL FACILITY C

DESIGN CRITERIA OUTLINE

1.0 DESIGN PURPOSE AND LIFE 1
- 1.1 Excerpts from Record of Decision – September 1998 1
- 1.2 Exerpts from Proposed Cleanup Plan – Upper & Lower New Bedford Harbor – November 1996 4
- 1.3 Excerpts from Scope of Work – Revised October 14, 1998 - USACE Remedial Design of New Bedford Harbor Superfund Site 4
- 1.4 Excerpts from USACE Draft Engineering Guidance for Scope of Work Dated 14 October 1998 for Remedial Design of New Bedford Harbor Superfund Site ..... OU #1 Upper and Lower Harbor 13 November 1998 6

2.0 DESIGN OBJECTIVES AND CRITERIA 7
- 2.1 Excerpts from Foster Wheeler Remedial Design Work Plan 7
- 2.2 CDF C Design Concept (March 2000) 13

3.0 REGULATORY REQUIREMENTS FOR CDF DESIGN 16
- 3.1 Fish and Wildlife, Endangered Species, and Cultural and Historical Resources 16
- 3.2 TSCA Design Standards 16
- 3.3 Massachusetts Solid Waste Management Facility Design Standards 17
  - 3.3.1 CDF Cover Systems 18
  - 3.3.2 Stormwater Controls 18
  - 3.3.3 Surface Water and Groundwater Protection 19
  - 3.3.4 Air Quality Protection Systems 19
  - 3.3.5 Groundwater, Surface Water, and Gas Monitoring Systems 19
  - 3.3.6 CDF Operation and Maintenance 20
  - 3.3.7 Environmental Monitoring 21
  - 3.3.8 Maintenance of Environmental Control and Monitoring Systems 22
  - 3.3.9 CDF Closure 22
  - 3.3.10 CDF Post-Closure 22
  - 3.3.11 CDF Post-Closure Use 23
- 3.4 Clean Water Act - Section 404 & Rivers and Harbors Act Requirements 23
- 3.5 Erosion and Sedimentation Control Plan 23
- 3.6 Stormwater Management Plan 24
- 3.7 NPDES Stormwater Discharge Requirements 24
- 3.8 Massachusetts Stormwater Management Policy 24
- 3.9 Air Monitoring and Fugitive Emissions Control 25
- 3.10 Wetlands Protection Requirements 25
- 3.11 Waterways Regulations 25
- 3.12 Water Quality Certification 26
- 3.13 Massachusetts Coastal Zone Management Program (MCZM) 26
- 3.14 Compliance with Project Decision Documents 26
- 3.15 Regulatory Assumptions 29

1.0 DESIGN PURPOSE AND LIFE

1.1 Excerpts from Record of Decision – September 1998

- Remedy is a hybrid of FS Alternatives #3 and #8.
- Dredged sediments will be placed in four shoreline confined disposal facilities (CDFs) (Figures 21a, b).
- Upon reaching storage capacity, first an interim and then a final cap will be installed at each CDF.
- Sidewalls of CDFs wili be lined with a synthetic impermeable material, but not the bottom of the CDFs.
- Each CDF will include a perimeter groundwater monitoring program to verify that they are operating safely.
- Once the CDFs have been filled with sediment, an interim cap (approx. 6 inches of soil or sediment) will be installed to prevent escape of PCB-dust or PCB volatilization (X.E).
- It is anticipated that approximately three years of sediment consolidation will be required before final capping.
- Once the dredged sediment and interim caps have sufficiently consolidated, the final impermeable CDF caps can be constructed. The caps will consist of three layers to promote surface drainage, prevent infiltration, allow collection and venting of any gas emissions (X.F).
- The selected remedy attains or appropriately waives ARARs.
- State of Massachusetts through its concurrence on the ROD agrees the remedy is properly managed under TSCA and CERCLA.
- EPA is using TSCA chemical waste landfill standards to design CDFs in the most protective manner possible.
- TSCA chemical waste landfill standards, such as hydrogeological conditions, leachate collection and bottom liner requirements… will be waived under TSCA.
- Conceptual CDF designs do include the sediment underlying the CDFs and a cover system both of which meet a drainage impermeability of 10^{-7} cm/sec.
- The CDF concept also includes groundwater, surface water and air emission monitoring during operation closure, post closure and erosion and stormwater drainage controls.
- Toxicity characteristic (TC) constituent concentrations are below TC regulatory limits for hazardous waste therefore sediment disposal is subject to MA solid waste management regulations. The substantive requirements of the MA SWM regulations that are more stringent than TSCA regulations for liners covers, monitoring or post closure will be followed.

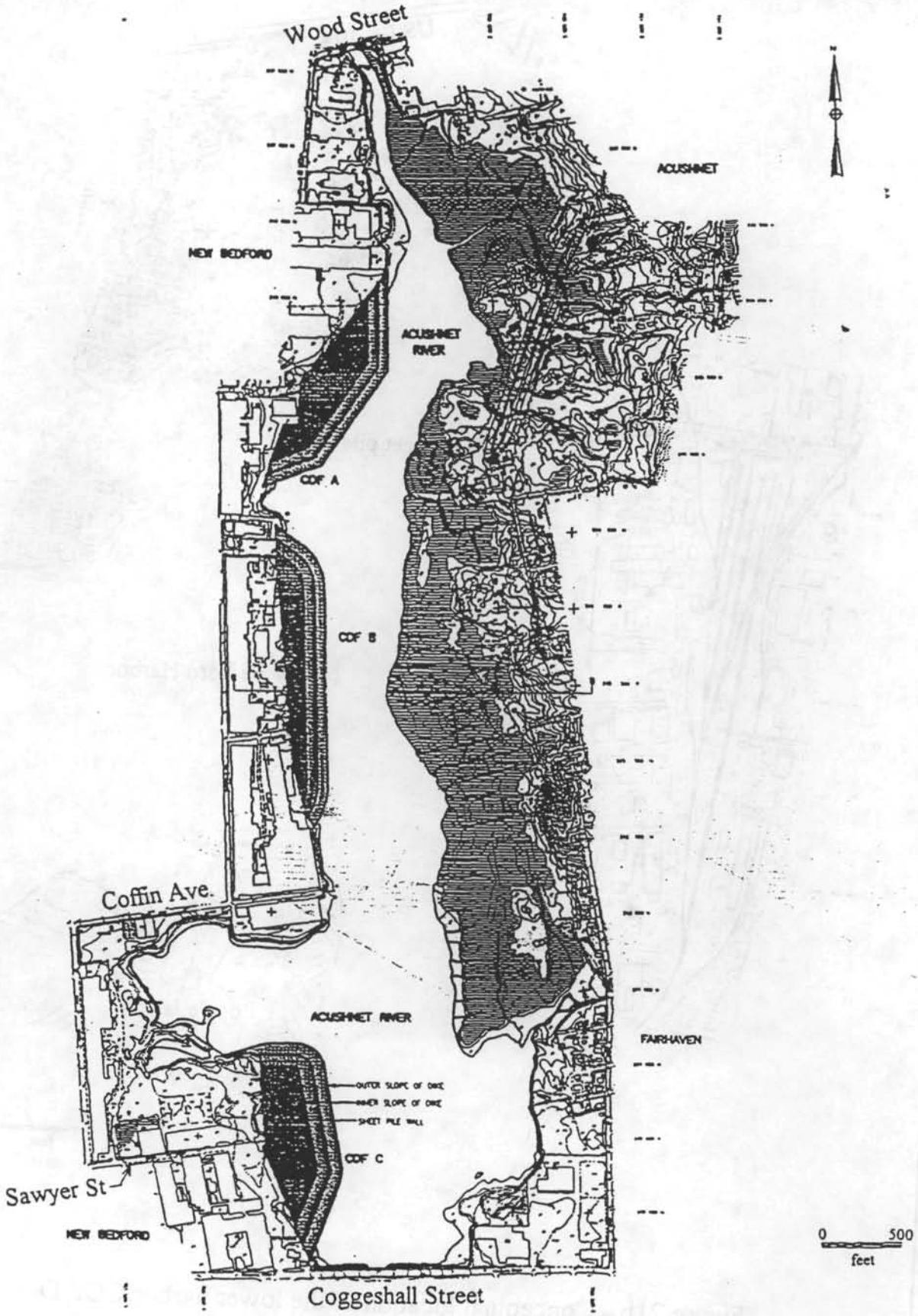


Figure 21a - Conceptual locations of upper harbor CDFs A, B and C
New Bedford Harbor Superfund Site, ROD 2

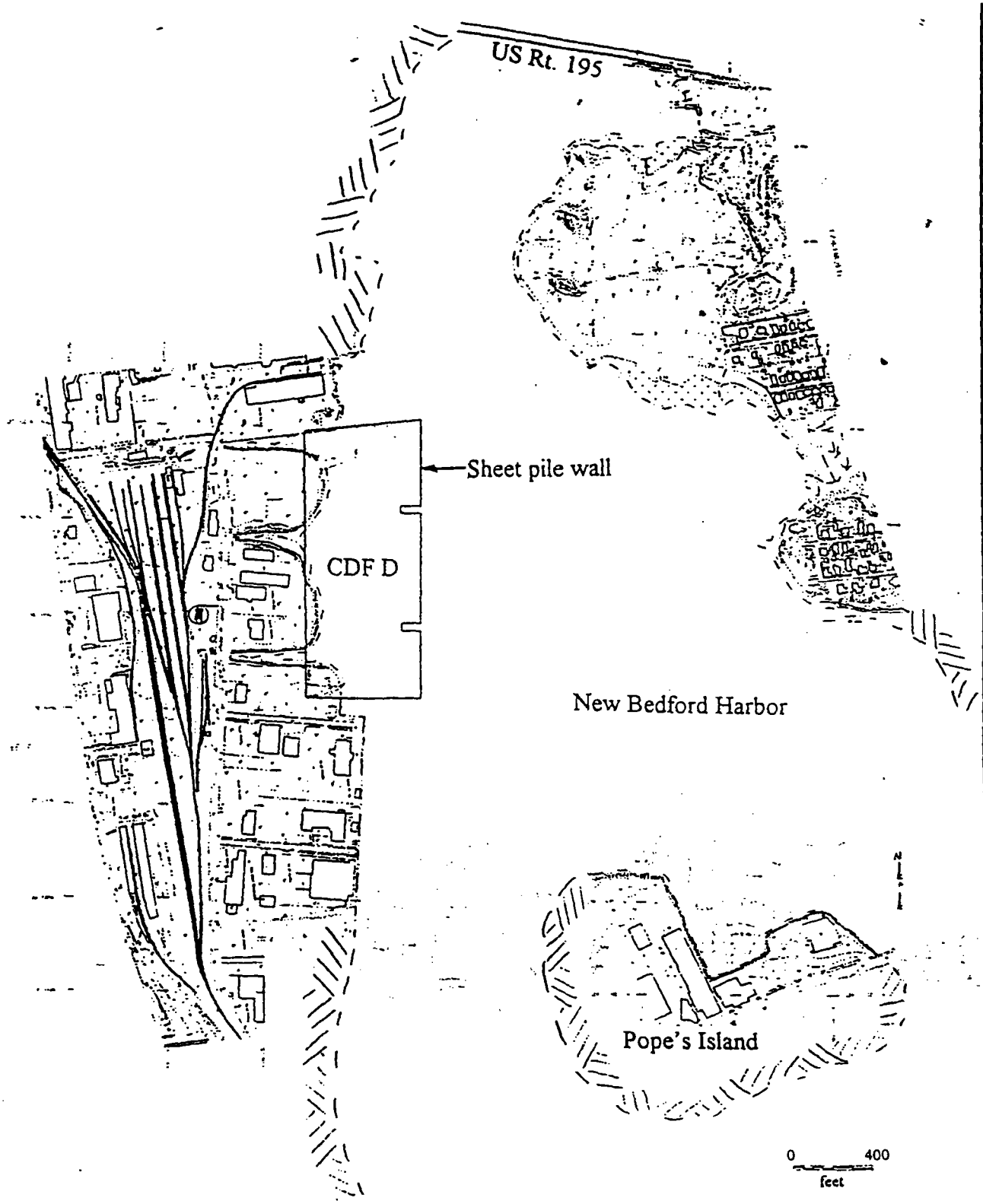


Figure 21b - Conceptual location of the lower harbor CDF D
New Bedford Harbor Superfund Site, ROD 2

- The selected remedy permanently isolates sediments from human and environmental receptors by containing them in shoreline CDFs in perpetuity in a safe and protective fashion.

1.2 Exerpts from Proposed Cleanup Plan – Upper & Lower New Bedford Harbor – November 1996

Construction of CDFs and Water Treatment Facilities

- First step in cleanup process is to design and construct the CDFs and associated water treatment facilities. Dredged contaminated sediments will then be piped into the CDFs and passively dewatered.

- The sidewalls of these CDFs will be lined with a synthetic impermeable material, but not the bottom of the CDFs, since a) the existing sediments in these areas are very low in permeability, b) the integrity of a man-made impermeable liner constructed in saturated conditions can't be guaranteed, c) the dredged sediments themselves will form into a highly impermeable product. Computer modeling indicates that long-term worst case PCB leakage rates from the CDFs would be at least 98 percent lower than the current rate of PCBs in the water fluxing seaward at the Coggeshall Street Bridge. Each CDF will include perimeter groundwater monitoring wells in order to verify that they are operating safely.

1.3 Excerpts from Scope of Work – Revised October 14, 1998 - USACE Remedial Design of New Bedford Harbor Superfund Site

OU #1 Upper and Lower Harbor

Task # 1 Work Plan For Remedial Design

Confined Disposal Facilities (CDFs)

- The location of the four CDFs are shown in the Record of Decision.

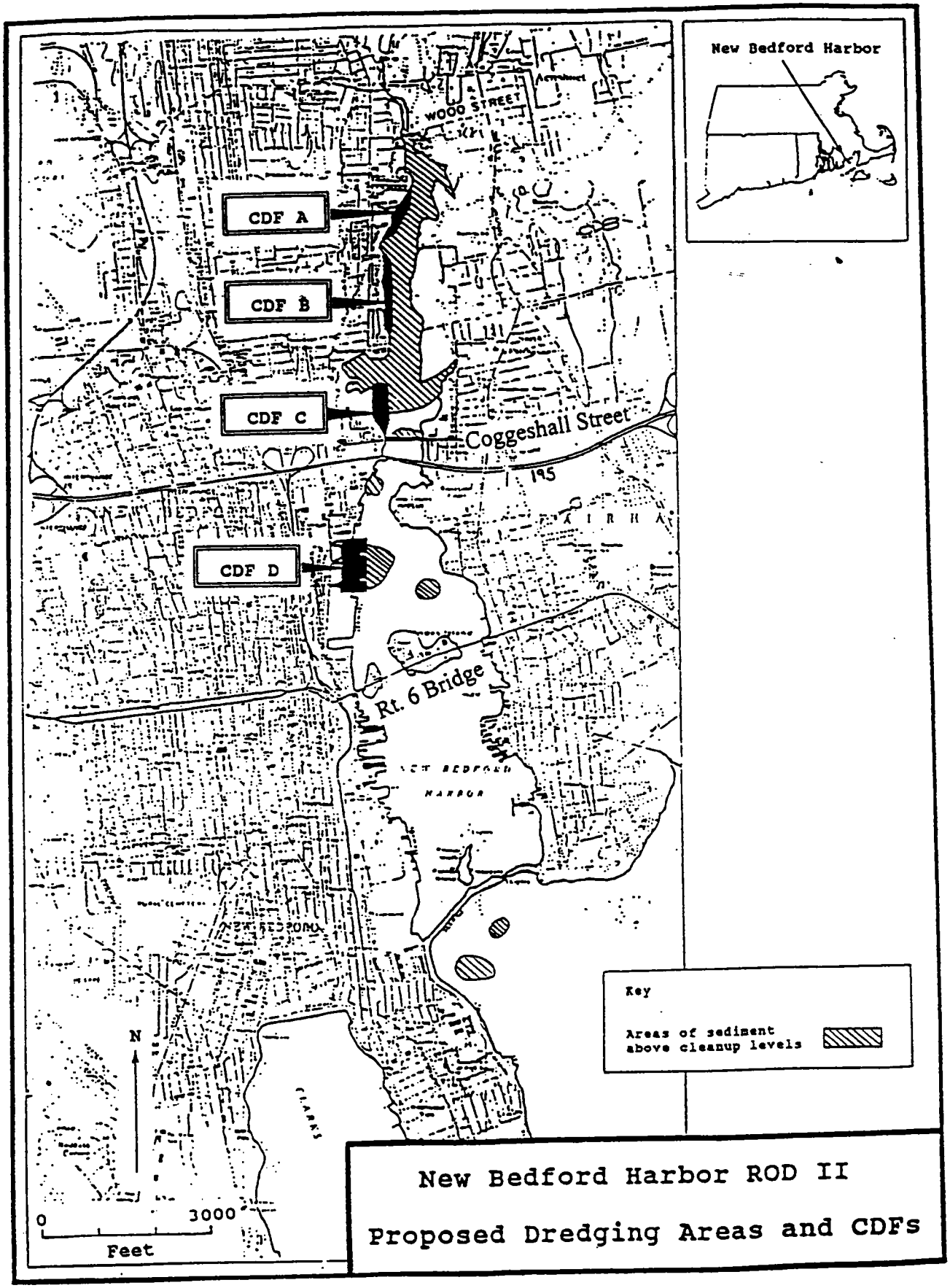
- The design of the first CDF should proceed to allow for the initiation of remedial dredging as soon as reasonably possible.

- One design challenge regarding the CDFs will be the control of PCB volatilization.

- The contractor shall evaluate airborne PCB control methods for the CDFs including floating covers, using foam and division of the CDFs into smaller cells.

- Once the CDFs are full, first an interim and then a final cap will be required. The purpose of the interim caps is to minimize infiltration and prevent escape of PCB laden dust while the underlying dredged sediment consolidates.

- An important element of the final cap design will be the beneficial reuse of the completed CDFs. Potential reuse possibilities for the three upper harbor CDFs include shoreline bird sanctuaries, parks or athletic fields.



New Bedford Harbor ROD II

Proposed Dredging Areas and CDFs

1.4 Excerpts from USACE Draft Engineering Guidance for Scope of Work Dated 14 October 1998 for Remedial Design of New Bedford Harbor Superfund Site OU #1 Upper and Lower Harbor 13 November 1998

1. The remedial design shall be accomplished in accordance with the Record of Decision dated 25 September 1998 and shall be prepared in compliance with all applicable Federal, State and local laws and regulations.

2.5.1 Remedial Design Objectives

Confined Disposal Facilities A, B and C

Foster Wheeler shall be responsible for developing a SOW for one geotechnical exploration and laboratory testing program to develop safe and economical dike and sheet pile wall sections, interim and permanent cover designs and dewatering systems for CDFs A, B and C.

Lessons learned and experience gained from the design, construction and use of the pilot study CDF shall be fully utilized in writing the Scope for the program.

2.5.2 Safe and economical sections for CDFs A, B and C shall be designed in accordance with the lessons learned and experience gained from the design, construction and use of the pilot study CDF, TM 5-818-8 Engineering Use of Geotextiles, EM 1110-2-1913.

Design and Construction of Levees and EM 1110-2-5027
Confined Disposal of Dredged Material

Consideration should be given to excavate/replace dike sections where the soft contaminated foundation materials are thin. New and innovative dike sections should be considered if it appears they are safe and economical. Methods of dewatering and consolidation of the sediments will also need to be explored.

2.5.3 Sheet Pile Wall Design

The landside feature of CDFs A, B and C is proposed to consist of sheet pile walls. Foster Wheeler is responsible to design the sheet pile wall sections, connections, and installation procedures for all three of these CDFs. The steel sheet pile walls shall be designed in accordance with the lessons learned and experience gained from the design, construction and use of the pilot study CDF, EM 1110-2-2504 and the current Corps of Engineers Guide Specification for steel sheet piling. The sheet pile walls shall be protected against corrosion commensurate with the appropriate design life for hazardous waste CDFs.

2.5.4 Interim and Permanent Cover Design

Design safe and economical interim and permanent caps for CDFs A, B and C that meet the requirements of ROD Sections X.E and X.F.

2.0 DESIGN OBJECTIVES AND CRITERIA

2.1 Excerpts from Foster Wheeler Remedial Design Work Plan

CDF C will consist of an approximate 6 to 8 acre near-shore facility to be located along the west shore of the Acushnet River, immediately north of the existing Coggeshall Street Bridge embankment, as shown on Figure 2-2. The facility will be located adjacent to an active gasoline service station and a combination of operating and abandoned manufacturing buildings along the shore. The Hot Spot operable unit and pilot dredging disposal facility are located within the northern portion of the CDF C site. The shoreline wall of the CDF will be placed outside the Hot Spot CDF which will be used as a settling basin for dredging discharge water after flowing out of the CDF. The existing Pilot Dredging CDF dike will be graded and sloped to accommodate the CDF C sidewall liner. The preliminary sidewall design will determine if a sheet pile wall is needed in this location. In accordance with the conceptual design defined in the ROD for OU#1, containment will be provided by a combination of a steel sheet pile wall along the shore and an earthen dike constructed within the river, combined with a liner along the interior sides of the facility, as shown in Figure 2-3 (both the inboard dike slope and the existing sloped shoreline, up to the proposed sheeting). The liner will extend up the sheet pile wall if the water or dredged material comes in contact with it. As indicated in the ROD for OU#1, the bottom of the facility will not require either a liner or a leachate collection system. Final design will include a relatively impermeable cover system with gas venting and drainage layers, among other components. The facility will be designed for future use as determined during the design phase, with input from the City of New Bedford. It is assumed that the future use will be recreational in nature.

Design of CDFs falls under the TSCA chemical waste landfill standards relative to PCB contamination. The ROD for OU#1 details specific TSCA requirements (hydrogeologic conditions, leachate collection and bottom liner requirements) which have been waived by the Regional Administrator. Relative to other possible hazardous substances in the sediment, the ROD for OU#1 indicates that the substantive requirements of the Massachusetts Solid Waste Management (MSWM) regulations shall be followed where they are more stringent than TSCA (with the exception that the same waivers obtained under TSCA apply to MSWM regulations). For the purposes of preparation of this Work Plan and associated Cost Estimate, Foster Wheeler has assumed that local, state, and federal permits and/or authorizations will not be required as part of the design; however, appropriate substantive requirements will be included.

The USACE October 14,1998 Scope of Work for OU#1, Remedial Design of New Bedford Harbor Superfund Site Upper and Lower Harbor, states the remedial design and action will be accomplished in accordance with the ROD dated 25 September 1998. The ROD states that the bottom of the CDFs will not be lined since the "existing sediments in the areas of the CDFs are inherently impermeable, the integrity of a man-made impermeable liner constructed in saturated conditions cannot be guaranteed and the dredged sediments themselves will compact into a highly impermeable material." The ROD also states that computer modeling indicates the leakage rates from the CDFs will be insignificant, and perimeter groundwater monitoring will be done to verify the CDFs are operating safely. In discussing how the selected remedy attains or appropriately waives ARARs, the ROD states "the conceptual CDF designs do include the sediment underlying the CDFs and a cover system both of which meet a drainage impermeability of 10^{-7} cm/sec". Foster Wheeler's basis of design for CDFs assumed in this Work Plan is the CDF concept from the ROD described above. It is further assumed the drainage impermeability of 10^{-7} cm/sec for the sediment underlying the CDFs is not a design criteria.

During field investigations, Foster Wheeler proposes to sample sediments in the areas where the CDFs will be constructed to obtain data for characterizing the thickness, classification, and engineering properties of the subsurface soils. Samples will be tested in the field and laboratory as described in Sections 2.2.3.8 and 2.2.5.3.1. This data will be compared to characterization data for soils sampled to develop the conceptual designs to determine if the site conditions are similar to those described in the

conceptual designs. The results of the sediment sampling and laboratory testing will be evaluated and described in the BD/DA reports. Issues of concern that arise from this evaluation will be considered in developing the basis of design for individual CDFs. Laboratory permeability testing of sediments at the bottom of the CDFs and modeling of CDF leakage have not been included in this Work Plan because it is assumed site conditions (impermeable sediments) will be as anticipated in the CDF design concept in the ROD. Should field data indicate further analyses are needed and the USACE agree, Foster Wheeler will propose an amendment to this Work Plan and Cost Estimate.

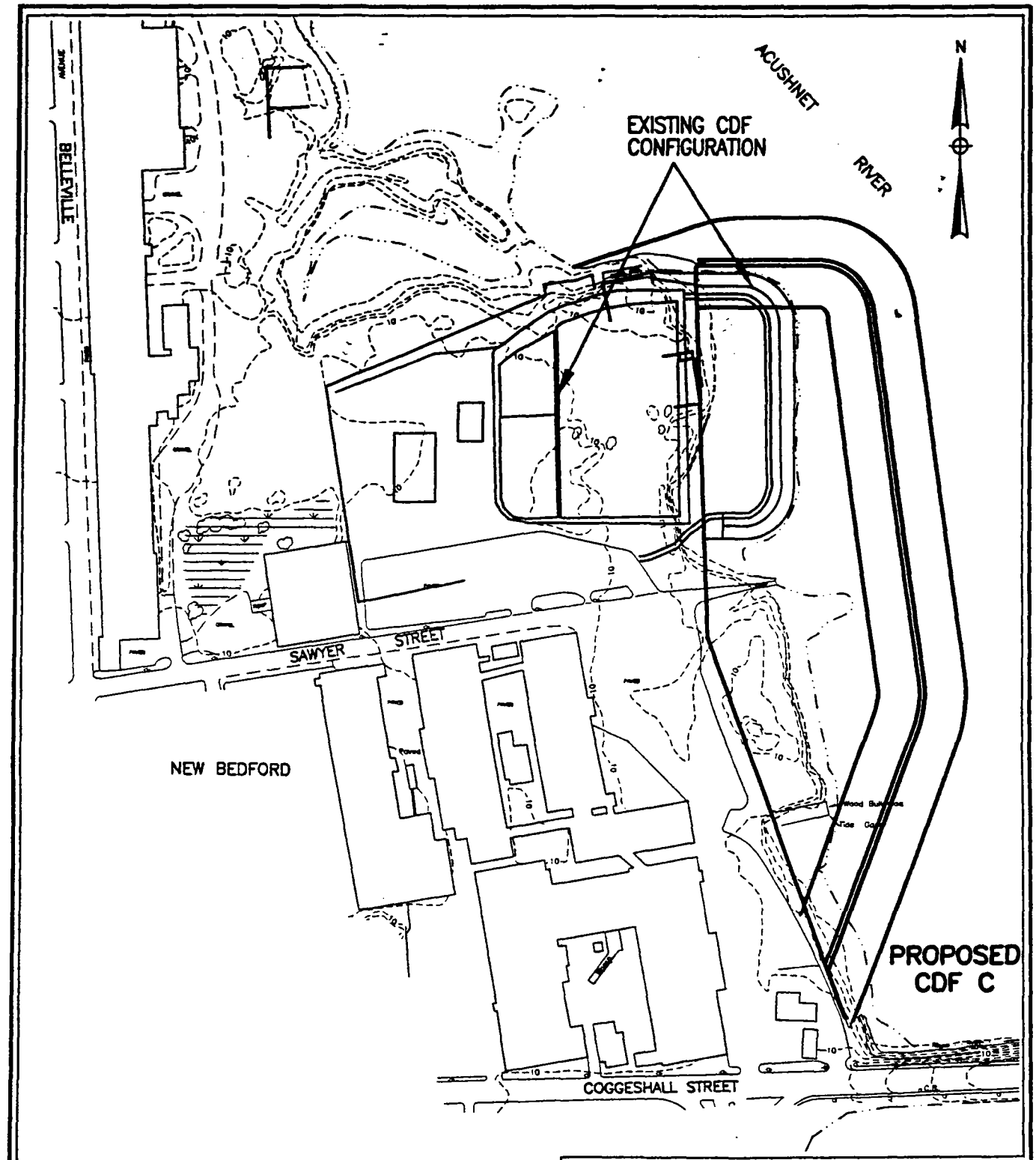
The following provides a brief description of the individual design elements as they relate to the overall CDF C design.

Dike Design

Based on the existing subsurface information and the engineering analyses conducted as part of the pilot dredging feasibility study, the dike design for CDF C requires various interrelated engineering analyses to determine maximum dike height assumed to be elevation +12 MLW and geometry, including stability and settlement analyses, design of a geomembrane support to allow fill placement over soft sediment, design of a wick drain system to accelerate strength gain and settlement, as well as staged fill and surcharge analyses. Depending on actual subsurface conditions encountered, Foster Wheeler will evaluate alternative conceptual dike designs to determine the most cost effective approach. The cost estimate for the 30% Design is based on evaluating the feasibility of extending the dike to the Coggeshall Street Bridge embankment and one other alternative, such as a higher dike to increase capacity. Foster Wheeler has assumed that the sand deposit anticipated below the organic clay strata is not susceptible to liquefaction in an earthquake event and will verify this during the geotechnical analysis and CDF dike design. If zones of loose sand are encountered below the proposed dike alignment, additional analyses for liquefaction or seismic densification will be required. The analyses required and cost estimate to perform them will be proposed as an amendment to this Work Plan should soil boring information indicate loose sands are present.

Sheet Pile Design

The conceptual design of the sheet pile wall on the land side of the CDF involves use of steel sheet piling to allow placement of material in the CDF to the preliminary finish grade of El. 12 (mean low water [MLW] datum), which is approximately 5 feet above existing site grade at CDF C. It is not anticipated that the sheeting will be required to directly retain contaminated dredged sediments in the final condition. Maximum elevation of the contaminated sediment is anticipated to be approximately El. 7 to El. 8; therefore, the above grade portion of the sheeting will be in direct contact only with the cap material. It is



NOTE:
BASE TOPOGRAPHY DOES NOT REFLECT EXISTING TOPOGRAPHY AT LOCATION OF EXISTING CONFINED DISPOSAL FACILITY AT NORTH END OF PROPOSED CDF C

0 500
SCALE IN FEET

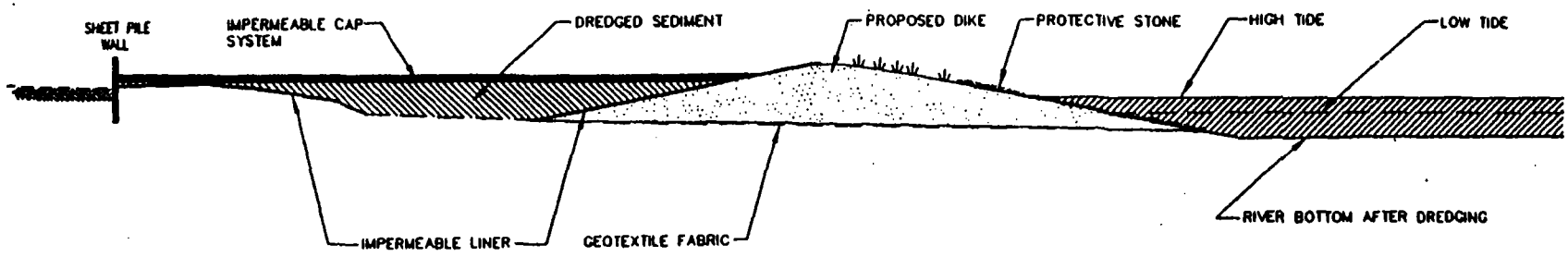
FIGURE 2-2

NEW BEDFORD HARBOR SUPERFUND SITE
NEW BEDFORD, MASSACHUSETTS

SITE PLAN
CDF C

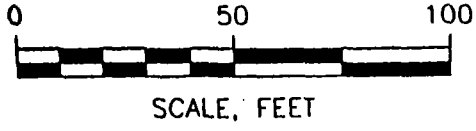
FOSTER WHEELER ENVIRONMENTAL CORPORATION
NEW ENGLAND TERC

CADDFILE: 5197NB14.DWG



TYPICAL CDF CROSS - SECTION

(to scale)



assumed, therefore, that it will not be necessary to line the sheeting, or evaluate means for reducing the permeability of the interlocks. Should the elevation of the sediment be high enough to contact the sheeting, it will be lined or the interlocks will be sealed. Structural design of the sheeting is anticipated to be based on the cantilever final condition, with a proposed cap finish grade of El. 12. Temporary construction conditions may require structural analysis of the sheeting for an interim grade higher than El. 12 if sediment dewatering utilizing a surcharge system is to be evaluated.

CDF Volume and Hydraulic Design

The initial volume estimate for CDF C will be prepared based on a detailed review of the design analyses and as-built data available for the pilot dredging feasibility study, as well as the Hot Spot sediment dredging and disposal. In addition, existing and proposed column settling and consolidation test data will be evaluated to account for differences in proposed dredging technologies and, possibly, differences in sediment characteristics (relative to final design of the overall dredging plan). Design parameters (such as bulking factors) will be evaluated during and subsequent to dredging operations associated with CDF C such that volume estimates for the subsequent CDF designs can be refined. It is envisioned that configurations (footprint area and/or height) of subsequent CDFs (A, B, and D) will be modified based on construction phase experience at the initial CDF (C). Additional information for these activities will be provided from the Dredging Technologies Subtask (20.91.01) and the Mass Balance Subtask (21.96).

Sidewall Liner

The interior of the CDF will incorporate a sidewall liner, which will be designed for the landward side of the earthen dike and the upland side (shoreline area) of the CDF. Liner design will involve analysis for appropriate geomembrane characteristics including strength, stability, and chemical compatibility. Associated activities involve grading and subgrade support design, design of a protective layer (if required) above the geomembrane, design of connections to sheet piling and other structural elements, and design of penetrations and anchor trenches. It has been assumed that existing utilities will be relocated or removed prior to liner design (i.e., no utility penetrations are envisioned to be required).

Floating Cover

Based on the Hot Spot dredging experience, air emissions control during dredging and filling of the proposed CDFs are anticipated to be of significant concern. It was necessary to provide a floating membrane cover over the Hot Spot CDF to reduce fugitive emissions. CDF C design will therefore involve development of a floating cover or alternate system to address this issue. Experience with the floating membrane cover utilized for the Hot Spot dredging operation identified system performance limitations which would need to be addressed prior to application for proposed CDFs. The larger size and irregular footprint of the proposed CDFs will further complicate design of a membrane floating cover system. Foster Wheeler will conduct a literature search to identify potential technologies which would either alleviate emissions concerns prior to the dredged material being placed in the CDFs, or accommodate a temporary cover to reduce emissions during dredging and CDF filling operations. The conceptual design relative to this issue has not advanced to the point where a preliminary scope and design estimate can be prepared. For this reason, the Work Plan does not include a specific design cost for a floating cover. Rather, the feasibility level literature search has been included as part of the 30% Design. The results of the evaluations will be reported in a technical memorandum and will include recommendations for a specific alternative for review by USACE and EPA. When an alternative is accepted, a design modification will be proposed to USACE.

Sediment Dewatering/Consolidation

Dewatering or stabilization of the dredged sediment will be required in order to provide a stable base for construction of the final cover and to accommodate future use of CDF C. Consolidation of the sediment under its own weight will presumably result in a sediment consistency similar to that which currently exists in the Hot Spot CDF, which is not adequate for cap construction or proposed future use. The anticipated problems with air emissions preclude relying on dessication (of the surface of the sediment when exposed to air over time) to partially accomplish dewatering or stabilization. Based on current knowledge of dewatering techniques, it has been assumed that the sediment will require dewatering within the CDF (vs. prior to placement). Some sediment dewatering methodologies will be evaluated as part of the work scope for removal of Hot Spot dredged material (Task Order No. 15). The results of the efforts for the Hot Spot work will be evaluated relative to application to CDF C sediment dewatering. Similar to the floating cover, the sediment dewatering design will require additional feasibility level review prior to establishing a specific design scope. A feasibility level review of sediment dewatering/stabilization technologies has been included in 30% Design. The results of the evaluations will be reported in a technical memorandum and will include a recommendation for a specific alternative for review by USACE and EPA. When an alternative is accepted, a Work Plan modification will be proposed to USACE.

Interim Cap

The conceptual design of CDF C includes provision for an interim cap (possibly consisting of "clean" navigation channel dredged material) designed to reduce emissions from the contaminated dredged material after the CDF is filled, and prior to construction of the final cap. Depending on magnitude and time rate of anticipated settlement (of both the subgrade and the dredged sediment itself), it may be necessary to design the interim cap to function as a surcharge to reduce post-cap construction settlement durations. Design of the interim cover will be partially dependent on the methodology selected for sediment dewatering, relative to surcharge requirements. We will evaluate alternatives as part of the design and recommend an approach to USACE before proceeding with the design. If navigation channel dredged material is to be used, physical characteristics data will be needed during the design. It is assumed this data will be made available to Foster Wheeler.

Final Cover

A final cover for CDF C will be designed which meets the applicable requirements of MSWM regulations. Design of the final cover will be done in two phases. The first, to be done with CDF dike design, will entail preparation of typical cross-sections with assumed final elevations of dredged material and the interim cover. The second will be done after the CDF is filled and the interim cover is in place. The cap will be designed to meet a drainage permeability of less than or equal to 10^{-7} cm/sec, in accordance with the ROD for OU#1. Cap components will consist of a geomembrane liner, gas transmission layer, drainage layer, low permeability soil layers, and cover soil capable of providing frost protection. The surface soil layer of the cover shall be capable of sustaining vegetative growth. This final cover will accommodate future use design considerations described below. It will include consideration of sloping and terracing of the final surface to accommodate future use without raising dike heights.

A gas management system will be designed to convey gases through the impermeable cap layer (geomembrane). It is assumed that the gas venting layer will be passive and will consist of surficial vents open to the atmosphere rather than an active extraction system designed to trap and treat gases. Based on the ROD for OU#1, evaluation of the need for treatment of gas emissions will be done when the CDF is in place and emissions can be sampled. The geocomposite drainage layer and subsurface drainage piping will be sized utilizing the U.S. Army Hydraulic Evaluation of Landfill Performance (HELP) model to assess the effects of surface storage, infiltration, soil moisture storage, and lateral drainage. Overall cap

stability, system performance, and anchor trench design will be analyzed relative to interface friction and estimated differential settlement.

A stormwater management plan to control the surface water run-off volume that results from a 24-hour, 25-year storm event will be prepared for the entire CDF and surrounding area. Necessary run-on control features will be designed using the peak discharge for a 25-year storm event to minimize surface water run-on to components of the CDF. Stormwater controls for the final cap will be sized using Soil Conservation Service (SCS) TR-20 or TR-55 methodologies. Applicable stormwater treatment measures and erosion/sediment control practices will be incorporated into the final design in accordance with Best Management Practices. Cap design includes permanent "armoring" of the seaward side of the berms with compatible habitat for the area and vegetated cover for the final cap. It is assumed that the USACE will provide hydraulic and/or hydrologic data for the design of the CDF based on the pre-existing conditions (before the CDFs are constructed) and post-construction conditions (based on preliminary layout and configuration of all CDFs). Information to be provided should include:

- 100-year floodplain, flood hazard area, and/or floodway water surface profile data in the upstream and downstream vicinity of the proposed CDF and supporting hydraulic calculations and/or modeling results.
- Hydraulic data that presents tidal influences and fluctuations for the Acushnet River in the vicinity of the proposed CDF.
- 100-year floodplain, flood hazard area, and/or floodway boundary data delineated on topographic base mapping in the upstream and downstream vicinity of the proposed CDF.
- Results and supporting documentation from available previous hydraulic studies that address or present channel velocity conditions, scour potential, and/or accepted Manning's roughness coefficient data for the Acushnet River in the vicinity of the proposed CDF.
- Available historical flood data including high water elevations with occurrence dates and nature/extent of flooding.

2.2 CDF C Design Concept (March 2000)

Summary of the Current Concept for CDF C

The first CDF being designed is CDF C. The base case concept design is an earthen dike within the water constructed on a geotextile fabric with fill placed in multiple lifts to achieve consolidation of underlying soft silt and clay sediments. The shoreline side of the CDF will be comprised of an earthen berm sloped to the water line. Due to the existing shoreline elevation being sufficient to support the sidewall liner, the earthen berm is easier to construct and less costly then the sheetpile wall option. The sidewalls of the CDF will be lined with a flexible membrane liner that will intersect the bottom sediments within the CDF. Once the sidewalls of the CDF are constructed and lined, the dredged material will be pumped and or placed in the CDF and will be allowed to settle and consolidate (or dewatered). The conceptual design for CDF C does not include a floating cover like the cover used in filling the Hot Spot CDF with dredged material. Foster Wheeler is preparing a Technical Memorandum that presents and evaluates alternatives to the floating cover. Alternatives to the floating cover to control PCB losses to ambient air will be evaluated further in the pre-design field tests of new dredging technologies.

When it is filled with consolidated dredged sediments CDF C will be covered with an impermeable cap. The cap will include a passive gas collection system. Gas collected and vented will be sampled and analyzed for constituents and treatment needs after the CDF is completed. The final land use design for the Surface of CDF and C will be determined during the final stages of the design through USACE and EPA consultation with the City of New Bedford.

Design Criteria

Design Criteria for CDF C were obtained from the previously designed project documents and from project meetings and discussions with USACE and EPA-Region 1. The design criteria can be categorized by each element of the CDF based on their specific design objectives. Table 2-1 presents the objectives and associated design criteria.

Table 2-1
CDF C Design Criteria

CDF Feature	Design Objective	Design Criteria
In-Water Dike	• Contain dredged sediments; optimize storage capacity. • Support sidewall liner. • Support final cap. • Provide habitat compatible with Acushnet River Estuary. • Withstand river currents and wave runup. • Maximum dike height = 4 to 5 feet above existing ground surface.	• Dike height = +10.7 feet NGVD. • Side slope < 3:1.
Shoreline Wall	• Contain dredged sediments; optimize storage capacity. • Support sidewall liner. • Support final cap. • Withstand stormwater runoff. • Maximum dike height = 4 to 5 feet above existing ground surface.	• Riprap dike face with stone = up to 100-year flood elevation. • Dike height = +10.7 feet NGVD. • Side slope < 3:1.
Sidewall Liner	• Prevent leaching of PCBs. • Withstand settlement of supporting soils.	• Control drainage, erosion for 24-hour, 25-year storm. • Dike height = +10.7 feet NGVD. • Liner permeability < $1x10^{-7}$ cm/sec.
Dredged Sediments	• Consolidate to support final cap. • Retain PCBs.	• Sediment permeability = 10^{-7} cm/sec.
CDF Hydraulic Structures	• Provide retention of dredge slurry. • Convey supernatant to Hot Spot CDF.	•
Interim Cap	• Control PCB volatilization from dewatered sediments in the CDF.	• Sand layer to be 6" thick.
Final Cap	• Prevent precipitation from entering CDF. • Collect CDF gases. • Withstand precipitation runoff. • Support final recreational land use. • Withstand dredged material settling.	• Permeability ≥ $1x10^{-7}$ cm/sec. • Passive gas collection. • Slop surface at > 5%. • Control drainage, erosion for 24-hour, 25-year storm.
Stormwater Controls	• Capture and convey precipitation to prevent flooding and erosion.	• Control drainage, erosion for 24-hour, 25-year storm.

3.0 REGULATORY REQUIREMENTS FOR CDF DESIGN

3.1 Fish and Wildlife, Endangered Species, and Cultural and Historical Resources

The design of the CDFs must consider the potential impacts to fish, wildlife, endangered species, as well as to areas where historical (e.g. sunken ships) and Native American artifacts may be located.

Under the Fish and Wildlife Coordination Act (16 USC Part 661 et. seq.; 40 CFR 6.302(g)), the Fish and Wildlife service and appropriate state agencies must be consulted during CDF design to determine ways to minimize adverse effects to fish and wildlife because CDF construction will result in structural modifications to New Bedford Harbor.

Given that CDF C will be located along the western shoreline, encompassing the existing Hot Spot CDF, the Sawyer Street combined sewer outfall, and industrial shoreline, it is anticipated that impacts to fish and wildlife will be minimal. USACE will review the CDF design. Also, Foster Wheeler scope for the CDF dike design design includes designing the waterfront portions of the dike to be compatible with the coastal estuary environment of the Acushnet River. As the dike design is developed beyond the conceptual stage the details of the habitat design will be discussed with USACE.

The federal Endangered Species Act (16 USC Part 1531 et. seq.; 40 CFR 6.302(h)) (ESA) requires consultation with appropriate federal and state agencies if a threatened or listed species or their habitat may be affected by a federal action. The CDF C location will be reviewed for ESA considerations by USACE as part of their design.

The National Historic Preservation Act of 1966 (16 USC 470 et. seq.; 40 CFR 800), as amended, and the National Preservation of Historical and Archeological Data Act of 1974 (16 USC 469 et. seq.) requires an assessment be conducted to determine potential project impacts to cultural resources which are eligible for, nominated to, or listed in the National Register of Historic Places (NRHP). Specifically, cultural resources concerns will involve evaluation of project impacts to potentially significant (per 36 CFR 60.4 - NRHP Criteria for Evaluation) cultural resources including:

- Standing structures (view sheds);
- Archeological sites (prehistoric and/or historic sites) which may be within the shoreline areas where the CDFs are located; and
- Underwater archeological resources.

Foster Wheeler has completed an Archaeological Survey (equivalent to a Stage IA investigation) of the CDF C vicinity based on this survey.

3.2 TSCA Design Standards

In the ROD, EPA has documented their determination that TSCA landfill requirements for the bottom liner, leachate collection and hydrologic conditions were not appropriate for shoreline CDFs and that the resulting CDF design would not pose an unreasonable risk to health or the environment. Therefore, the EPA Regional Administrator waived the following TSCA chemical waste landfill requirements for the CDFs:

- Soils (except soils which meet permeability requirement):
  - In-place soil thickness of 4 feet or compacted soil liner thickness of 3 feet,
  - Greater than 30% soil passing the No. 200 sieve,

- Liquid Limit >30, and
- Plasticity Index >15,
- Hydrologic conditions,
- Leachate collection, and
- Bottom liner.

Based on review of both the TSCA landfill and Massachusetts solid waste regulations, the following Massachusetts solid waste requirements are more stringent:

- Covers,
- Surface water and groundwater protection,
- Groundwater, surface water and gas monitoring systems, and
- Closure/post closure.

The TSCA requirements for flood protection are more stringent and must be met. Therefore, the CDF design must incorporate the TSCA flood protection requirements. Per 40 CFR 761.75 (b)(4)(i), if the facility site is below the 100-year flood water elevation, the site must have surface water diversion dikes around the perimeter with a minimum height equal to two feet above the 100-year floodwater elevation.

Under the OU#1 Remedial Design Work Plan the USACE will perform hydrologic modeling of the Acushnet River to provide information on flood elevations and river flow velocities with CDF C in place. Foster Wheeler will use this information to design dike protection from flooding and wave and current erosion. The CDF C dike is anticipated to have a top elevation of 12 feet above mean low water. This elevation will be compared to the USACE developed 100-year flood water elevation to determine if this requirement can be met.

CDFs will meet the TSCA soil permeability standard of 1×10^{-7} cm/sec (40 CFR 761.75(b)(1)(i)).

3.3 Massachusetts Solid Waste Management Facility Design Standards

The MADEP, under 310 CMR 30.501(3)(a), exempts facilities that store, manage, treat and dispose of PCBs greater than 50 ppm from the Massachusetts hazardous waste regulations provided that the facilities are properly managed under TSCA. Since Massachusetts, through its concurrence with the ROD (Section XII (B)), agreed that the remedy is properly managed under TSCA, the Massachusetts hazardous waste regulations (310 CMR 30.00) for the design of the CDFs do not apply to TSCA regulated PCBs. However, sediment disposal within the CDFs is subject to the relevant and appropriate requirements of the Massachusetts solid waste regulations, 310 CMR 19.00 and hazardous waste regulations, 310 CMR 30.0, as stated in the ROD. It was determined that the substantive, relevant and appropriate requirements of the Massachusetts solid waste program which are more stringent than TSCA regulations for covers, monitoring, surface water and groundwater protection, closure and post-closure will be followed. Hence, Foster Wheeler has designed CDF C to comply with the following substantive, relevant and appropriate requirements under the Massachusetts solid waste regulations:

- The cap, side walls, and bottom material will meet a maximum permeability standard of 1×10^{-7} cm/sec;
- Cover system (including gas venting, drainage, top slope $\geq 5\%$, erosion protection, infiltration protection, and freeze/thaw protection);
- Stormwater controls;
- Surface and groundwater protection;
- Air quality protection systems;

- Groundwater, surface water, and gas monitoring systems;
- Operation and maintenance;
- Environmental monitoring; and
- Closure/post-closure.

The following Massachusetts solid waste landfill requirements are not considered appropriate for the CDF design:

- Bottom liner (referenced in the surface water and groundwater protection requirements), and
- Leachate collection requirements.

3.3.1 CDF Cover Systems

CDF C will comply with the following Massachusetts solid waste landfill final cover system requirements, per 310 CMR 19.112.

The final cover will meet the following general design standards, if appropriate for the CDF final use.

19.112(2):

1. Have a final top slope of not less than five percent (5%) and side slopes no greater than three horizontal to one vertical (3:1),
2. Be constructed of material(s) that are compatible with gases expected to be generated,
3. Be constructed so as to minimize erosion of all layers of the final cover by using terraces or other appropriate stormwater controls,
4. Be constructed so that the low permeability layer is protected from the adverse affects of frost and/or freeze thaw cycles, and
5. Be constructed to maintain slope stability.

The final cover system will consist of, at a minimum, the following components if appropriate for CDF final use:

1. The subgrade layer,
2. A CDF gas venting layer (unless the subgrade layer is designed to function as a gas venting layer, or there is an active gas collection and extraction system),
3. A low permeability layer or layers,
4. A drainage layer,
5. Filter material (when required),
6. A layer capable of supporting vegetation, and
7. A vegetative cover.

The final cover system components (numbered 1-7 above) will meet the detailed requirements given in 310 CMR 19.112 (4) thru (10), if appropriate for CDF final use.

3.3.2 Stormwater Controls

CDF C will comply with the following stormwater control requirements for solid waste landfills, per 310 CMR 19.115, if appropriate for CDF design.

The stormwater controls will prevent erosion, discharge of pollutants and protect the physical integrity of the CDF. These controls will be designed to:

1. Prevent flow onto the active portion of the CDF during the peak discharge from a 24-hour, 25-year storm, and
2. Control the run-off from the active portion of the CDF of at least the water volume resulting from a 24-hour, 25-year storm.

3.3.3 Surface Water and Groundwater Protection

The CDFs will comply with the following Massachusetts surface water and groundwater protection requirements for solid waste landfills, per 310 CMR 19.116, if appropriate for CDF design.

The CDFs will be designed to prevent direct discharge of contaminated run-off from the facility to any surface water bodies or to groundwater. The CDF cap, cover and side walls will be designed to prevent contaminated run-off. A groundwater monitoring system will be installed to check for potential contaminants in the groundwater.

3.3.4 Air Quality Protection Systems

Passive gas collection and vents are being designed into the CDF C cap, 310 CMR 19.117(1)(2). The gas vents will meet the appropriate performance and design standards detailed in 310 CMR 19.117 (3)(a) and (b). The gas vents will be installed concurrently with the phased construction of the CDF. The OU #1 Work Plan explains that the need for treatment of gases vented from CDF C will be evaluated after the CDF is built and capped.

3.3.5 Groundwater, Surface Water, and Gas Monitoring Systems

The CDFs must comply with the following substantive, relevant and appropriate Massachusetts groundwater, surface water and gas monitoring requirements for solid waste landfills, per 310 CMR 19.118. These monitoring systems must be capable of detecting and quantifying the release of contaminants into the ground, groundwater, surface water or the air.

Groundwater Monitoring System, 310 CMR 19.118(2)(A): 1) The groundwater monitoring system must be capable of yielding representative groundwater samples for analysis and 2) consist of sufficient number of wells properly located and screened at appropriate depths to detect the release of contaminants from the CDF into the groundwater. The groundwater monitoring system will, as appropriate:

1. At a minimum, be composed of one (1) monitoring well, or cluster of wells, installed hydraulically upgradient from the limit of the filled or proposed fill area capable of yielding groundwater samples which are representative of background water quality,
2. At a minimum, be composed of three (3) monitoring wells, or clusters of wells, installed within 150 meters of filled areas, areas proposed to be filled or at the property boundary (which ever is less), and be located hydraulically downgradient from the limit of the filled areas or areas proposed to be filled, and be capable of detecting contaminants that migrate from the CDF to the groundwater,
3. Be composed of wells constructed in a manner that ensures the integrity of the monitoring well and facilitates sample collection,
4. Be composed of wells readily accessible to sampling equipment and located so that they do not interfere with routine CDF operations,
5. Be composed of wells designed with locking caps and secured to prevent tampering with or vandalism, and
6. Be composed of wells which should be made as permanent as possible.

The requirements for downgradient groundwater monitoring wells will be met in the following manner:

- Before CDF construction: wells will be installed in the harbor, if feasible, and
- During CDF construction: wells will be installed through the dike on the water side (i.e., outside of the containment liner).

Surface Water Monitoring System: Permanent surface water sampling location markers will be established upstream and downstream of the CDF in sufficient numbers and locations to adequately represent surface waters flowing through or past the facility. All surface water sampling locations will be readily accessible to sampling equipment and located so that they do not interfere with routine CDF operations.

Gas Monitoring System, 19.121 Gas Recovery Operations: Gas monitoring wells for the monitoring of explosive and other landfill gases will be provided to determine if gas is migrating beyond the CDF boundaries. The gas monitoring wells also must be capable of yielding representative air samples for analysis and consist of a sufficient number of wells properly located to detect the presence and migration of landfill gases.

3.3.6 CDF Operation and Maintenance

Operation and maintenance of the CDF C will comply with the following substantive, relevant and appropriate solid waste landfill requirements, per 310 CMR 19.130, as appropriate for CDF final use.

The CDFs will be operated in accordance with appropriate conditions, such as proper sequencing of CDF operations, proper grading of the CDF, proper maintenance of drainage systems and application of adequate amounts and appropriate types of cover materials, which will prevent pollution of groundwater, surface water and air quality, and prevent nuisance conditions from developing.

Based on the ROD, the CDF will not be used to dispose of any federal or Massachusetts hazardous wastes. Although materials containing PCBs ≥ 50 ppm are usually considered a Massachusetts hazardous waste (i.e., MA02), these wastes will be disposed in accordance with the federal TSCA PCB regulations, per 310 CMR 30.501(3)(a). Consequently, these PCB wastes although still considered Massachusetts's hazardous wastes are adequately regulated under TSCA.

19.130(15)(E) Maintenance of Interim or Final Cover

The CDF will be operated such that vectors, dust, odors and other nuisance conditions are prevented from developing.

19.130(18) Top Slope and Side Slope, 19.130(19)

The CDF will have sufficient stormwater drainage controls and diversion structures, channels or ditches to promote drainage off of the CDF, minimize run-on onto the CDF, prevent ponding on the CDF or uncontrolled ponding adjacent to the filled area. Stormwater drainage structures will be designed, constructed and maintained so as to ensure integrity of the drainage structures and so as to prevent erosion of the CDF.

19.130(20)

Soil erosion control measures will be instituted as are necessary to ensure the retention and integrity of the cover(s). The CDF will be operated such that no solid waste or leachate are carried off-site due to erosion and that siltation due to erosion must not migrate off-site. Where significant settlement, ponding of waters or erosion of the CDF or cover material occurs during operation, closure or post-closure, corrective actions will be instituted immediately.

19.130(21)

The CDF will be designed to incorporate property boundary markers and elevation markers.

The final cover will be designed to meet the substantive, relevant and appropriate standards of 310 CMR 19.112. These cover requirements are more stringent from TSCA requirements. Some Massachusetts solid waste cover requirements, however, are not appropriate for CDFs due to final use (see section 3.8.3.1 above).

19.130(22)

Access roads will be constructed, graded and maintained to ensure that traffic flow will not be interrupted by inclement weather or traffic patterns.

19.130(26)

No materials are to be stored, held, maintained or placed at the CDF in such a manner as to pose a fire hazard. Any disruption of the finished grade or covered surfaces as a result of fire fighting activities will be repaired or replaced immediately upon termination of such activities.

3.3.7 Environmental Monitoring

Environmental monitoring of surface water, groundwater and landfill gas at the CDFs will comply with the following solid waste landfill requirements, per 310 CMR 19.132, as appropriate for CDF design.

19.132(1 thru 4) Environmental Monitoring Requirements

Surface Water & Groundwater Monitoring: Sampling and analysis of surface water and groundwater will be:

1. Conducted in accordance with methods approved by the EPA,
2. Conducted at sampling points as agreed to by the EPA,
3. Conducted on a schedule as agreed to by the EPA, and
4. Performed semi-annually, at a minimum (however the EPA may require more frequent or additional monitoring in cases where data are determined to be unacceptable).

Background groundwater quality data has been collected at sampling points hydraulically upgradient of the CDF. Existing harbor sampling data is considered sufficient to meet the intent of establishing background surface water quality.

3.3.8 Maintenance of Environmental Control and Monitoring Systems

Maintenance of environmental control and monitoring systems at CDF C will comply with the following Massachusetts solid waste landfill requirements, per 310 CMR 19.133, as appropriate for CDF final use.

19.133(1)(A thru C)(E)

The CDF will be operated in a manner that will protect all environmental control systems and monitoring systems. All CDF environmental control systems will be regularly maintained per the approved Operations and Maintenance Plan. The EPA will be notified if environmental control systems, monitoring devices or surface water sampling location markers are damaged or destroyed and the extent of the damage will be reported, in writing, within 14 days of discovery and must provide a schedule for repair or replacement before the next scheduled sampling round.

19.133(1)(D)

Surface water, groundwater and gas monitoring locations will be maintained so as to meet the requirements in 310 CMR 19.118 (Groundwater, Surface Water & Gas Monitoring Systems), given in Section 1.2.3.5 above.

3.3.9 CDF Closure

Closure of CDF C will comply with the following solid waste landfill requirements, per 310 CMR 19.140, as appropriate for CDF final use.
The CDF will be designed to eliminate any conditions that could attract vectors or cause nuisance conditions and must take all practicable measures to prevent pollution of the environment and prevent a threat to public health and safety. The design also must incorporate any additional closure requirements that may be imposed by the EPA.

3.3.10 CDF Post-Closure

Post-closure of CDF C will comply with the following Massachusetts solid waste landfill requirements, per 310 CMR 19.142, as appropriate for CDF final use.

During the post-closure period, the CDFs must be maintained and monitored to detect and prevent any adverse impacts of the CDF on public health, safety or the environment. The following activities will be performed:

1. Corrective actions must be taken to remediate and/or mitigate conditions which would compromise the integrity of the final cover,
2. Maintain the integrity of liner system (e.g., sidewall liners) and final cover system,
3. Monitor and maintain the environmental monitoring systems for surface water, groundwater and air quality,
4. Maintain access roads,
5. Maintain landfill gas collection control systems, and
6. Protect and maintain any surveyed benchmarks.

3.3.11 CDF Post-Closure Use

Massachusetts solid waste landfill requirements per 310 CMR 19.143(3) and (4) which provide criteria for approval of post-closure use and post-closure construction will be reviewed when post-closure uses are identified.

3.4 Clean Water Act - Section 404 & Rivers and Harbors Act Requirements

Since CDF construction will occur below mean high water, CDF C is a regulated structure placed in navigable waters and thus must comply with the substantive requirements of a Section 10 of the Rivers and Harbors Act permit (construction of the structures) and a Section 404 of the Clean Water Act permit (dredging and filling of tidal waters) during CDF construction.

Since the project involves activities in tidal waters and wetlands, and will require greater than 1 acre of fill, the project activities must meet the substantive requirements of an individual Section 404 permit.

The design of CDF C must minimize impacts to the environment by avoiding, minimizing and mitigating impacts as follows (40 CFR 230.70-76):

- Silt screens/curtains or other appropriate methods will be used during CDF construction and project activities to confine suspended particulates/turbidity;
- The CDF will be oriented to minimize undesirable obstruction to the water current or circulation pattern in New Bedford Harbor;
- The CDF will be designed to minimize or prevent the creation of standing water bodies in areas of normally fluctuating water levels and will minimize or prevent the drainage of areas subject to fluctuations;
- Sediments will be dewatered in the CDF to reduce their liquid components; chemical flocculants may be added to enhance dewatering;
- The CDF will have side walls to reduce the potential for erosion, slumping, or leaching of sediments into the aquatic ecosystem;
- The CDFs will be capped with clean material;
- Diked areas of the CDF will be protected from erosion by runoff and wave action vegetation; and
- The CDF design will utilize natural bottom contours and shoreline grading to minimize the size of the mound(s).

Although permits will not be required for project activities, the activities must meet the substantive requirements under Section 10 and Section 404 permitting programs, respectively. The USACE has authority for implementing Section 10 and Section 404 regulatory programs. These requirements will be complied with through their review and approval of the CDF C design.

3.5 Erosion and Sedimentation Control Plan

The Sedimentation and Erosion Control Plan for the CDF C will be prepared as part of the Remedial Action Plan for CDF construction.

3.6 Stormwater Management Plan

Foster Wheeler will prepare a Stormwater Management Plan designed to control the surface water run-off that results from a 24-hour, 25-year storm event for the CDF C work area. Elements of the plan will include:

- Stormwater run-on controls to be designed using the peak discharge from 25-year storm events to minimize surface water run-on to the CDFs;
- Stormwater controls for the final caps to be sized and designed using Soil Conservation Service (SCS) TR-20 or TR-55 methodologies, and
- Applicable stormwater treatment measures and sedimentation and erosion control measures will be incorporated into the final design and detailed in the Project Erosion and Sedimentation Control Plan.

3.7 NPDES Stormwater Discharge Requirements

Although NPDES stormwater discharge permits are not required for activities under CERCLA, the CDF design must meet NPDES Stormwater Discharge requirements for industrial activities (40 CFR 122.26(a)(14)(v)) because the CDFs are regulated as landfills. The CDF final design and operations will comply with the following substantive requirements; Foster Wheeler will prepare an Erosion and Sedimentation Control Plan as part of the Remedial Action Plan which specifies how sedimentation and erosion controls will be implemented at CDF C to prevent off-site siltation. The plan will include:

- The location and nature of the construction activity;
- The total area of the site that is expected to be disturbed;
- Proposed measures, including Best Management Practices (BMP) and state and local erosion and sediment control requirements, which will be used to control pollutants in stormwater discharges during construction;
- Proposed measures, including BMP and state and local erosion and sediment control requirements, which will be used to control pollutants in stormwater discharges after construction is completed;

3.8 Massachusetts Stormwater Management Policy

MADEP has issued a Stormwater Management Policy implemented under the Massachusetts Wetlands Protection Act (WPA), 310 CMR 10.00, which applies to work conducted within coastal and inland wetlands, riverfront areas and land subject to coastal storm flowage. In New Bedford, the regulated area extends 25 feet inland from the riverfront, within 100 feet of coastal wetlands, and the land between mean low water and the landward boundary of the 100-year flood. Since the CDF C will be constructed in or within 100 feet of the coastal wetlands, these activities will comply, to the extent possible, with the Massachusetts WPA Stormwater Management Policy. The requirements that will be considered are:

- All new stormwater discharges will be treated to remove at least 80% of the Total Suspended Solids (TSS) (untreated discharges are not allowed);
- The Stormwater Management Plan will include sedimentation and erosion controls designed to remove at least 80% of the TSS from stormwater discharges related to CDF construction,
- Post-development discharge rates will not exceed pre-development peak discharge rates;
- Loss of annual recharge to groundwater will be minimized;
- Sedimentation and erosion controls will be installed; and
- An Operation & Maintenance Plan will be prepared for the stormwater management system.

3.9 Air Monitoring and Fugitive Emissions Control

Even though fugitive air emissions are expected to be minimal because sediments will be already be wet during excavation and handling activities, Foster Wheeler will implement air monitoring and fugitive emission controls. An appropriate level of air monitoring and BACT will be required to control potential air releases from the capped CDFs in excess of the Ambient Air Levels (AALs). The AAL for PCBs is 0.0005 $\mu g/m^3$ for an annual average. Foster Wheeler will develop and implement controls to limit fugitive emissions during sediment excavation, dewatering and placement in the CDF to minimize on-site exposure to and off-site migration of site contaminants. The emissions program has the following elements:

- A pre-design field test of new dredging systems and sediment handling dewatering is being planned for the spring and summer of 2000. Air Monitoring will be performed during this field test to obtain data in sources of airborne PCBs and ambient levels during dredging and CDF filling;

- An air monitoring program has been conducted at each CDF to establish baseline conditions prior to construction activities. The air monitoring program is described in Section 2.2.3.3 of the Work Plan and subsections for the SAP. In addition to the baseline sampling, air monitoring has also been conducted around the perimeter of the Hot Spot CDF at the Sawyer Street area. Results from the CDF baseline and Sawyer Street air monitoring will be used to establish ambient air action levels for future construction activities. Air monitoring samples analyzed for PCB congeners as specified in the SAP;

- The current plan for the CDF design includes maintaining a two-foot water layer above sediments placed in the CDFs and placing an interim cap consisting of six inches of soil or sediment on top of the dredged sediments after the CDFs have been filled. This interim cap will prevent emission of PCB dust or PCB volatilization while the underlying sediment consolidates; and

- Water sprays and covers on stockpiles will be used to control fugitive dust emissions during material handling. Run-off from water sprays must be contained and managed in accordance with the Stormwater Management Plan.

3.10 Wetlands Protection Requirements

CDF construction activities have the potential to impact areas protected under the Massachusetts Wetlands Protection Regulations (310 CMR 10). If project design can not meet the performance standards, then either mitigation methods or evaluating a variance of the requirement will be employed. Mitigation methods applicable to CDF C construction are listed in Table 1-2.

3.11 Waterways Regulations

The MADEP Waterways regulations focus on the long-term viability of marine industrial uses within the New Bedford Designated Port Area, maintaining or improving public access, and protecting public rights in tidelands. Public rights include fishing, fowling, and navigation in Commonwealth tidelands. The CDF C construction will comply with substantive requirements to the extent predictable. If the performance standards cannot be met, then mitigation methods may be considered.

3.12 Water Quality Certification

Water Quality Certification Standards are satisfied through the remedy meeting the substantive requirements of Section 402 of the Clean Water Act and the Massachusetts Wetlands Regulations.

3.13 Massachusetts Coastal Zone Management Program (MCZM)

The MCZM program is a federally funded and approved state Coastal Zone Management (CZM) Program under the Federal Coastal Zone Management Act of 1972. The MZCM has established policies that are based upon existing Massachusetts Water Quality, Wetlands and Waterways regulations. The ARARs from these regulations have already been identified elsewhere in this section.

3.14 Compliance with Project Decision Documents

Remediation activities will be conducted in accordance with the following:

- The U.S. EPA Record of Decision, dated September 1998,
- The USACE's October 14, 1998 Scope of Work,
- The November 13, 1998 Draft Engineering Guidance for the Scope of Work, and
- The Foster Wheeler Remedial Design Work Plan, dated April 1999.

All work conducted in areas deemed to be "on-site" will be conducted in accordance with these decision documents and the substantive requirements of the identified Applicable or Relevant and Appropriate Requirements (ARARs). ARARs for the OU #1 Remedial Action are listed in the RCP. Any work in areas deemed to be "off-site" will be conducted in accordance with both administrative and substantive requirements of applicable federal, state, and local regulations.

Table 3-1
Mitigation Methods Applicable to CDF C Construction

Performance Standard	Mitigation Method
• Projects shall not alter the bottom topography in a manner which 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).	• Foster Wheeler will time the construction activity to avoid the critical life stages of the various aquatic species to the maximum extent possible. • USACE and EPA will review the proposed design for CDF C to evaluate the potential for erosion and storm damage. If areas are to be impacted, Foster Wheeler will design a protective measure.
• If a proposed CDF is located in a designated port area, which is determined to be significant to marine fisheries, then water quality and water circulation interests should be protected (310 CMR 10.26).	• There are no current port areas or marine activities at the designated locations for CDF. CDF design will support existing uses and that CDF C final use design will support future water-dependent boating and recreation uses.
• Water-dependent projects on tidelands 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). • Massachusetts water quality standards must be met for dredging operations and discharge of effluent from CDFs (310 CMR 10.27).	• Foster Wheeler will attempt to minimize the tideland and salt marsh area required by the CDFs by increasing the height and volume of the CDFs, however community concerns have limited CDF height to 4-5 feet above the existing shoreline. • The impacts to tidelands and coastal beaches have been minimized by locating CDFs on contiguous shoreline parcels with industrial land use. • Final CDF C design of the waterfront side of the CDFs will incorporate habitat for marine life. • Foster Wheeler 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. • Foster Wheeler will follow the approved sedimentation and erosion control plan during construction to minimize sedimentation in New Bedford Harbor.
• CDF construction should not destroy any portion or have an adverse effect on a salt marsh (310 CMR 10.32).	• The CDF C area is an industrial shoreline with very small (if any) salt marsh.
• If the CDF construction 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.

Table 3-1 (cont'd)
Mitigation Methods Applicable to CDF C Construction

Performance Standard	Mitigation Method
• If construction results in the increase in horizontal extent and levels of flood waters during peak flow, then the CDF design should provide compensatory storage for lost flood storage volume (310 CMR 10.57).	• The CDF design will be reviewed by the USACE and flood modeling will be performed to evaluate impacts. Results of the USACE evaluation and mitigation measures will be discussed between EPA and USACE.
• New fill in tidelands below the high water mark for water-dependent purposes can be approved only if reasonable measures have been taken to minimize the amount of fill; including relocating the fill to an area above high water.	• CDF construction will place fill below the highwater level. However EPA has committed to the City of New Bedford that the height of the CDFs will not exceed 4 to 5 feet above the existing shoreline.
• New fill in tidelands within Designated Port Areas (DPA) must be designed to accommodate water-dependent industrial use.	• The CDF C area does not support a water-dependent industrial use.
• Preserve the availability and suitability of tidelands used for water-dependent uses that are reserved primarily as locations for maritime industry or other water-dependent uses. These rights include littoral or riparian property owner's rights to approach property from a waterway and to approach waterway from their property. Project shall not disrupt off-site water-dependent use within the project vicinity without providing mitigation or compensation and project shall not displace water-dependent use in a DPA (310 CMR 9.36).	• CDF C will be designed and constructed to accommodate other water-dependent aesthetic or recreational uses such as parks, sports fields and open space. EPA will work with the City of New Bedford to provide for future use of the sites. • Alternative access to the water is available to the general public. CDF construction will not block access to the waterfront. • Appropriate mitigation will be determined based upon the degree of impact to water-dependent uses.
• Navigational impacts from capping or sediment covering must be minimized.	• Foster Wheeler anticipates minimal navigational impacts from capping or sediment covering activities for CDF C.
• All fill and structures, including the subaqueous capping of polluted sediments, should be designed and constructed in a manner that does not unreasonably restrict the ability to dredge any channels (310 CMR 9.37).	• CDF C will be located outside of customary boating channels.
• Design and timing of dredging and dredge 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. • Design and timing of dredging and dredge disposal should minimize adverse effects on shellfish beds, fisheries resources and submerged aquatic vegetation (CMR 310 9.40(2)).	• The USACE will consult with Mass MADEP and other appropriate authorities regarding proposed design and timing of work activities.
• Shoreward extent of dredging should be a sufficient distance from adjacent marshes (at least 25 feet from marsh boundary) to avoid slumping; bottomslope 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.

3.15 Regulatory Assumptions

Consistent with the National Contingency Plan (NCP), 40 CFR 300.5, "on-site" means the Acushnet River, the existing CDF and Sawyer Street facilities, and all areas in close proximity to the site contamination. Areas associated with the investigation and relocation of combined sewer overflows/storm drains are considered to be in close proximity to the site contamination.

Consistent with CERCLA Section 121(e)(1), it will not be necessary to obtain permits for on-site activities. However, all on-site activities must comply with all substantive requirements of the state and federal rules and regulations identified as ARARs in the Record of Decision (ROD).

APPENDIX B
ALTERNATIVES CONSTRUCTION COST ESTIMATES

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor

Option 1a. Floating Dike	Quantity		Unit Rate	Total	Duration	SUBTOTALS
Mobilization				$384,000		
Geotextile	22,667	sy	$25.84	$585,719	2	
Fill Lifts 1-3	43,200	cy	$66.19	$2,859,577	7	
Fill Lifts 4-6	26,245	cy	$31.41	$824,465	2	
Wic Drains	126,480	vlf	$1.20	$152,197	1	
Geomembrane	132,000	sf	$1.75	$231,423	1	$5,037,380
Supervision & Management	16	mnth	$15,000.00	$240,000		
Administration	16	mnth	$20,000.00	$320,000		
Procurement	16	mnth	$20,000.00	$320,000		
Engineering & QC	16	mnth	$50,000.00	$800,000		
Health & Safety	16	mnth	$35,000.00	$560,000		
Temporary Facilities	16	mnth	$20,000.00	$320,000		
Project Utilities	16	mnth	$10,000.00	$160,000		
Misc. Expenses	16	mnth	$10,000.00	$160,000		$2,880,000
TOTAL COST				$7,917,380		
22.12 Fee 10%				$791,738		
TOTAL				$8,709,000		

3 Months of Project Support Costs included to cover project oversight during Settlement Time.

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Mobilization

Craft Labor	Units	Unit Rate	Total Cost	Comments
Operator	hrs	43.15	0	
Operator OT	hrs	57.54	0	
Laborer	hrs	32.62	0	
Laborer OT	hrs	46.73	0	
Subtotal Cost	0		0	

Equipment	Units	Unit Rate	Total Cost	Comments
			0	
			0	
			0	
Subtotal Cost			0	

Materials	Units	Unit Rate	Total Cost	Comments
			0	
			0	
			0	
Subtotal Cost			0	

Subcontract	Units	Unit Rate	Total Cost	Comments
Mobilize Heavy Equipment	4 ea	500	2,000	Mob/Demob
Mobilize Cranes	4 ea	40,000	160,000	
Mobilize Boats	4 ea	500	2,000	
Mobilize Barges	8 ea	20,000	160,000	
Mob Conveyors	10 ea	1,000	10,000	
Misc.	1 ea	50,000	50,000	
			0	
Subtotal Cost			384,000	

TOTAL COST **384,000**

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Geotextile 22667 sy

Craft Labor	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Operator	1,280 hrs	43.15	55,233	4 ea. @40 Hrs/wk x 40 Days
Operator OT	320 hrs	57.54	18,412	4 ea. @10 Hrs/wk x 40 Days
Laborer	1,920 hrs	32.62	62,621	6 ea. @40 Hrs/wk x 40 days
Laborer OT	480 hrs	46.73	22,432	6 ea. @10 Hrs/wk x 40 days
Subtotal Cost	4,000		158,698	

Equipment	**Units**	**Unit Rate**	**Total Cost**	**Comments**
100' Barge w/ Winch	2.0 mnth	3,800	7,600	
Excavator	2.0 mnth	10,000	20,000	PC-300
Workboats	4.0 mnth	6,000	24,000	2 ea
180' Barge	2.0 mnth	7,600	15,200	2 -90x30's
Crane	15.0 day	2,000	30,000	
Subtotal Cost			96,800	

Materials	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Geotextile	26,067 sy	8.75	228,087	15% for Waste
			0	
			0	
Subtotal Cost			228,087	

Subcontract	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Delivery & Prep	1 ls	50,000	50,000	
Geotextile - Field Seams	26,067 sy	2.00	52,134	
			0	
			0	
Subtotal Cost			102,134	

TOTAL COST **585,719**

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Fill Lifts 1-3	43200 cy	350 cy/day	123 days

Craft Labor	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Operator	6,336 hrs	43.15	273,401.05	6 ea. @40 Hrs/wk x 6 months
Operator OT	1,584 hrs	57.54	91,141.57	6 ea. @10 Hrs/wk x 6 months
Laborer	9,504 hrs	32.62	309,974.29	9 ea. @40 Hrs/wk x 6 months
Laborer OT	2,376 hrs	46.73	111,039.68	9 ea. @10 Hrs/wk x 6 months
Subtotal Cost	19,800		785,556.59	

Equipment	**Units**	**Unit Rate**	**Total Cost**	**Comments**
140' Material Barges	18 mnth	8,500.00	153,000.00	3 ea
Cranel W/ Barge	12 mnth	18,800.00	225,600.00	2 ea
90' Deck Barges	18 mnth	3,800.00	68,400.00	3 ea
Pushboats	12 mnth	6,000.00	72,000.00	2 ea
Loaders	12 mnth	10,000.00	120,000.00	2 ea
100' Conveyor's	24 mnth	8,000.00	192,000.00	4 ea
Feed Conveyor	6 mnth	6,000.00	36,000.00	1 ea
			0.00	
Subtotal Cost			867,000.00	

Materials	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Fuel & Maint.	25%	867,000.00	216,750.00	
Small Tools	7 mnth	3,000.00	21,000.00	
Fill Material	67,680 tn	14.00	947,520.00	42300 cy @ 1.6 tons/cy
			0.00	
			0.00	
			0.00	
Subtotal Cost			1,185,270.00	

Subcontract	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Sieve & Proctor	10 ea	175.00	1,750.00	
In-Place Density Test	hr	75.00	0.00	
Surveys	1 ls	20,000.00	20,000.00	
Subtotal Cost			21,750.00	

TOTAL COST **2,859,576.59**

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Fill Lifts 4-6	21430 cy	500 cy/day	42.9 days

Craft Labor	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Operator	2,160 hrs	43.15	93,204.90	6 ea. @40 Hrs/wk x 9 weeks
Operator OT	540 hrs	57.54	31,070.99	6 ea. @10 Hrs/wk x 9weeks
Laborer	1,440 hrs	32.62	46,965.80	4 ea. @40 Hrs/wk x 9 weeks
Laborer OT	360 hrs	46.73	16,824.19	4 ea. @10 Hrs/wk x 9 weeks
Subtotal Cost	4,500		188,066	

Equipment	**Units**	**Unit Rate**	**Total Cost**	**Comments**
D5 Dozer	3 mnth	5,500	16,500	1 - D5
Excavator	3 mnth	10,000	30,000	1 ea
Loaders	3 mnth	10,000.00	30,000	1 ea
90' Deck Barges	9 mnth	3,800.00	34,200.00	3 ea
100' Conveyor's	12 mnth	8,000.00	96,000	4 ea
Feed Conveyor	3 mnth	6,000.00	18,000	1 ea
			0	
Subtotal Cost			224,700	

Materials	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Fuel & Maint.	25%	224,700	56,175	
Small Tools	0.25 mnth	2,500	625	
Misc. Supplies	1 ls	1,000	1,000	
Fill Material	34,288 cy	6.75	231,444.00	21,430 cy @ 1.6 tn/cy
Armor Stone	4,815 cy	22	105,930	Armor for entire slope
			0	
Subtotal Cost			395,174	

Subcontract	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Sieve & Proctor	3 ea	175.00	525	
In-Place Density Test	80 hr	75.00	6,000	
Surveys	1 ls	10,000.00	10,000	
Subtotal Cost			16,525	

TOTAL COST	**824,465**

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Wic Drains 126480 vlf

Craft Labor	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Operator	320 hrs	43.15	13,808.13	2 ea. @40 Hrs/wk x 4 weeks
Operator OT	80 hrs	57.54	4,603.11	2 ea. @10 Hrs/wk x 4 weeks
Laborer	320 hrs	32.62	10,436.84	2 ea. @40 Hrs/wk x 4 weeks
Laborer OT	80 hrs	46.73	3,738.71	2 ea. @10 Hrs/wk x 4 weeks
Subtotal Cost	800		32,586.80	

Equipment	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Excavator	1.0 mnth	10,000.00	10,000.00	PC 300
100' Barge	1.0 mnth	3,800	3,800.00	
Pushboats	1.0 mnth	6,000.00	6,000.00	
Subtotal Cost			19,800.00	

Materials	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Fuel & Maint.	25%	19,800.00	4,950.00	
			0.00	
			0.00	
Subtotal Cost			4,950.00	

Subcontract	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Wick Drains	126,480 vlf	0.75	94,860.00	~$0.15/lf mat. + ~$0.60/lf installation
Subtotal Cost			94,860.00	

TOTAL COST **152,196.80**

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Geomembrane 132000 sf

Craft Labor	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Operator	176 hrs	43.15	7,594	1 ea. @40 Hrs/wk x 1 months
Operator OT	44 hrs	57.54	2,532	1 ea. @10 Hrs/wk x 1 months
Laborer	176 hrs	32.62	5,740	1 ea. @40 Hrs/wk x 1 months
Laborer OT	44 hrs	46.73	2,056	1 ea. @10 Hrs/wk x 1 months
Subtotal Cost	440		17,923	

Equipment	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Loader	1 mnth	10,000	10,000	
			0	
			0	
Subtotal Cost			10,000	

Materials	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Fuel & Maint.	25%	10,000	2,500	
Small Tools	1 mnth	3,000	3,000	
			0	
			0	
Subtotal Cost			5,500	

Subcontract	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Liner Sub	132,000 sf	1.25	165,000	100 mil HDPE on ~2:1 slope
Cushion Geotextile	132,000 sf	0.25	33,000	
Subtotal Cost			198,000	

TOTAL COST **231,423**

Labor Rates

Decision No:

Equip Oper Engi0004I Group 1

Rate	26.04	Base	
Fringe	10.62	Hlth & Wlfre,etc	
Fringe a	0.00	Haz Premium	
Fringe b	1.04	Holiday	10 Days
FICA	2.07	7.65%	
FUTA	0.22	0.80%	
SUTA	1.38	5.10%	
Work Comp	1.78	6.57%	
	43.15		

Equip Oper OT Engi0004I Group 1

Rate	39.06	Base	
Fringe	10.62	Hlth & Wlfre,etc	
Fringe a	0.00	Haz Premium	
Fringe b	0.00	Holiday	10 Days
FICA	2.99	7.65%	
FUTA	0.31	0.80%	
SUTA	1.99	5.10%	
Work Comp	2.57	6.57%	
	57.54		

Laborer - Haz Labo0022L Group 6

Rate	20.95	Base	
Fringe	7.45	Hlth & Wlfre,etc	
Fringe a	0.00	Haz Premium	
Fringe b	0.00	Holiday	0 Days
FICA	1.60	7.65%	
FUTA	0.17	0.80%	
SUTA	1.07	5.10%	
Work Comp	1.38	6.57%	
	32.62		

Laborer - HazOT Labo0022L Group 6

Rate	31.43	Base	
Fringe	7.45	Hlth & Wlfre,etc	
Fringe a	0.00	Haz Premium	
Fringe b	0.00	Holiday	10 Days
FICA	2.99	7.65%	
FUTA	0.31	0.80%	
SUTA	1.99	5.10%	
Work Comp	2.57	6.57%	
	46.73		

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor

Option 1b. Displacement	Quantity		Unit Rate	Total	Duation	SUBTOTALS
Mobilization				$33,000	1	
Pre-Dredge	10,661	cy	$118.41	$1,262,412	2	
Place Fill	79,500	cy	$24.54	$1,951,166	5	
Geomembrane	81,480	sf	$1.91	$155,643	1	$3,402,220
Supervision & Management	9	mnth	$15,000.00	$135,000		
Administration	9	mnth	$20,000.00	$180,000		
Procurement	9	mnth	$20,000.00	$180,000		
Engineering & QC	9	mnth	$50,000.00	$450,000		
Health & Safety	9	mnth	$35,000.00	$315,000		
Temporary Facilities	9	mnth	$20,000.00	$180,000		
Project Utilities	9	mnth	$10,000.00	$90,000		
Misc. Expenses	9	mnth	$10,000.00	$90,000		$1,620,000
TOTAL COST				$5,022,220		
22.12 Fee 10%				$502,222		
TOTAL				$5,524,442		

Pre-Dredge duration revised to 2 months to account for increased to dredging quantity.

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Mobilization

Craft Labor	Units	Unit Rate	Total Cost	Comments
Operator	hrs	43.15	0	
Operator OT	hrs	57.54	0	
Laborer	hrs	32.62	0	
Laborer OT	hrs	46.73	0	
Subtotal Cost	0		0	

Equipment	Units	Unit Rate	Total Cost	Comments
			0	
			0	
			0	
Subtotal Cost			0	

Materials	Units	Unit Rate	Total Cost	Comments
			0	
			0	
			0	
Subtotal Cost			0	

Subcontract	Units	Unit Rate	Total Cost	Comments
Mobilize Equipment	16 ea	500	8,000	Mob/Demob
Misc.	1 ls	25,000	25,000	
			0	
			0	
			0	
			0	
			0	
Subtotal Cost			33,000	

TOTAL COST	**33,000**

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Pre-Dredge

Craft Labor	Units		Unit Rate	Total Cost	Comments
Operator	2,232	hrs	43.15	96,312	1.5 Operators 24/7 Water Treatment
Operator OT		hrs	57.54	0	
Laborer		hrs	32.62	0	
Laborer OT		hrs	46.73	0	
Subtotal Cost	2,232			96,312	

Equipment	Units	Unit Rate	Total Cost	Comments
			0	
			0	
			0	
			0	
Subtotal Cost			0	

Materials	Units	Unit Rate	Total Cost	Comments
			0	
Subtotal Cost			0	

Subcontract	Units		Unit Rate	Total Cost	Comments
Water Treatment	2	mnth	50,000	100,000	Power,Sampling, Supplies
Dredging	10,661	cy	100	1,066,100	Revised Dredge Quantity
				0	
				0	
Subtotal Cost				1,166,100	

TOTAL COST	**1,262,412**

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Place Fill

Craft Labor	Units	Unit Rate	Total Cost	Comments
Operator	4,400 hrs	43.15	189,861.84	5 ea. @40 Hrs/wk x 5 months
Operator OT	1,100 hrs	57.54	63,292.76	5 ea. @10 Hrs/wk x 5 months
Teamsters	2,640	43.15	113,916.00	3 ea. @40 Hrs/wk x 5 months
Teamster OT	660	57.54	37,976.40	3 ea. @10 Hrs/wk x 5 months
Laborer	3,520 hrs	32.62	114,805.29	4 ea. @40 Hrs/wk x 5 months
Laborer OT	880 hrs	46.73	41,125.81	4 ea. @10 Hrs/wk x 5 months
Subtotal Cost	13,200		560,978.10	

Equipment	Units	Unit Rate	Total Cost	Comments
Excavator	5 mnth	10,000	50,000	PC 300
35 Ton End Dumps	15 mnth	12,000	180,000	3 ea
988 Cat Loader	10 mnth	12,000	120,000	2 ea
Backhoe	5 mnth	2,600	13,000	Case 580
Dozer	5 mnth	7,500	37,500	D-6 Cat
			0.00	
Subtotal Cost			400,500.00	

Materials	Units	Unit Rate	Total Cost	Comments
Fuel & Maint.	25%	400,500.00	100,125.00	
Small Tools	5 mnth	2,500.00	12,500.00	
Fill Material	114,750 tn	6.75	774,562.50	76,500 cy @ 1.5 tons/cy
Armor Stone	3,000 cy	22.00	66,000.00	
			0.00	
			0.00	
			0.00	
			0.00	
			0.00	
Subtotal Cost			953,187.50	

Subcontract	Units	Unit Rate	Total Cost	Comments
Sieve & Proctor	20 ea	175.00	3,500.00	
In-Place Density Test	440 hr	75.00	33,000.00	5 months 4hrs/day
Subtotal Cost			36,500.00	

TOTAL COST **1,951,165.60**

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Geomembrane

Craft Labor	Units	Unit Rate	Total Cost	Comments
Operator	176 hrs	43.15	7,594	1 ea. @40 Hrs/wk x 1 month
Operator OT	44 hrs	57.54	2,532	1 ea. @10 Hrs/wk x 1 month
Laborer	176 hrs	32.62	5,740	1 ea. @40 Hrs/wk x 1 month
Laborer OT	44 hrs	46.73	2,056	1 ea. @10 Hrs/wk x 1 month
Subtotal Cost	440		17,923	

Equipment	Units	Unit Rate	Total Cost	Comments
Loader	1 mnth	10,000	10,000	
			0	
			0	
Subtotal Cost			10,000	

Materials	Units	Unit Rate	Total Cost	Comments
Fuel & Maint.	25%	10,000	2,500	
Small Tools	1.0 mnth	3,000	3,000	
			0	
			0	
Subtotal Cost			5,500	

Subcontract	Units	Unit Rate	Total Cost	Comments
Liner Sub	81,480 sf	1.25	101,850	100 mil HDPE on ~2:1 slope
Cushion Geotextile	81,480 sf	0.25	20,370	
Subtotal Cost			122,220	

TOTAL COST **155,643**

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Blank

Craft Labor	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Operator	hrs	43.15	0	
Operator OT	hrs	57.54	0	
Laborer	hrs	32.62	0	
Laborer OT	hrs	46.73	0	
Subtotal Cost	0		0	

Equipment	**Units**	**Unit Rate**	**Total Cost**	**Comments**
			0	
			0	
			0	
			0	
			0	
			0	
			0	
			0	
			0	
			0	
			0	
			0	
			0	
Subtotal Cost			0	

Materials	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Fuel & Maint.	25%	0	0	
Small Tools	0 mnth	2,500	0	
			0	
			0	
Subtotal Cost			0	

			4	
Subcontract	**Units**	**Unit Rate**	**Total Cost**	**Comments**
			0	
			0	
			0	
			0	
Subtotal Cost			0	

TOTAL COST **0**

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Blank 2

Craft Labor	Units		Unit Rate	Total Cost	Comments
Operator		hrs	43.15	0	
Operator OT		hrs	57.54	0	
Laborer		hrs	32.62	0	
Laborer OT		hrs	46.73	0	
Subtotal Cost	0			0	

Equipment	Units	Unit Rate	Total Cost	Comments
			0	
			0	
			0	
			0	
Subtotal Cost			0	

Materials	Units		Unit Rate	Total Cost	Comments
Fuel & Maint.	25%		0	0	
Small Tools	0	mnth	2,500	0	
				0	
				0	
Subtotal Cost				0	

Subcontract	Units	Unit Rate	Total Cost	Comments
			0	
			0	
			0	
			0	
			0	
Subtotal Cost			0	

TOTAL COST	**0**

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Blank 3

Craft Labor	Units		Unit Rate	Total Cost	Comments
Operator		hrs	43.15	0	
Operator OT		hrs	57.54	0	
Laborer		hrs	32.62	0	
Laborer OT		hrs	46.73	0	
Subtotal Cost	0			0	

Equipment	Units		Unit Rate	Total Cost	Comments
				0	
				0	
Subtotal Cost				0	

Materials	Units		Unit Rate	Total Cost	Comments
Fuel & Maint.	25%		0	0	
Small Tools		mnth	2,500	0	
				0	
				0	
Subtotal Cost				0	

Subcontract	Units		Unit Rate	Total Cost	Comments
				0	
				0	
				0	
				0	
				0	
				0	
Subtotal Cost				0	

TOTAL COST **0**

Labor Rates

Decision No:

Equip Oper Engi0004I Group 1

Rate	26.04	Base	
Fringe	10.62	Hlth & Wlfre,etc	
Fringe a	0.00	Haz Premium	
Fringe b	1.04	Holiday	10 Days
FICA	2.07	7.65%	
FUTA	0.22	0.80%	
SUTA	1.38	5.10%	
Work Comp	1.78	6.57%	
	43.15		

Equip Oper OT Engi0004I Group 1

Rate	39.06	Base	
Fringe	10.62	Hlth & Wlfre,etc	
Fringe a	0.00	Haz Premium	
Fringe b	0.00	Holiday	10 Days
FICA	2.99	7.65%	
FUTA	0.31	0.80%	
SUTA	1.99	5.10%	
Work Comp	2.57	6.57%	
	57.54		

Laborer - Haz Labo0022L Group 6

Rate	20.95	Base	
Fringe	7.45	Hlth & Wlfre,etc	
Fringe a	0.00	Haz Premium	
Fringe b	0.00	Holiday	0 Days
FICA	1.60	7.65%	
FUTA	0.17	0.80%	
SUTA	1.07	5.10%	
Work Comp	1.38	6.57%	
	32.62		

Laborer - HazOT Labo0022L Group 6

Rate	31.43	Base	
Fringe	7.45	Hlth & Wlfre,etc	
Fringe a	0.00	Haz Premium	
Fringe b	0.00	Holiday	10 Days
FICA	2.99	7.65%	
FUTA	0.31	0.80%	
SUTA	1.99	5.10%	
Work Comp	2.57	6.57%	
	46.73		

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor

Revised by Mark Otten 4/29/00

Option 1c. Excavate & Remove Clay	Quantity		Unit Rate	Total	Duration	SUBTOTALS
Mobilization				$169,000		
Drive Sheets	109,000	sf	$22.82	$2,487,060	4	
Pre-Dredge	8,524	cy	$111.52	$950,556	1	
Excavate Clay	33,000	cy	$104.40	$3,445,066	2	
Marine Fill	60,570	cy	$25.25	$1,529,297	5	
Land Fill	21,430	cy	$20.47	$438,721		
Geomembrane	81,480	sf	$1.91	$155,643	1	$9,175,343
Supervision & Management	13	mnth	$15,000.00	$195,000		
Administration	13	mnth	$20,000.00	$260,000		
Procurement	13	mnth	$20,000.00	$260,000		
Engineering & QC	13	mnth	$50,000.00	$650,000		
Health & Safety	13	mnth	$35,000.00	$455,000		
Temporary Facilities	13	mnth	$20,000.00	$260,000		
Project Utilities	13	mnth	$10,000.00	$130,000		
Misc. Expenses	13	mnth	$10,000.00	$130,000		$2,340,000
TOTAL COST				$11,515,343		
22.12 Fee 10%				$1,151,534		
TOTAL				$12,666,877		

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Mobilization

Craft Labor	Units	Unit Rate	Total Cost	Comments
Operator	hrs	43.15	0	
Operator OT	hrs	57.54	0	
Laborer	hrs	32.62	0	
Laborer OT	hrs	46.73	0	
Subtotal Cost	0		0	

Equipment	Units	Unit Rate	Total Cost	Comments
			0	
			0	
			0	
Subtotal Cost			0	

Materials	Units	Unit Rate	Total Cost	Comments
			0	
			0	
			0	
Subtotal Cost			0	

Subcontract	Units	Unit Rate	Total Cost	Comments
Mobilize Equipment	16 ea	500	8,000	
Mobilize Crane	2 ea	40,000	80,000	
Mobilize Barges	4 ea	20,000	80,000	
Mobilize Boats	2 ea	500	1,000	
			0	
			0	
			0	
Subtotal Cost			169,000	

TOTAL COST **169,000**

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Drive Sheets

Craft Labor	Units	Unit Rate	Total Cost	Comments
Operator	hrs	43.15	0	
Operator OT	hrs	57.54	0	
Laborer	hrs	32.62	0	
Laborer OT	hrs	46.73	0	
Subtotal Cost	0		0	

Equipment	Units	Unit Rate	Total Cost	Comments
			0	
			0	
			0	
			0	
Subtotal Cost			0	

Materials	Units	Unit Rate	Total Cost	Comments
			0	
			0	
			0	
Subtotal Cost			0	

Subcontract	Units	Unit Rate	Total Cost	Comments
Temporary Sheets	59,000 sf	20.34	1,200,060	
Permanent Sheets	50,000 sf	25.74	1,287,000	
			0	
			0	
Subtotal Cost			2,487,060	

TOTAL COST	**2,487,060**

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Pre-Dredge

Craft Labor	**Units**		**Unit Rate**	**Total Cost**	**Comments**
Operator	1,116	hrs	43.15	48,156	1.5 Operators 24/7 Water Treatment
Operator OT		hrs	57.54	0	
Laborer		hrs	32.62	0	
Laborer OT		hrs	46.73	0	
Subtotal Cost	1,116			48,156	

Equipment	**Units**	**Unit Rate**	**Total Cost**	**Comments**
			0	
			0	
			0	
			0	
Subtotal Cost			0	

Materials	**Units**	**Unit Rate**	**Total Cost**	**Comments**
			0	
Subtotal Cost			0	

Subcontract	**Units**		**Unit Rate**	**Total Cost**	**Comments**
Water Treatment	1	mnth	50,000	50,000	Power,Sampling, Supplies
Dredging	8,524	cy	100	852,400	Revised Dredging Quantity
				0	
				0	
Subtotal Cost				902,400	

TOTAL COST	**950,556**

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Excavate Clay	33000 cy	750 cy/day	44 days

Craft Labor	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Operator	1,056 hrs	43.15	45,566.84	3 ea. @40 Hrs/wk x 2 months
Operator OT	264 hrs	57.54	15,190.26	3 ea. @10 Hrs/wk x 2 months
Laborer	2,112 hrs	32.62	68,883.18	26ea. @40 Hrs/wk x 2 months
Laborer OT	528 hrs	46.73	24,675.48	6 ea. @10 Hrs/wk x 2 months
Subtotal Cost	3,960		154,315.76	

Equipment	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Clamshell & Barge	2 mnth	15,000.00	30,000.00	1 ea
Spoils Barge	2 mnth	8,500.00	17,000.00	1 ea
Pushboats	4 mnth	6,000.00	24,000.00	2 ea
Bottom Dump Barge	2 mnth	12,000.00	24,000.00	
Pump & Pipeline	2 mnth	20,000.00	40,000.00	
			0.00	
Subtotal Cost			135,000.00	

Materials	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Fuel & Maint.	25%	135,000.00	33,750.00	
Small Tools	0 mnth	2,500.00	0.00	
			0.00	
			0.00	
			0.00	
			0.00	
			0.00	
			0.00	
			0.00	
Subtotal Cost			33,750.00	

Subcontract	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Disposal Facility Research & Approval - Regulatory Compl.	1 ls	20,000.00	20,000.00	
Clay Disposal Fees	49,500 tn	60.00	2,970,000.00	33,000 cy @ 1.5 tons/cy
Analytical Testing	66 ea	2,000.00	132,000.00	1 sample/500 cy
Subtotal Cost			3,122,000.00	

TOTAL COST **3,445,065.76**

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Marine Fill	60570 cy	750 cy/day	80.8 days

Craft Labor	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Operator	3,200 hrs	43.15	138,081.34	5 ea. @40 Hrs/wk x 4 months
Operator OT	800 hrs	57.54	46,031.10	5 ea. @10 Hrs/wk x 4 months
Teamsters	640 hrs	43.15	27,616.00	1 ea. @40 Hrs/wk x 4 months
Teamster OT	160 hrs	57.54	9,206.40	1 ea. @10 Hrs/wk x 4 months
Laborer	3,840 hrs	32.62	125,242.14	6 ea. @40 Hrs/wk x 4 months
Laborer OT	960 hrs	46.73	44,864.52	6 ea. @10 Hrs/wk x 4 months
Subtotal Cost	9,600		391,041.49	

Equipment	**Units**	**Unit Rate**	**Total Cost**	**Comments**
140' Material Barges	8 mnth	8,500.00	68,000.00	2 ea
Cranel W/ Barge	4 mnth	18,800.00	75,200.00	1 ea
90' Deck Barges	8 mnth	3,800.00	30,400.00	2 ea
Pushboats	8 mnth	6,000.00	48,000.00	2 ea
Loaders	4 mnth	10,000.00	40,000.00	1 ea
100' Conveyor's	8 mnth	8,000.00	64,000.00	2 ea
Feed Conveyor	4 mnth	6,000.00	24,000.00	1 ea
			0.00	
Subtotal Cost			349,600.00	

Materials	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Fuel & Maint.	25%	349,600.00	87,400.00	
Small Tools	4 mnth	2,500.00	10,000.00	
Fill Material	92,112 tn	6.75	621,756.00	57,570 cy @ 1.6 tn/cy
Armor Stone	3,000 cy	22.00	66,000.00	
			0.00	
			0.00	
			0.00	
			0.00	
			0.00	
Subtotal Cost			785,156.00	

Subcontract	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Sieve & Proctor	20 ea	175.00	3,500.00	
In-Place Density Test	0 hr	75.00	0.00	
Subtotal Cost			3,500.00	

TOTAL COST **1,529,297.49**

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Land Fill	21430 cy	750 cy/day	28.6 days	
				Use same Land Fill volume as Alt 1A

Craft Labor	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Operator	1,440 hrs	43.15	62,136.60	6 ea. @40 Hrs/wk x 6 weeks
Operator OT	360 hrs	57.54	20,713.99	6 ea. @10 Hrs/wk x 6 weeks
Laborer	960 hrs	32.62	31,310.53	4 ea. @40 Hrs/wk x 6 weeks
Laborer OT	240 hrs	46.73	11,216.13	4 ea. @10 Hrs/wk x 6 weeks
Subtotal Cost	3,000		125,377	

Equipment	**Units**	**Unit Rate**	**Total Cost**	**Comments**
D5 Dozer	2 mnth	5,500	11,000	1 - D5
Excavator	2 mnth	10,000	20,000	1 ea
Loaders	2 mnth	10,000.00	20,000	1 ea
90' Deck Barges	0 mnth	3,800.00	0.00	
100' Conveyor's	0 mnth	8,000.00	0	
Feed Conveyor	0 mnth	6,000.00	0	
			0	
Subtotal Cost			51,000	

Materials	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Fuel & Maint.	25%	51,000	12,750	
Small Tools	0.25 mnth	2,500	625	
Misc. Supplies	1 ls	1,000	1,000	
Fill Material	34,288 cy	6.75	231,444.00	21,430 cy @ 1.6 tn/cy
			0	
Subtotal Cost			245,819	

Subcontract	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Sieve & Proctor	3 ea	175.00	525	
In-Place Density Test	80 hr	75.00	6,000	
Surveys	1 ls	10,000.00	10,000	
Subtotal Cost			16,525	

TOTAL COST **438,721**

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Geomembrane

Craft Labor	Units	Unit Rate	Total Cost	Comments
Operator	176 hrs	43.15	7,594	1 ea. @40 Hrs/wk x 1 month
Operator OT	44 hrs	57.54	2,532	1 ea. @10 Hrs/wk x 1 month
Laborer	176 hrs	32.62	5,740	1 ea. @40 Hrs/wk x 1 month
Laborer OT	44 hrs	46.73	2,056	1 ea. @10 Hrs/wk x 1 month
Subtotal Cost	440		17,923	

Equipment	Units	Unit Rate	Total Cost	Comments
Loader	1 mnth	10,000	10,000	
			0	
			0	
Subtotal Cost			10,000	

Materials	Units	Unit Rate	Total Cost	Comments
Fuel & Maint.	25%	10,000	2,500	
Small Tools	1.0 mnth	3,000	3,000	
			0	
			0	
Subtotal Cost			5,500	

Subcontract	Units	Unit Rate	Total Cost	Comments
Liner Sub	81,480 sf	1.25	101,850	
Cushion Geotextile	81,480 sf	0.25	20,370	
Subtotal Cost			122,220	

TOTAL COST **155,643**

Labor Rates

Decision No:

Equip Oper Engi0004I Group 1

Rate	26.04	Base	
Fringe	10.62	Hlth & Wlfre,etc	
Fringe a	0.00	Haz Premium	
Fringe b	1.04	Holiday	10 Days
FICA	2.07	7.65%	
FUTA	0.22	0.80%	
SUTA	1.38	5.10%	
Work Comp	1.78	6.57%	
	43.15		

Equip Oper OT Engi0004I Group 1

Rate	39.06	Base	
Fringe	10.62	Hlth & Wlfre,etc	
Fringe a	0.00	Haz Premium	
Fringe b	0.00	Holiday	10 Days
FICA	2.99	7.65%	
FUTA	0.31	0.80%	
SUTA	1.99	5.10%	
Work Comp	2.57	6.57%	
	57.54		

Laborer - Haz Labo0022L Group 6

Rate	20.95	Base	
Fringe	7.45	Hlth & Wlfre,etc	
Fringe a	0.00	Haz Premium	
Fringe b	0.00	Holiday	0 Days
FICA	1.60	7.65%	
FUTA	0.17	0.80%	
SUTA	1.07	5.10%	
Work Comp	1.38	6.57%	
	32.62		

Laborer - HazOT Labo0022L Group 6

Rate	31.43	Base	
Fringe	7.45	Hlth & Wlfre,etc	
Fringe a	0.00	Haz Premium	
Fringe b	0.00	Holiday	10 Days
FICA	2.99	7.65%	
FUTA	0.31	0.80%	
SUTA	1.99	5.10%	
Work Comp	2.57	6.57%	
	46.73		

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor

Option 2 Pile Supported Concrete Wall	Quantity		Unit Rate	Total	Duration	SUBTOTALS
Mobilization				$169,000		
Drive Piles	51,000	vlf	$31.13	$1,587,630	6	
De-watering & Water Treatment	1	mo	$226,202	$226,202		
Interior Sheets	54,320	sf	$25.74	$1,398,197	3	
Exterior Sheets	54,320	sf	$20.34	$1,104,869	3	
Base Forms	30,000	sf	$10.00	$300,000	1	
Wall Forms	40,740	sf	$10.85	$442,029	2	
Rebar	80	ton	$1,200.00	$96,000	1	
Concrete-Base	3,320	cy	$107.00	$355,240	1.5	
Concrete-Wall	1,510	cy	$117.00	$176,670	1	
Geomembrane	81,000	sf	$1.90	$153,900	1	$6,009,737
Supervision & Management	20	mnth	$15,000.00	$292,500		
Administration	20	mnth	$20,000.00	$390,000		
Procurement	20	mnth	$20,000.00	$390,000		
Engineering & QC	20	mnth	$50,000.00	$975,000		
Health & Safety	20	mnth	$35,000.00	$682,500		
Temporary Facilities	20	mnth	$20,000.00	$390,000		
Project Utilities	20	mnth	$10,000.00	$195,000		
Misc. Expenses	20	mnth	$10,000.00	$195,000		$3,510,000
TOTAL COST				$9,519,737		
22.12 Fee 10%				$951,974		
TOTAL				$10,471,711		

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

De-watering & Water Treatment

Craft Labor	Units	Unit Rate	Total Cost	Comments
Operator	2,232 hrs	43.15	96,312	3 Operators 24/7 Water Treatment, Pumping
Operator OT	hrs	57.54	0	
Laborer	744 hrs	32.62	24,266	1 Laborer for support
Laborer OT	hrs	46.73	0	
Subtotal Cost	2,976		120,577	

Equipment	Units	Unit Rate	Total Cost	Comments
100 GPM Pumps (3) ea	1 mo	4,500	4,500	2 operating, 1 standby pump @ $1,500/mo
			0	
			0	
			0	
Subtotal Cost			4,500	

Materials	Units	Unit Rate	Total Cost	Comments
Fuel & Maint.	25%	4,500.00	1,125.00	
			0	
Subtotal Cost			1,125	

Subcontract	Units	Unit Rate	Total Cost	Comments
Water Treatment	1 mnth	100,000	100,000	Power,Sampling, Supplies
			0	
			0	
Subtotal Cost			100,000	

TOTAL COST	**226,202**

APPENDIX C

VALUE ENGINEERING CONSTRUCTION COST ESTIMATES

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor

Revised Option 1a. Floating Dike - VE Proposal 7,90 -	Quantity		Unit Rate	Total	Duration	SUBTOTALS	
Mobilization				$ 384,000			
Geotextile	22,667	sy	$25.84	$ 585,715	2		
Fill Lifts 1-3	37,860	cy	$66.19	$ 2,505,953	7		
Fill Lifts 4-6	20,905	cy	$31.41	$ 656,713	2		
Wic Drains	126,480	vlf	$1.20	$ 152,197	1		
Vinyl Sheet Pile	21,760	sf	$13.00	$ 282,880	1		1,360 lf @ 16' height; Geoguard 500
Geomembrane	132,000	sf	$1.75	$ 231,423	1	$ 4,798,881	
Supervision & Managemen	14	mnth	$15,000.00	$ 210,000			
Administration	14	mnth	$20,000.00	$ 280,000			
Procurement	14	mnth	$20,000.00	$ 280,000			
Engineering & QC	14	mnth	$50,000.00	$ 700,000			
Health & Safety	14	mnth	$35,000.00	$ 490,000			
Temporary Facilities	14	mnth	$20,000.00	$ 280,000			
Project Utilities	14	mnth	$10,000.00	$ 140,000			
Misc. Expenses	14	mnth	$10,000.00	$ 140,000		$ 2,520,000	
TOTAL COST				$ 7,318,881			
22.12 Fee 10%				$ 731,888			
TOTAL				$ 8,050,770			

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor

Revised Option 1b. Displacement - VE Proposal 39							
	Quantity		Unit Rate		Total	Duation	SUBTOTALS
Mobilization				$	33,000	1	
Pre-Dredge	7,100	cy	$113.82	$	808,156	1	
Geotextile	22,667	sy	$25.84	$	585,715	2	
Place Fill	79,500	cy	$24.54	$	1,951,166	5	
Geomembrane	81,480	sf	$1.91	$	155,643	1	$3,533,679
Supervision & Management	10	mnth	$15,000.00	$	150,000		
Administration	10	mnth	$20,000.00	$	200,000		
Procurement	10	mnth	$20,000.00	$	200,000		
Engineering & QC	10	mnth	$50,000.00	$	500,000		
Health & Safety	10	mnth	$35,000.00	$	350,000		
Temporary Facilities	10	mnth	$20,000.00	$	200,000		
Project Utilities	10	mnth	$10,000.00	$	100,000		
Misc. Expenses	10	mnth	$10,000.00	$	100,000		$1,800,000
TOTAL COST				$	5,333,679		
22.12 Fee 10%				$	533,368		
TOTAL				$	5,867,047		

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor

Revised by Mark Otten 4/29/00

Revised Option 1c. Excavate & Remove Clay
Modified by VE Proposal 38, 42

	Quantity		Unit Rate	Total	Duration	SUBTOTALS
Mobilization				$169,000		
Drive Sheets	0	sf		$0		
Pre-Dredge	8,524	cy	$111.52	$950,556	1	
Excavate Clay	48,300	cy	$104.33	$5,039,187	3	
Marine Fill	72,520	cy	$38.00	$2,755,805	5	
Land Fill	21,430	cy	$20.47	$438,721		
Geomembrane	81,480	sf	$1.91	$155,643	1	$9,508,912
Supervision & Management	10	mnth	$15,000.00	$150,000		
Administration	10	mnth	$20,000.00	$200,000		
Procurement	10	mnth	$20,000.00	$200,000		
Engineering & QC	10	mnth	$50,000.00	$500,000		
Health & Safety	10	mnth	$35,000.00	$350,000		
Temporary Facilities	10	mnth	$20,000.00	$200,000		
Project Utilities	10	mnth	$10,000.00	$100,000		
Misc. Expenses	10	mnth	$10,000.00	$100,000		$1,800,000
TOTAL COST				$11,308,912		
22.12 Fee 10%				$1,130,891		
TOTAL				$12,440,000		

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Mobilization

Craft Labor	Units	Unit Rate	Total Cost	Comments
Operator	hrs	43.15	0	
Operator OT	hrs	57.54	0	
Laborer	hrs	32.62	0	
Laborer OT	hrs	46.73	0	
Subtotal Cost	0		0	

Equipment	Units	Unit Rate	Total Cost	Comments
			0	
			0	
			0	
Subtotal Cost			0	

Materials	Units	Unit Rate	Total Cost	Comments
			0	
			0	
			0	
Subtotal Cost			0	

Subcontract	Units	Unit Rate	Total Cost	Comments
Mobilize Equipment	16 ea	500	8,000	
Mobilize Crane	2 ea	40,000	80,000	
Mobilize Barges	4 ea	20,000	80,000	
Mobilize Boats	2 ea	500	1,000	
			0	
			0	
			0	
Subtotal Cost			169,000	

TOTAL COST	**169,000**

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Drive Sheets

Craft Labor	Units	Unit Rate	Total Cost	Comments
Operator	hrs	43.15	0	
Operator OT	hrs	57.54	0	
Laborer	hrs	32.62	0	
Laborer OT	hrs	46.73	0	
Subtotal Cost	0		0	

Equipment	Units	Unit Rate	Total Cost	Comments
			0	
			0	
			0	
			0	
Subtotal Cost			0	

Materials	Units	Unit Rate	Total Cost	Comments
			0	
			0	
			0	
Subtotal Cost			0	

Subcontract	Units	Unit Rate	Total Cost	Comments
Temporary Sheets	0 sf	20.34	0	
Permanent Sheets	0 sf	25.74	0	
			0	
			0	
Subtotal Cost			0	

TOTAL COST	**0**

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Pre-Dredge

Craft Labor	Units	Unit Rate	Total Cost	Comments
Operator	1,116 hrs	43.15	48,156	1.5 Operators 24/7 Water Treatment
Operator OT	hrs	57.54	0	
Laborer	hrs	32.62	0	
Laborer OT	hrs	46.73	0	
Subtotal Cost	1,116		48,156	

Equipment	Units	Unit Rate	Total Cost	Comments
			0	
			0	
			0	
			0	
Subtotal Cost			0	

Materials	Units	Unit Rate	Total Cost	Comments
			0	
Subtotal Cost			0	

Subcontract	Units	Unit Rate	Total Cost	Comments
Water Treatment	1 mnth	50,000	50,000	Power,Sampling, Supplies
Dredging	8,524 cy	100	852,400	
			0	
			0	
Subtotal Cost			902,400	

TOTAL COST	**950,556**

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Excavate Clay	48300 cy	750 cy/day	64 days

Craft Labor	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Operator	1,546 hrs	43.15	66,693.29	3 ea. @40 Hrs/wk x 3 months
Operator OT	386 hrs	57.54	22,233.02	3 ea. @10 Hrs/wk x 3 months
Laborer	3,091 hrs	32.62	100,819.92	26ea. @40 Hrs/wk x 3 months
Laborer OT	773 hrs	46.73	36,115.94	6 ea. @10 Hrs/wk x 3 months
Subtotal Cost	5,796		225,862.16	

Equipment	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Clamshell & Barge	3 mnth	15,000.00	45,000.00	1 ea
Spoils Barge	3 mnth	8,500.00	25,500.00	1 ea
Pushboats	6 mnth	6,000.00	36,000.00	2 ea
Bottom Dump Barge	3 mnth	12,000.00	36,000.00	
Pump & Pipeline	3 mnth	20,000.00	60,000.00	
			0.00	
Subtotal Cost			202,500.00	

Materials	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Fuel & Maint.	25%	202,500.00	50,625.00	
Small Tools	0 mnth	2,500.00	0.00	
			0.00	
			0.00	
			0.00	
			0.00	
			0.00	
			0.00	
			0.00	
Subtotal Cost			50,625.00	

Subcontract	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Disposal Facility Research & Approval - Regulatory Compl.	1 ls	20,000.00	20,000.00	
Clay Disposal Fees	72,450 tn	60.00	4,347,000.00	48,300 cy @ 1.5 tons/cy
Analytical Testing	97 ea	2,000.00	193,200.00	1 sample/500 cy
Subtotal Cost			4,560,200.00	

TOTAL COST **5,039,187.16**

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Marine Fill	72520 cy	750 cy/day	96.7 days
			96,950 less 24,430 land fill

Craft Labor	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Operator	4,000 hrs	43.15	172,601.67	5 ea. @40 Hrs/wk x 5 months
Operator OT	1,000 hrs	57.54	57,538.87	5 ea. @10 Hrs/wk x 5 months
Teamsters	800 hrs	43.15	34,520.00	1 ea. @40 Hrs/wk x 5 months
Teamster OT	200 hrs	57.54	11,508.00	1 ea. @10 Hrs/wk x 5 months
Laborer	4,800 hrs	32.62	156,552.67	6 ea. @40 Hrs/wk x 5 months
Laborer OT	1,200 hrs	46.73	56,080.65	6 ea. @10 Hrs/wk x 5 months
Subtotal Cost	12,000		488,801.86	

Equipment	**Units**	**Unit Rate**	**Total Cost**	**Comments**
140' Material Barges	10 mnth	8,500.00	85,000.00	2 ea
Cranel W/ Barge	5 mnth	18,800.00	94,000.00	1 ea
90' Deck Barges	10 mnth	3,800.00	38,000.00	2 ea
Pushboats	10 mnth	6,000.00	60,000.00	2 ea
Loaders	5 mnth	10,000.00	50,000.00	1 ea
100' Conveyor's	10 mnth	8,000.00	80,000.00	2 ea
Feed Conveyor	5 mnth	6,000.00	30,000.00	1 ea
			0.00	
Subtotal Cost			437,000.00	

Materials	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Fuel & Maint.	25%	437,000.00	109,250.00	
Small Tools	4 mnth	2,500.00	10,000.00	
Fill Material	116,032 tn	14.00	1,624,448.00	72520 cy @ 1.6 tn/cy
Armor Stone	3,000 cy	22.00	66,000.00	
			0.00	
			0.00	
			0.00	
			0.00	
			0.00	
Subtotal Cost			1,809,698.00	

Subcontract	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Sieve & Proctor	116 ea	175.00	20,305.60	1 test/1000 tons
In-Place Density Test	0 hr	75.00	0.00	
Subtotal Cost			20,305.60	

TOTAL COST **2,755,805.46**

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Land Fill	21430 cy	750 cy/day	28.6 days	
				Use same Land Fill volume as Alt 1A

Craft Labor	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Operator	1,440 hrs	43.15	62,136.60	6 ea. @40 Hrs/wk x 6 weeks
Operator OT	360 hrs	57.54	20,713.99	6 ea. @10 Hrs/wk x 6 weeks
Laborer	960 hrs	32.62	31,310.53	4 ea. @40 Hrs/wk x 6 weeks
Laborer OT	240 hrs	46.73	11,216.13	4 ea. @10 Hrs/wk x 6 weeks
Subtotal Cost	3,000		125,377	

Equipment	**Units**	**Unit Rate**	**Total Cost**	**Comments**
D5 Dozer	2 mnth	5,500	11,000	1 - D5
Excavator	2 mnth	10,000	20,000	1 ea
Loaders	2 mnth	10,000.00	20,000	1 ea
90' Deck Barges	0 mnth	3,800.00	0.00	
100' Conveyor's	0 mnth	8,000.00	0	
Feed Conveyor	0 mnth	6,000.00	0	
			0	
Subtotal Cost			51,000	

Materials	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Fuel & Maint.	25%	51,000	12,750	
Small Tools	0.25 mnth	2,500	625	
Misc. Supplies	1 ls	1,000	1,000	
Fill Material	34,288 cy	6.75	231,444.00	21,430 cy @ 1.6 tn/cy
			0	
Subtotal Cost			245,819	

Subcontract	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Sieve & Proctor	3 ea	175.00	525	
In-Place Density Test	80 hr	75.00	6,000	
Surveys	1 ls	10,000.00	10,000	
Subtotal Cost			16,525	

TOTAL COST **438,721**

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Geomembrane

Craft Labor	Units	Unit Rate	Total Cost	Comments
Operator	176 hrs	43.15	7,594	1 ea. @40 Hrs/wk x 1 month
Operator OT	44 hrs	57.54	2,532	1 ea. @10 Hrs/wk x 1 month
Laborer	176 hrs	32.62	5,740	1 ea. @40 Hrs/wk x 1 month
Laborer OT	44 hrs	46.73	2,056	1 ea. @10 Hrs/wk x 1 month
Subtotal Cost	440		17,923	

Equipment	Units	Unit Rate	Total Cost	Comments
Loader	1 mnth	10,000	10,000	
			0	
			0	
Subtotal Cost			10,000	

Materials	Units	Unit Rate	Total Cost	Comments
Fuel & Maint.	25%	10,000	2,500	
Small Tools	1.0 mnth	3,000	3,000	
			0	
			0	
Subtotal Cost			5,500	

Subcontract	Units	Unit Rate	Total Cost	Comments
Liner Sub	81,480 sf	1.25	101,850	100 mil HDPE on ~2:1 slope
Cushion Geotextile	81,480 sf	0.25	20,370	
Subtotal Cost			122,220	

TOTAL COST **155,643**

Labor Rates

Decision No:

Equip Oper Engi0004I Group 1

Rate	26.04	Base	
Fringe	10.62	Hlth & Wlfre,etc	
Fringe a	0.00	Haz Premium	
Fringe b	1.04	Holiday	10 Days
FICA	2.07	7.65%	
FUTA	0.22	0.80%	
SUTA	1.38	5.10%	
Work Comp	1.78	6.57%	
	43.15		

Equip Oper OT Engi0004I Group 1

Rate	39.06	Base	
Fringe	10.62	Hlth & Wlfre,etc	
Fringe a	0.00	Haz Premium	
Fringe b	0.00	Holiday	10 Days
FICA	2.99	7.65%	
FUTA	0.31	0.80%	
SUTA	1.99	5.10%	
Work Comp	2.57	6.57%	
	57.54		

Laborer - Haz Labo0022L Group 6

Rate	20.95	Base	
Fringe	7.45	Hlth & Wlfre,etc	
Fringe a	0.00	Haz Premium	
Fringe b	0.00	Holiday	0 Days
FICA	1.60	7.65%	
FUTA	0.17	0.80%	
SUTA	1.07	5.10%	
Work Comp	1.38	6.57%	
	32.62		

Laborer - HazOT Labo0022L Group 6

Rate	31.43	Base	
Fringe	7.45	Hlth & Wlfre,etc	
Fringe a	0.00	Haz Premium	
Fringe b	0.00	Holiday	10 Days
FICA	2.99	7.65%	
FUTA	0.31	0.80%	
SUTA	1.99	5.10%	
Work Comp	2.57	6.57%	
	46.73		

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor

Revised Option 2 Pile Supported Concrete Wall - VE Proposal 72						
	Quantity		Unit Rate	Total	Duration	SUBTOTALS
Mobilization				$169,000		
Drive Piles	61,200	vlf	$31.13	$1,905,156	7.5	
Dewatering & Water Treatment	1	ls	$226,202.00	$226,202		
Interior Sheets	65,184	sf	$25.74	$1,677,836	3.75	
Exterior Sheets	65,184	sf	$20.34	$1,325,843	3.75	
Base Forms	36,000	sf	$10.00	$360,000	2.5	
Wall Forms	48,888	sf	$10.85	$530,435	5	
Rebar	96	ton	$1,200.00	$115,200	1.25	
Concrete-Base	3,984	cy	$107.00	$426,288	2	
Concrete-Wall	2,265	cy	$117.00	$265,005	1.25	
Geomembrane	97,200	sf	$1.90	$184,680	1.25	$7,185,645
Supervision & Management	28	mnth	$15,000.00	$423,750		
Administration	28	mnth	$20,000.00	$565,000		
Procurement	28	mnth	$20,000.00	$565,000		
Engineering & QC	28	mnth	$50,000.00	$1,412,500		
Health & Safety	28	mnth	$35,000.00	$988,750		
Temporary Facilities	28	mnth	$20,000.00	$565,000		
Project Utilities	28	mnth	$10,000.00	$282,500		
Misc. Expenses	28	mnth	$10,000.00	$282,500		$5,085,000
TOTAL COST				$12,270,645		
22.12 Fee 10%				$1,227,064		
TOTAL				$13,497,709		

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor

Revised by Mark Otten 4/29/00

Option 3 Sheet Pile Wall ***Modified by VE Proposal 52***	Quantity		Unit Rate	Total	Duration	SUBTOTALS
Mobilization				$169,000		
Drive Sheets	68,000	sf	$25.74	$1,750,320	3	
Pre-Dredge	3,550	cy	$127.65	$453,156	1	
Excavate Clay	30,200	cy	$113.61	$3,431,037	2	
Marine Fill	42,800	cy	$38.77	$1,659,251	3	
Land Fill	12,000	cy	$24.59	$295,085		
Vinyl Sheet Piles	50,000	sf	$15.00	$750,000	1	$8,507,849
Supervision & Management	10	mnth	$15,000.00	$150,000		
Administration	10	mnth	$20,000.00	$200,000		
Procurement	10	mnth	$20,000.00	$200,000		
Engineering & QC	10	mnth	$50,000.00	$500,000		
Health & Safety	10	mnth	$35,000.00	$350,000		
Temporary Facilities	10	mnth	$20,000.00	$200,000		
Project Utilities	10	mnth	$10,000.00	$100,000		
Misc. Expenses	10	mnth	$10,000.00	$100,000		$1,800,000
TOTAL COST				$10,307,849		
22.12 Fee 10%				$1,030,785		
TOTAL				$11,339,000		

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Mobilization

Craft Labor	Units	Unit Rate	Total Cost	Comments
Operator	hrs	43.15	0	
Operator OT	hrs	57.54	0	
Laborer	hrs	32.62	0	
Laborer OT	hrs	46.73	0	
Subtotal Cost	0		0	

Equipment	Units	Unit Rate	Total Cost	Comments
			0	
			0	
			0	
Subtotal Cost			0	

Materials	Units	Unit Rate	Total Cost	Comments
			0	
			0	
			0	
Subtotal Cost			0	

Subcontract	Units	Unit Rate	Total Cost	Comments
Mobilize Equipment	16 ea	500	8,000	
Mobilize Crane	2 ea	40,000	80,000	
Mobilize Barges	4 ea	20,000	80,000	
Mobilize Boats	2 ea	500	1,000	
			0	
			0	
			0	
Subtotal Cost			169,000	

TOTAL COST	**169,000**

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Drive Sheets

Craft Labor	Units		Unit Rate	Total Cost	Comments
Operator		hrs	43.15	0	
Operator OT		hrs	57.54	0	
Laborer		hrs	32.62	0	
Laborer OT		hrs	46.73	0	
Subtotal Cost	0			0	

Equipment	Units	Unit Rate	Total Cost	Comments
			0	
			0	
			0	
			0	
Subtotal Cost			0	

Materials	Units	Unit Rate	Total Cost	Comments
			0	
			0	
			0	
Subtotal Cost			0	

Subcontract	Units		Unit Rate	Total Cost	Comments
Temporary Sheets	0	sf	20.34	0	
Permanent Sheets	68,000	sf	25.74	1,750,320	
				0	
				0	
Subtotal Cost				1,750,320	

TOTAL COST **1,750,320**

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Pre-Dredge 3550 cy 50 percent of Alt 1C volume

Craft Labor	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Operator	1,116 hrs	43.15	48,156	1.5 Operators 24/7 Water Treatment
Operator OT	hrs	57.54	0	
Laborer	hrs	32.62	0	
Laborer OT	hrs	46.73	0	
Subtotal Cost	1,116		48,156	

Equipment	**Units**	**Unit Rate**	**Total Cost**	**Comments**
			0	
			0	
			0	
			0	
Subtotal Cost			0	

Materials	**Units**	**Unit Rate**	**Total Cost**	**Comments**
			0	
Subtotal Cost			0	

Subcontract	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Water Treatment	1 mnth	50,000	50,000	Power,Sampling, Supplies
Dredging	3,550 cy	100	355,000	
			0	
			0	
Subtotal Cost			405,000	

TOTAL COST **453,156**

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Excavate Clay	30200 cy	750 cy/day	40 days

Craft Labor	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Operator	960 hrs	43.15	41,424.40	3 ea. @40 Hrs/wk x 2 months
Operator OT	240 hrs	57.54	13,809.33	3 ea. @10 Hrs/wk x 2 months
Laborer	1,920 hrs	32.62	62,621.07	26ea. @40 Hrs/wk x 2 months
Laborer OT	480 hrs	46.73	22,432.26	6 ea. @10 Hrs/wk x 2 months
Subtotal Cost	3,600		140,287.06	

Equipment	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Clamshell & Barge	2 mnth	15,000.00	30,000.00	1 ea
Spoils Barge	2 mnth	8,500.00	17,000.00	1 ea
Pushboats	4 mnth	6,000.00	24,000.00	2 ea
Bottom Dump Barge	2 mnth	12,000.00	24,000.00	
Pump & Pipeline	2 mnth	20,000.00	40,000.00	
			0.00	
Subtotal Cost			135,000.00	

Materials	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Fuel & Maint.	25%	135,000.00	33,750.00	
Small Tools	0 mnth	2,500.00	0.00	
			0.00	
			0.00	
			0.00	
			0.00	
			0.00	
			0.00	
			0.00	
Subtotal Cost			33,750.00	

Subcontract	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Disposal Facility Research & Approval - Regulatory Compl.	1 ls	20,000.00	20,000.00	
Clay Disposal Fees	45,300 tn	60.00	2,970,000.00	30,200 cy @ 1.5 tons/cy
Analytical Testing	61 ea	2,000.00	132,000.00	1 sample/500 cy
Subtotal Cost			3,122,000.00	

TOTAL COST **3,431,037.06**

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Marine Fill	42800 cy	750 cy/day	57.1 days	
			54,800 less (12,000 land fill)	

Craft Labor	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Operator	2,400 hrs	43.15	103,561.00	5 ea. @40 Hrs/wk x 3 months
Operator OT	600 hrs	57.54	34,523.32	5 ea. @10 Hrs/wk x 3 months
Teamsters	480 hrs	43.15	20,712.00	1 ea. @40 Hrs/wk x 3 months
Teamster OT	120 hrs	57.54	6,904.80	1 ea. @10 Hrs/wk x 3 months
Laborer	2,880 hrs	32.62	93,931.60	6 ea. @40 Hrs/wk x 3 months
Laborer OT	720 hrs	46.73	33,648.39	6 ea. @10 Hrs/wk x 3 months
Subtotal Cost	7,200		293,281.12	

Equipment	**Units**	**Unit Rate**	**Total Cost**	**Comments**
140' Material Barges	6 mnth	8,500.00	51,000.00	2 ea
Cranel W/ Barge	3 mnth	18,800.00	56,400.00	1 ea
90' Deck Barges	6 mnth	3,800.00	22,800.00	2 ea
Pushboats	6 mnth	6,000.00	36,000.00	2 ea
Loaders	3 mnth	10,000.00	30,000.00	1 ea
100' Conveyor's	6 mnth	8,000.00	48,000.00	2 ea
Feed Conveyor	3 mnth	6,000.00	18,000.00	1 ea
			0.00	
Subtotal Cost			262,200.00	

Materials	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Fuel & Maint.	25%	262,200.00	65,550.00	
Small Tools	4 mnth	2,500.00	10,000.00	
Fill Material	68,480 tn	14.00	958,720.00	42800 cy @ 1.6 tn/cy
Armor Stone	3,000 cy	22.00	66,000.00	
			0.00	
			0.00	
			0.00	
			0.00	
			0.00	
Subtotal Cost			1,100,270.00	

Subcontract	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Sieve & Proctor	20 ea	175.00	3,500.00	
In-Place Density Test	0 hr	75.00	0.00	
Subtotal Cost			3,500.00	

TOTAL COST **1,659,251.12**

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Land Fill	12000 cy	750 cy/day	16 days
			Use 1/2 Land Fill volume as Alt 1A

Craft Labor	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Operator	960 hrs	43.15	41,424.40	6 ea. @40 Hrs/wk x 4 weeks
Operator OT	240 hrs	57.54	13,809.33	6 ea. @10 Hrs/wk x 4 weeks
Laborer	640 hrs	32.62	20,873.69	4 ea. @40 Hrs/wk x 4 weeks
Laborer OT	160 hrs	46.73	7,477.42	4 ea. @10 Hrs/wk x 4 weeks
Subtotal Cost	2,000		83,585	

Equipment	**Units**	**Unit Rate**	**Total Cost**	**Comments**
D5 Dozer	2 mnth	5,500	11,000	1 - D5
Excavator	2 mnth	10,000	20,000	1 ea
Loaders	2 mnth	10,000.00	20,000	1 ea
90' Deck Barges	0 mnth	3,800.00	0.00	
100' Conveyor's	0 mnth	8,000.00	0	
Feed Conveyor	0 mnth	6,000.00	0	
			0	
Subtotal Cost			51,000	

Materials	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Fuel & Maint.	25%	51,000	12,750	
Small Tools	0.25 mnth	2,500	625	
Misc. Supplies	1 ls	1,000	1,000	
Fill Material	19,200 cy	6.75	129,600.00	12,000 cy @ 1.6 tn/cy
			0	
Subtotal Cost			143,975	

Subcontract	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Sieve & Proctor	3 ea	175.00	525	
In-Place Density Test	80 hr	75.00	6,000	
Surveys	1 ls	10,000.00	10,000	
Subtotal Cost			16,525	

TOTAL COST	**295,085**

FOSTER WHEELER ENVIRONMENTAL

New Bedford Harbor - Hot Spot

Geomembrane

Craft Labor	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Operator	176 hrs	43.15	7,594	1 ea. @40 Hrs/wk x 1 month
Operator OT	44 hrs	57.54	2,532	1 ea. @10 Hrs/wk x 1 month
Laborer	176 hrs	32.62	5,740	1 ea. @40 Hrs/wk x 1 month
Laborer OT	44 hrs	46.73	2,056	1 ea. @10 Hrs/wk x 1 month
Subtotal Cost	440		17,923	

Equipment	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Loader	1 mnth	10,000	10,000	
			0	
			0	
Subtotal Cost			10,000	

Materials	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Fuel & Maint.	25%	10,000	2,500	
Small Tools	1.0 mnth	3,000	3,000	
			0	
			0	
Subtotal Cost			5,500	

Subcontract	**Units**	**Unit Rate**	**Total Cost**	**Comments**
Liner Sub	81,480 sf	1.25	101,850	100 mil HDPE on ~2:1 slope
Cushion Geotextile	81,480 sf	0.25	20,370	
Subtotal Cost			122,220	

TOTAL COST **155,643**

Labor Rates

Decision No:

Equip Oper	Engi0004I Group 1		
Rate	26.04	Base	
Fringe	10.62	Hlth & Wlfre,etc	
Fringe a	0.00	Haz Premium	
Fringe b	1.04	Holiday	10 Days
FICA	2.07	7.65%	
FUTA	0.22	0.80%	
SUTA	1.38	5.10%	
Work Comp	1.78	6.57%	
	43.15		

Equip Oper OT	Engi0004I Group 1		
Rate	39.06	Base	
Fringe	10.62	Hlth & Wlfre,etc	
Fringe a	0.00	Haz Premium	
Fringe b	0.00	Holiday	10 Days
FICA	2.99	7.65%	
FUTA	0.31	0.80%	
SUTA	1.99	5.10%	
Work Comp	2.57	6.57%	
	57.54		

Laborer - Haz	Labo0022L Group 6		
Rate	20.95	Base	
Fringe	7.45	Hlth & Wlfre,etc	
Fringe a	0.00	Haz Premium	
Fringe b	0.00	Holiday	0 Days
FICA	1.60	7.65%	
FUTA	0.17	0.80%	
SUTA	1.07	5.10%	
Work Comp	1.38	6.57%	
	32.62		

Laborer - HazOT	Labo0022L Group 6		
Rate	31.43	Base	
Fringe	7.45	Hlth & Wlfre,etc	
Fringe a	0.00	Haz Premium	
Fringe b	0.00	Holiday	10 Days
FICA	2.99	7.65%	
FUTA	0.31	0.80%	
SUTA	1.99	5.10%	
Work Comp	2.57	6.57%	
	46.73		

APPENDIX D

VALUE ENGINEERING WORKSHOP NOTES

George Willant
04/17/2000 01:52 PM

To: Allen Ikalainen/Boston/FWENC@FWENC, Karen Hartel/Boston/FWENC@FWENC, Mark Otten/Bellevue/FWENC@FWENC

cc:
Subject: FW: CDF VE Meeting 4/10/11

To All,

FYI and use. We need to talk again together when everyone's back.

George
----- Forwarded by George Willant/Boston/FWENC on 04/17/00 01:53 PM -----

"Hunt, Robert G NAE" <Robert.G.Hunt@nae02.usace.army.mil>
04/14/00 09:33 AM

To: "GWILLANT@FWENC.COM" <GWILLANT@FWENC.COM>, "aikalain@fwenc.com" <IMCEACCMAIL·aikalain+40fwenc+2Ecom+20at+201@dms.usace.army.mil>

cc: "Godfrey, Randy N NAE" <Randy.N.Godfrey@nae02.usace.army.mil>, "Gately, Steven E NAE" <Steven.E.Gately@nae02.usace.army.mil>

Subject: FW: CDF VE Meeting 4/10/11

George: please pass along to Alan since this probably won't reach him. Please add Randy's attached list of items in your FCN & CDF C design as discussed at the VE meeting and note Steve Gately's comments. The level of detail in the Technical memorandum should be commensurate with the item being addressed. That is, only perform the critical analysis and Id the pros & cons to the point decisions can be made at the next On-Board review whether to proceed with some version of the floating dike or go with a wall option. The wall options need preliminary/comparative costs and enough analysis to say whether it can be built. I want to avoid schedule slippage wherever possible. Can this be done?
Thanks,
Bob
> -----Original Message-----
> From: Gately, Steven E NAE
> Sent: Thursday, April 13, 2000 1:59 PM
> To: Godfrey, Randy N NAE; Hunt, Robert G NAE
> Subject: RE: CDF VE Meeting 4/10/11
>
> I have no changes to the list but I would like to consolidate some of the
> tasks listed as follows. The list is not intended to be all inclusive:
>
> 1) Modifications to the current floating embankment design
>
> To reduce the time required prior to the commencement of dredging, FW

> should look at filling the CDF as it is being constructed. As part of
> this FW should consider using sheeting on top of the embankment.
>
> 2) Non-floating embankment or partially floating embankment
>
> These options are dependent on finding a way to dispose of clean dredge
> material off site. If we are able to solve this problem, both of these
> options be come viable. Using sheet piling (to reduce organic clay
> excavation) or an open cut excavation, excavate below the centerline of
> the embankment alignment to the top of the exist sands and backfill with
> sand. Construct embankment on top of this noncompressible foundation. A
> subset of this case is the "displacement embankment" where the organics is
> deliberately pushed out of the way.
>
> 3) Structural cantilever or batter pile walls
>
> FW should continue to look at structural wall options, including steel
> cantilever walls with high section modulus.
>
> 4) Structural steel cantilever walls or batter pile walls with a passive
> soil berm bearing on sand
>
> FW should consider the following option. Drive a steel cantilever wall.
> Excavate on the outboard side of the CDF to remove organics and construct
> a sand berm. Place the excavated organic material into the CDF which
> should have sufficient additional volume because a vertical wall is being
> used instead of an embankment. If necessary to reduce berm size, use
> vibrocompaction techniques to densify sand berm and underlying sand. The
> steel cantilever wall will have to be sufficiently strong to resist
> initial moment into the CDF as well as other loads. If necessary, form
> and pour a smooth concrete wall on the inside of the steel wall for
> geomembrane placement.
> -----Original Message-----
> From: Godfrey, Randy N NAE
> Sent: Thursday, April 13, 2000 12:07 PM
> To: Gately, Steven E NAE; Matthews, Erik W NAE
> Cc: Hunt, Robert G NAE
> Subject: CDF VE Meeting 4/10/11
>
>
> Steve:
> Please look over the list of items that we want FWENC to investigate as
> part of their Technical Analysis under "Modifications to Current Earthen
> Dike Design" . Please send any changes directly to Bob H so that he can
> inform FWENC (copy furnish me any changes). Response requested by COB
> today if possible since FWENC is presently working on CDF C dike design
> and the technical analyses of the options.
> Please also note the items that are listed under CDF D for our
> consideration as part of our design. We will need to coordinate with the
> City on these issues in our meeting on 20 Apr.
> << File: NBVE4-1011.CDFC.r1.doc >>
> Thanks, Randy <<NBVE4-1011.CDFC.r1.doc>>

NEW BEDFORD HARBOR (CDF-C) SPECULATION LIST

√ = Develop; X = Delete; C = Comment; ? = Research further; B.D. = being done

BEING DONE (B.D.) BY FWENC as part of Current Design or Technical Analyses of Alternatives FOR CDF C

B.D. 12. Use ballasted flocculation to precipitate contaminants
B.D. 20. Use geosynthetic for cap (increase storage).
B.D. 22. Reduce frost layer thickness requirement (coastal climate).
B.D. 24. Innovative subtitle "C" compliance with cap requirements.
B.D. 28. Compete unit cost of disposal vs. construction cost.
B.D. 29. Develop risk-based logic for alternatives.
B.D. 35. Install wick drains before geotextile placement (do not puncture).
B.D. 43. Animal construction, pile it up, ride the mud wave.
B.D. 44. Steepen side slopes to 1 on 2.
B.D. 45. Steepen inside only to maximize capacity.
B.D. 48. Identify enhancements (cathodic protection, etc.) to increase service life.
B.D. 51. Use dredged material to construct part of dike (inside, within liner, etc.)
B.D. 56. Segmenting CDF for distillation/settlement.
B.D. 66. Identify site use more compatible with cap requirements.
B.D. 67. No utilities, etc. under cap.
B.D. 68. Use simple plastic drain systems
B.D. 70. Use sheetpile wall with Oceanside batter (Alt. 3).
B.D. 72. Investigate mods to Alt. 2 to increase life cycle benefits.
B.D. 74. Build CDF in sections, under cover to reduce emissions and improve settlement and drying times.
B.D. 79. Precise delineation, testing and select excavation.
B.D. 85. Tie disposal or rebuilding of sites to navigation dredging.
B.D. 88. Disposal in railroad yards (overexcavated "clean" mat'l.).

Modifications to Current Earthen Dike Designs (Alts 1A, 1B, 1C)

√ 4. Wall supported by ½ dike.
√ 5. Taller dike.
√ 6. Taller dike by adding sheetpile wall.
√ 7. Vinyl sheetpile
√ 18. Use less contaminated material in cap buildup
√ 37. Delete interior separator liner along debris cell.
√ 38. Dredge base slot @ C/L embankment to install sand foundation.
√ 39. Use geotextile in foundation of Alt. 1B.
√ 41. Modify Alt. 1C, use sheetpile under core of embankment, slope grade back 1 on 3.
√ 42. Same as 41, but no sheet pile.

√ 46. Alt. 1A, start placing contaminated dredge fill before dike is completed to full height.
√ 47. Confirm that inside liner is needed along debris cell and landside.
√ 49. Construct first lifts at A, B, C simultaneously.
√ 50. Fill as lifts are added. (Same as 46)
√ 61. Build an Oceanside stability berm with excess excavation.
√ 69. Sell/recycle stabilized dredge material.
√ 90. Construct top 4' sheet pile (vinyl).

New Dike Wall Designs (ND):

√ND 36. Using vertical wall concept, optimize alignment for more storage.
?ND 40. Pipe pile, conc. Fill wall for containment (high modulus section for /bending).
?ND 52. Alt. 3 with berm section on outside.

To Be Evaluated as part of the PDFT & DEWATERING Tests

√ 2. Distribute clay material after dredging harbor.
√ 11. Dredge and separate contaminants.
? 14. Use vortex dredge (soliflo).
√ 19. Use unsuitable (clean) dirt in cap buildup.
? 21. Use unsuitable (clean) clay for inside liner of embankment section.
53. Separate (fines) contaminants from dredged material, return clean residual sand to estuary.
√ 25. Market excess useable excavation for landfill.
√ 26. Build field facility for city with excess excavation.
X 27. Excavate deep hole for containment (to eliminate CDF A & B).
√ 58. Separate coarse grain from fine grain; place coarse (clean) back in estuary (same as 53).
√ 59. Reuse clean excavation for wetland restoration.

CDF D DESIGN CONSIDERATIONS (by NAE)

? 9. Excavate land portion of CDF "D".
X 13. Use upland disposal.
√ 15. Construct containment out of geotube (RR Yard).
√ 32. Mine sand from interior to build containment berm (and leapfrog to other CDF's).
C 30. Consider alternate cap on CDF "D" considering future uses.
√ 31. Mine out center of CDF "D" for more capacity and market fill, to replace other sites (one large site at "D").
√ 33. Excavate landward embankment for more capacity (31& 33 – reduces number of CDF's to 2).

√ 34. 33 use to build containment dikes.
√ 63. Construct one large CDF, cap with dredged sediments.
√ 59. Reuse clean excavation for wetland restoration.
X 87. Take it to Mass. Bay disposal site.
X 89. Place material (permanent or temporary) between the two bridges.
X 80. Mine sand from radio tower area to build embankment, refill with contaminants and cap.
? 81. Same as 80, but refill with clean surplus and create wetlands (NRD $).

Speculation Ideas/Study Topics

In CDF – C Scope:
(Design/Construction/Use-Operation)

Dike – 4,5,6,7, 35, 37, 38, 39, 40, 41, 42, 47, 52, 90

Capacity – 36, 61

Excavation –

Schedule – 46, 50

Project-Wide Scope (Other CDF's)
(Planning/Phasing)

General – 9, 63

Phasing – 49

Cap – 18, 19, 30

Disposal - 2, 15, 53, 58, 59, 81

Material – 11, 14, 25, 26, 31, 32, 33, 34

Excavation - 69

Priority List

In CDF-C Scope Priority List

40, 38-41-42, 36, 37-47, 5-6-7, 90-7,
39, 4-52, 61, 46-50,

Project – Wide Scope (Other CDF's) Priority List

9-31-32-33-34-63, 49, 2-11-53-58-59-83

18-19,14, 25-31-69, 26-31