Boston Coastal Storm Risk Management Study Draft Integrated Feasibility Report

APPENDIX M
COST ENGINEERING

July 2026

USACE NEW ENGLAND DISTRICT

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Acronyms and Abbreviations

Acronym	Definition
ARA	Abbreviated Risk Analysis
CWCCIS	Civil Works Construction Cost Index System
DB	Design-Build
IFR/PEA	Integrated Feasibility Report/Programmatic Environmental Assessment
MII	Micro-Computer Aided Cost Estimating System, Generation 2
MPC	Midpoint of Construction
OMRR&R	Operations, Maintenance, Repair, Rehabilitation, and Replacement
PED	Pre-Construction Engineering and Design
PDT	Project Delivery Team
ROM	Rough Order of Magnitude
RSLC	Relative Sea Level Change
S&A	Supervision and Administration
TPCS	Total Project Cost Summary
TSP	Tentatively Selected Plan
USACE	U.S. Army Corps of Engineers
WBS	Work Breakdown Structure

1.0 Introduction

This appendix lists and describes the current working cost estimate as part of this Draft Integrated Feasibility Report and Programmatic Environmental Assessment (IFR/PEA). Included within are details regarding the development of the cost estimate including the scope of work, major assumptions, markups, and contingency development.

Coastal storm risk will increase at an uncertain rate over the period of analysis (2040-2089). Inundation occurs in areas within the study under the existing condition under a variety of event conditions and within the geographically diverse and complex study area. Over time, frequency and intensity of inundation will increase as water surface elevations are further impacted by RSLC. What is a high-frequency, low-consequence event under existing conditions will increase in consequence over time as water surface elevations change due to RSLC. The plan formulation strategies sought to identify different approaches to manage coastal storm risk now and into the future under multiple SLC conditions.

Formulation of alternatives to manage coastal storm risk included:

- Evaluate as an entire system within Boston Harbor, however, evaluate each neighborhood independently and incrementally within the larger system. Within each neighborhood prioritize risk and separability to identify incremental implementation strategies.
- Evaluate alternatives against both the high and intermediate USACE SLC scenarios to evaluate for phased and adaptable approaches for risk management.
    - Differing geographic conditions and urban density will impact adaptability and land utilization for risk management approaches.
    - Where land utilization and urban density allow, maximize adaptable and or nature-based features to manage risk where practical.
- Consider institutional plans at the regional, local, and state levels to tie this system into larger systems and comprehensive approaches to risk reduction.
    - Consider recommendations under the larger Boston Metropolitan Watershed Study done by the New England District, USACE and Commonwealth of Massachusetts.
    - Consider projects and recommendations under the Climate Ready Boston initiative led by the City of Boston.
    - Consider recommendations made as a result of the Planning Assistance to States Study for New Charles River Dam (USACE and Commonwealth of MA).

2.0 Cost Estimate

2.1 General Information

2.1.1 Estimate Structure

For the Draft Report Array of Alternatives and Recommended Actions, each cost estimate was structured by consistent steps that initially grouped the work into five different neighborhoods. The estimates were then further grouped into sub-areas that included mixtures of more discreet locations of specific and common features of work. Effort was also taken to organize the estimate per the Civil Works Work Breakdown Structure (WBS) guideline/template.

The project costs were developed in TRACES Micro-Computer Aided Cost Estimating System, Generation 2 (MII) cost estimating software. The costs were then summarized within a completed summary sheet utilized for the economic analysis (See Attachment M3). TPCS are updated regularly to incorporate historic inflation and future escalation rates to Mid-Point of Construction (MPC) by use of the USACE developed Civil Works Construction Cost Index System (CWCCIS). Due to the scale of this project and the fact it is spread across a complex rage of locations and will be a series of multiple construction contracts spread over a significant period of time, grossly assuming an escalation to MPC was not feasible. Consequently, the TPCS was not provided at this stage, but rather costs were incorporated into a spreadsheet summarizing all costs through First Cost (Attachment M3). For this appendix, it is important to note that the term “First Cost” represents the costs escalated to the time of the signing of the Chief’s Report. Therefore, for this project the First Cost represents costs escalated to FY2028Q1.

2.2 Acquisition Strategy

For simplicity it is assumed that this will be advertised as Full and Open/Unrestricted projects. Given the size of the whole project, it is unrealistic to assume it will not be broken up into sub-projects, and multiple contracts. The risks to the estimated cost and schedule associated with this opportunity were discussed in the Abbreviated Risk Assessment (ARA) (Attachment M2). There was discussion that certain locations and particular scopes of work may be more suitable for DB contracts due to their complexity – e.g. the Surge Barrier or locations of flood wall over tunnels but that is not currently considered.

All work is considered to be performed through a prime contractor, sub-contracting all trade specific work out accordingly. Although it is likely that some horizontal GCs can self-perform work, given the volume, complexity and scale that this project will present it is unlikely that self-perform primes will be able to perform a majority of the work alone. Utilization of various heavy-dock building and foundation subcontractors will be required to maintain production and schedule across various locations in the city. Consequently, since the current level of scoping and design does not necessarily provide the ability to determine sections that may or may not be more suitable for self-perform work, assuming a GC fully subcontracting all work provides a more consistent and conservative approach.

Due to the volume of the work, acquisition strategy with respect to contract value is critical for trying to package the location segments into executable projects, and to have the work fit within the allowable project timeframe. As a result, for the sake of assigning schedule durations for the economic analysis, each discreet location in each neighborhood was broken into more manageable contract awards. Breaking it into smaller contract awards accounts for various areas within each discreet location, potentially requiring more or less PED and contract award for more or less complex areas. For example – in Charlestown, the discreet location for the Navy Yard is $584.1M in construction contract value. Various areas within the Navy Yard present less complex challenges, and others quite a bit more. As a result, we assumed (generally for all areas) to split the total construction contract value into more reasonable and executable areas that may be simpler to more complex to award – resulting in portion of the work being completed earlier, and other starting later. Consequently, using a contract value generally <$100M, the Navy Yard was split into 6 separate contract awards. Durations for PED and Construction were assigned in order to spread the $584.1M over a more reasonable duration for the sake of the economic model.

2.3 Project Mark-ups

- 2024 MII Cost Book
- Escalation to MPC: Not included in MII cost estimate model. All project costs are being reported in First Cost values (2028Q1)

- Productivity: 85% for overall land efforts, 70% for marine work
- Overtime markup: assumes 30% for all heavy construction and utilities. Site improvements and finishes demo and replacement and the harbor walk do not include OT. (Assumption is that the site finishes & relocation work will not likely be critical path, and can be commenced in parallel with, and completed to keep up with the floodwall installation)
- Sales Tax: 6.25% (Boston MA)

2.4 Prime Contractor Mark-ups

- JOOH: 10%
- HOOH: 6%
- Profit: 8%
- Bond: 2%

2.5 Sub-Contractor Mark-ups:

Dock Builder & Floodwall Construction

- SubJOOH: 5%
- SubHOOH: 8%
- Profit: 10%
- Bond: 1%

General Sub (All Other than Dock Builder) & Mech Sub (Closures/Gates)

- SubJOOH: 5%
- SubHOOH: 10%
- Profit: 10%
- Bond: 0%

2.6 Cost Contingency

For the Draft Report and the Array of Alternatives the Cost Contingency was applied in Mii to the features of work developed through the Abbreviated Risk Analysis (ARA) See Attachment M2. Moakley Park is being reported with both the 80% and 50% Confidence Level contingency in order to provide a range in expected cost.

2.7 Pricing

Pricing for features of work were derived from multiple methods. Some features of work were costed by developing an assumed WBS for each scope of work and applying

appropriate MII Cost Book CSI activities with quantities and appropriate markups. Other features were costed by contacting specialized contractors and applying discussed and derived equipment and labor spreads. Other methods were also used including Local vendor pricing was solicited for some materials including pipe and steel sheet pile, etc.

Generally, for the major features of work (piles, flood walls and levees) a detailed take-off was performed from the typical detail according to all alignment layouts. A detailed estimate was completed in Mii to account for the best level of detail provided, as well as the expectation of what level of effort would be necessary. Crews and equipment spreads were established, and various assumptions were made depending on location with respect to pile installations. This was performed for areas where the flood wall is being built on land, and separately from the water since equipment spreads, crew buildup, construction logic and productions vary much differently from the land to the water.

These major features of work which could be priced in more detail in accordance with the typical detail and proposed layout were then converted into a per linear foot unit price. Conversion to a per linear foot unit price was performed in order to expedite the pricing of the entire project where the typical detail and pricing assumptions remained the same alignment to alignment. Because all flood walls were based on the same typical detail, the more detailed price effort would not change alignment to alignment, however there were areas where significant differences in pile production & equipment spread could occur. In these cases, the detailed estimate was adjusted accordingly to reflect the various productions specific to a particular alignment and a new detailed price item was created, and subsequently converted to a per linear foot unit price. For example, in the Navy Yard – the land-based pile installation around the dry dock is expected to be very difficult so the equipment spread, and production were priced very conservatively – to include an extra rock drill and lower pile installation. This situation was not typical in most other areas, so a separate detailed price was determined to increase the pile production and vary the equipment spread. These detailed prices were then converted into a per liner foot unit price so in areas where the same pile production occurred the liner foot price could be used.

This was similarly performed for the different levee sizes – a detailed estimate was performed for each of the 3’, 6’, and 9’ levee heights to account for discreet assumptions specific to the typical detail. This was then converted to a linear foot price to simplify and expedite pricing where the typical detail did not vary alignment to alignment. Any particular one-off areas were priced in a detailed manner based on the expectation of work.

All notes and assumptions are provided in the detailed estimates, and are not carried over into the unit price estimate. In an effort to review the detailed and discreet assumption and pricing notes, it is necessary to review the folder labeled “Detailed Estimates for Unit Pricing.” Those detailed prices were converted into unit prices under the folder “Unit Pricing” with corresponding activity titles. The “Unit Prices” are used in

the “Alignment Pricing” folder for the actual neighborhood and alignment pricing. Detailed pricing is also used in the “Alignment Pricing” folder when it was the original pricing activity for that alignment.

Generally, all other features of work were approximated using the drawings, site-visit information and satellite imagery. This included: heavy demo items (eg. existing concrete piers in Navy Yard); as many utilities that could be identified (limited to San Sewer, Storm Drains and Gas – no Elec or Comm utility as-built information was available); any noticeable site finishes to include demolition and replacements (curb, sidewalk, brick patio, fence relocation and asphalt roads etc.). Further, depending on the individual discreet location, various other features of work were required to be accounted for, for example dock and marina removal and replacements in the Navy Yard.

The first neighborhood priced was Charlestown. Following completion of the detailed pricing, the detailed estimate was provided for an over-the-shoulder review by a Cost SME from the MCX (Jeff Gaeta). The intent of the over the shoulder review was to provide concurrence with the take-off calculations and logic, to review equipment and labor spreads and to review the construction logic used for building the crews with regards to productions. The intent, at this point of the pricing was to get an independent level of confidence before the detailed estimates were converted into a linear foot unit price in order to expedite the pricing effort when the typical detail did not vary.

Generally, the pricing effort intended to provide as detailed of an effort in pricing the known typical detail, and identify anything that could be identified and accounted for – whether existing information was sufficient to provide detailed take-offs or not, the intent was to be able to separate items from a risk standpoint.

2.8 Cost Sources

Cost sourcing included the use of the 2024 Cost Book – English, with material costs per local pricing and plugged material or subcontractor pricing as appropriate per estimator's and design engineers’ judgment. When other than cost book pricing was utilized it was captured as a separate User Cost in Mii in order that the cost book escalation was not assessed.

Pricing for the Surge Barrier and the Dry Dock Caisson were based on previously provide information that was provided to the PDT. The Dry Dock price was based on the quote from Steel America dated March 29, 2023 escalated to current. The Surge Barrier price was based on the median of the Hazen & Sawyer pricing in Appendix M - Nov 22, 2022 escalated to current.

Industry foundation contractors were engaged to assist in determining potential construction logic for pile installation production and equipment spreads for various conditions. This input was used in building the pricing effort.

The Mechanical Closures pricing was based on the 35% Design for the Fairfield New

Haven Flood Wall. Pricing was pro-rated according to height and length.

Various relocations require the removal and relocation of Storm and San Sewer. Pricing was based on linear foot price calculated from the Fairfield New Haven Floodwall Conveyance ROM 2024 escalated to current. New Haven Drainage Conveyance ROM SOW included H Pile & Lagging shoring, dewatering, Exc & B'Fill, 6'x6' pre-cast culvert and connection structures to existing w/bypass.

The Real Estate costs were provided by the Project Delivery Team's (PDT) Real Estate team; the derivation of those costs is discussed in the IFR/PEA.

Cultural Resources mitigation costs were provided and were developed for each recommended site alternative in accordance with ER 1105-2-100. Environmental mitigation costs were provided, and were developed using the mitigation cost estimate utilizing the 2026 MA ILF fee.

Pre-Construction Engineering, and Design (PED = 12.0%) and Construction Management Supervision and Administration (S&A = 10%) costs were discussed with the PDT.

2.9 Wage Rates

The cost estimate includes labor rates per Heavy & Highway General Decision Number: MA20250008 09/26/2025 Heavy - updated 10/31/2025

2.10 Equipment

MII Equipment 2024 Region 01

2.11 Material

2024 Cost Book – English. Revised material costs, per quotes received for the major and/or various items as noted in the estimate costs items. Cost book material escalated per ENR Material Index Jan 2021 to Oct 2025 = 69.33%

2.12 OMRR&R

At this initial point of design, OMRR&R costs have not been accounted for. In all likelihood, they will be a percentage of the first project cost. Larger, more complex features such as the Surge Barrier are expected to carry larger OMRR&R costs. OMRR&R costs will be included in the final report.

2.13 Real Estate Costs

Real Estate costs are provided in the IFR/PEA.

3.0 Schedule

Detailed schedules have not been considered at this stage. However, in order to account for the duration of construction with respect to time in the economic modeling, PED & Construction durations were calculated for each neighborhood's discreet locations. Due to the large construction contract values for any one discreet location –

each area was broken down into a more manageable and executable contract value. For example, in East Boston the discreet location for Waterfront West is $458.6M. It is unreasonable to assume that the entire Waterfront West will be designed and constructed under a single contract award for various reasons. As a result, generally the total value was broken into more manageable contract awards <$100M.

Understanding that any discreet location will have areas that are more or less complicated, would allow simpler segments to be designed and constructed earlier. More complicated sections would take more time to enter and complete PED for various reasons including for example, real estate, utility discovery and relocation, and more complicated design around tunnels - which ultimately forces certain sections to be awarded and completed later. To account for this, by breaking the discreet locations down into <$100M pieces would spread the overall total construction value out over a certain amount of time.

In order to calculate the construction duration, each of the discreet areas were broken out by their large features of work and construction durations were determined accordingly. For example, Waterfront West at $458.6M was broken into five contract award segments averaging $91.72M each – large work features included the following durations: mob/demo = 6 mos, utilities = 6 mos, floodwall construction from land = 6 mos and restoration/site finishes = 6 mos. is 24 mos total construction duration – and 24 mos of PED was added for each segment for a total of 48 mos. Each contract award segment assumes each award starts at the MPC of the previous award, for a total duration for all five contract award segments of 144 mos.

There were outliers within the Downtown neighborhood for the Waterside alignment which at $1,624M was not able to be broken into contract award segments <$100M. In this case the contract award segments were broken down in order that the overall contraction duration would be less than 15 years based on their durations – this calculated to 10 ea construction award segments averaging $162.4M each. In this case, the design period would have to be escalated in order to meet the 15-year limit to construct.

4.0 Scope of Work

4.1 Array of Alternatives for the Draft Report and TSP

The scope of work was broken into five Neighborhoods – Charlestown, East Boston, Dorchester, South Boston and Downtown – and within those neighborhoods, further broken into sub-areas of discreet locations. These discreet locations were generally grouped separately because of geography. The effort to identify the scope of work was a joint effort between the cost engineer and the design team. Scope identification included the processing and incorporation of LiDAR to develop existing conditions surfaces, incorporation of utility information as available (generally limited to San and Storm Sewer and Gas utility locations), processing and cataloging existing boring/subsurface information, review of NOAA charts for water depth information

along existing water-side wall feature, detailed review of satellite imagery (Google Earth), onsite site inspections and visual surveys and localized topographic surveys. These efforts were consolidated and used by various factions of the PDT to assist in identifying scope, as well as to incorporate the information into design assumptions necessary for determining the typical details and variations accordingly, for example varying pile lengths in different alignments.

Generally, the scope of work was determined by following each alignment station to station and identifying any scope of work that was encountered and identifying and quantifying it to the best degree possible. This effort was heavily dependent on satellite imagery and the preliminary plans for all site features incidental to building the flood wall.

A significant portion of the scope of work is the pile installation. Different alignments did identify different pile lengths, and different understanding of subsurface conditions. These variations were identified and accounted for by adjust the pricing activities accordingly – in other words if a specific area required 33’ or 60’ piles it was priced accordingly. For example, more urban locations (Charlestown - Little Mystic) assumed 2 land piles per day, compared to areas outside (Dorchester – Neponset River) were priced at 4 land piles per day based on the understanding that the more urban areas will likely encounter more adversity, compared to likely native materials outside the urban areas. Generally, an effort was made to identify the particular variations in the scope of work assumptions and in any of the discreet locations and account for it specifically.

Upon completion of the pricing effort, in coordination with performing and completing the ARA, the Mii estimate was sorted from being by Neighborhood and discreet locations into the major scopes of work. These major scopes of work were based on the estimate WBS: Demo & Civil Work; Utilities; Land Based Earthwork, Piles & Flood Wall; Water Based Earthwork, Piles & Flood Wall; Closures; the Harbor Walk; Levee’s; Dry Dock Gate; Surge Barrier and Cultural Resources/Fish & Wildlife. These WBS scopes of work were isolated in order to categorize them separately in terms of assigning risk and were populated as the Features of Work in the ARA. During the risk assessment, and as a result of the discussion of various higher risks in specific areas, it was determined to split those areas of the Land and Water Based wall scope of work into its own ARA feature of work as High-Risk. Consequently, two new ARA features of work were created. These specific areas of High Risk were based on, for example, their proximity to existing tunnels, or very dense areas of suspected utilities, or urban environments etc. By re-characterizing these locations, the appropriate risk could be assigned, more appropriately to the lower risk, vs. higher risk areas.

In some instances, the naming convention of certain alignments differs between Cost and the main report. The following table serves as a crosswalk to relate the naming conventions by neighborhood.

Cost Engineering	Main Report
East Boston	
Waterfront West	Border Street (w/ Atlantic Works), SCREENED
Waterfront West Alt	Border Street (interior connection)
Marginal Street	East Boston Waterfront
Summer Street to Airport	Tomahawk Drive
Wood Island	Wood Island Marsh
Constitution Beach	Constitution Beach
Rail Yard	Orient Heights Railyard
Route 1A	Chelsea Creek (part of Alt. EB2)
Middle of 1A	Route 1A (part of Alt EB2A)
Charlestown	
Navy Yard	Navy Yard
Chelsea Street	Chelsea Street
Little Mystic	Little Mystic Channel
Schraffts	Schrafft Center
Ryan Playground	Schrafft Center
Downtown	
Waterside	Downtown Full Perimeter
Commercial Street	Commercial Street
Lovejoy Wharf	Lovejoy Wharf
Paul Revere Park	Paul Revere Park
Landside	Interior Alignment from Rowe's Wharf to Fleet Street, SCREENED
Hybrid, Waterside north to Fleet St	Downtown Perimeter to Fleet Street
South Boston	
Fan Pier Park to Seaport Blvd	Outboard Floodwall from Fan Pier to

	Commonwealth Pier
Seaport Blvd (west of Alt)	Seaport Blvd west of D Street
Seaport Blvd (east of Alt thru Marine Terminal)	Raymond L. Flynn Marine Park
Dry Dock	Raymond L. Flynn Marine Park
Pappas Way	Pappas Way
Surge Barrier	Fort Point Channel Surge Barrier
Parapet Wall	Parapet Walls
D Street	D Street
Haul Street	D Street
Summer Street to Pappas	D Street
Dorchester	
Neponset River	Neponset River
Tenean Beach	Tenean Beach
Victory Road	Victory Road
Morrissey Blvd	Morrissey Blvd
Pattens Cove	Pattens Cove
Harbor Point	Columbia Point
Moakley Park	Moakley Park

4.2 Recommended Plan

The Recommended Plan was formulated based upon the performance (cost, benefits, and impacts) of the array of alternatives under varying levels of RSLC. The Recommended Plan combines different scales and alignments of the initial alternatives in the five neighborhoods and represents costs for scope and assumptions based on the chosen alignments. To estimate the cost of this plan, a detailed MII estimate was completed utilizing scope developed by the Engineering team, and a detailed quantity take-off developed by the Engineering team and checked by the Cost engineer. Inside the MII estimate the costs are structured first by neighborhood, then again by geographical alignments, and then by work feature.