Appendix A – Activity Specific Information:

I. Dredging and the Disposal of Dredged Material

II. Shoreline Erosion or Stabilization Structures, Breakwaters or Wave Attenuators

Appendix A: Activity Specific Information

I. Dredging and Disposal of Dredged Material

A. Dredging

Dredging requirements include both maintenance dredging and new dredging. **Attachment I, CA17**, Dredging Operations, provides a work description and dredging plans. Additional earthwork activities are shown in CA 14, Pier Removal. **Drawing SUM-2** provides project summaries of dredging and excavation volumes.

Maintenance Dredging. As shown in Figure 1, an October 2016 bathymetric survey of the Norwalk River at the bridge site, maintenance dredging to meet the federal channel depth of ten feet will be required at the locations of the existing bridge substructure, including the swing span's pivot pier and rest piers and the protective fenders. Following the removal of the pivot pier fender system, those portions of the Norwalk River that are not currently maintained as part of the 170-foot federal navigation channel (the pivot pier and immediately north and south of the pivot pier) will be dredged to match the federal channel depth and tie into the existing 125-foot navigation channel that exists upstream of the bridge. The maintenance dredging will increase the effective width of the navigation channel and improve the alignment through the proposed Walk Bridge to and from the Stroffolino Bridge.

The extent of work for maintenance dredging at the bridge is defined by the need to achieve the authorized dredge depth in the channel at the bridge location. The extent of the work area is shown in **Attachment I, CA17** (Drawings CA17-2, CA17-3, CA17-6). Over-dredging by as much as one-foot below the authorized dredging elevation of -13.98 NAVD88 (to Elevation -14.98 NAVD88) is allowable. The side slopes of the channel are required to be at a maximum of a 3:1 slope. Following the dredging operation, a post-dredging hydrographic survey will be conducted to confirm that the dredging has been completed in conformance with the allowable and permitted project footprint and depth. Prior to work start, the work area will be enclosed by a turbidity curtain.

New Dredging. New dredging will be required in two areas: in the area of the proposed Maritime Aquarium and Sheffield Island Ferry vessel dock relocations (Attachment I - CA3, CA17-4, CA17-7) and at the Marine Staging Yard (Attachment I - CA 4, CA17-5, CA17-7). Dredging will be west of the navigation channel and will not impact the navigation channel.

The new temporary docking facilities for the vessels, approximately 100 feet south of their existing location, will require dredging to provide sufficient depth for docking. The extent of dredging is defined by the need to provide sufficient water depth consistent with conditions at existing dock locations for maintaining vessel operations during construction. Dredging will be performed to the authorized dredge depth of -8.0 ft. (NAVD88) to the limits and footprint shown in CA17. Prior to work start, the work area will be enclosed by a turbidity curtain. Dredging conducted between December 1st and January 31st will be conducted within a turbidity curtain. If necessary to dredge from February 1st through November 30th, dredging will be conducted within a marine enclosure enclosed by a turbidity curtain.

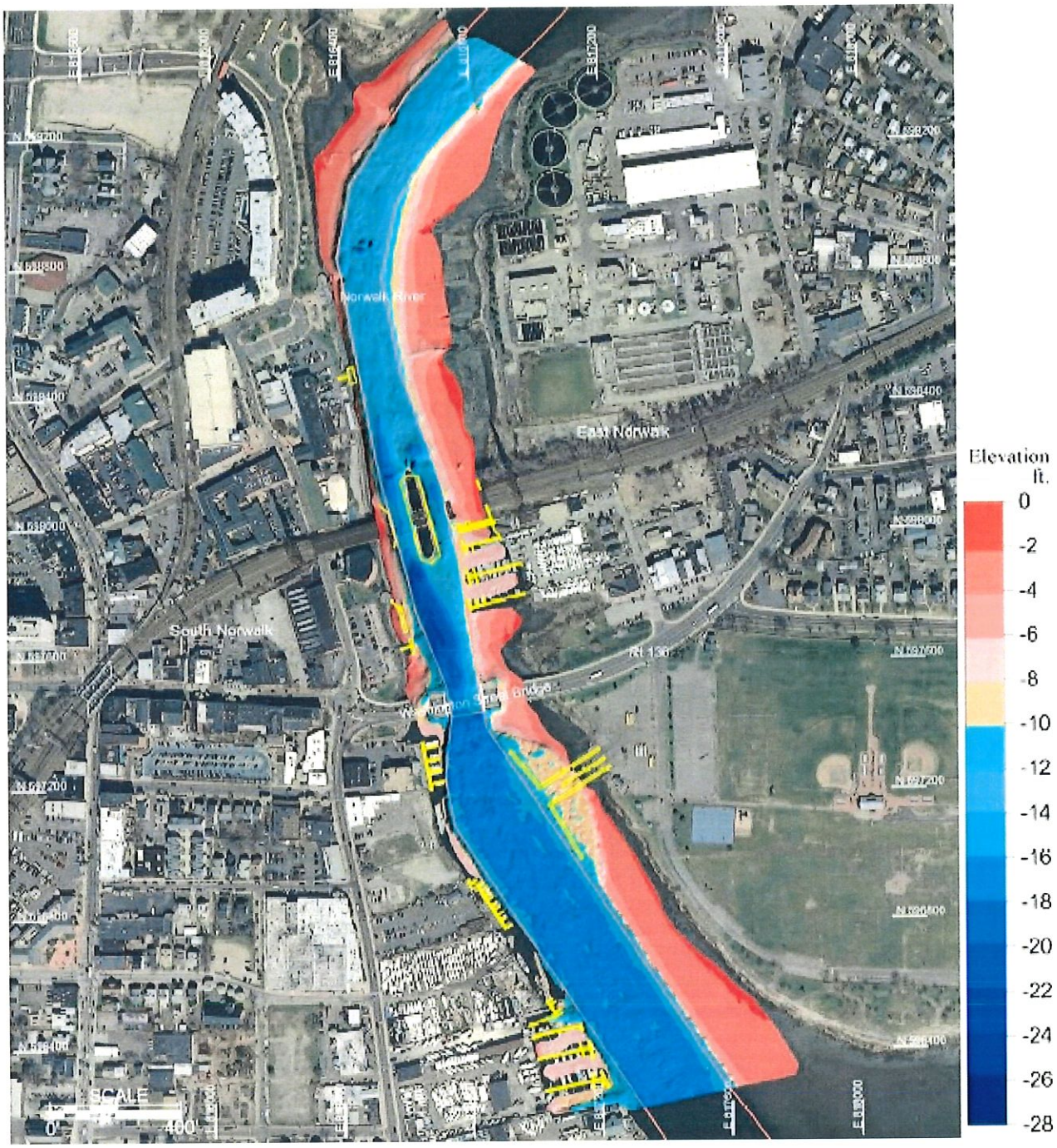

Figure 1 – Bathymetric Survey of the Norwalk River at Walk Bridge, October 19-20, 2016

Dredging will be required at the Marine Staging Yard to enable removal of the existing bulkhead and installation of the new permanent sheet pile bulkhead, and to accommodate construction vessel drafts. Prior to work start, the work area will be enclosed by a turbidity curtain. Dredging conducted between December 1st and January 31st will be conducted within a turbidity curtain. If necessary to dredge from February 1st through November 30th, dredging will be conducted within a marine enclosure enclosed by a turbidity curtain. Dredging will be performed to Elevation -11.0 ft (NAVD88) between the bulkhead and the marine enclosure.

Dredging Restrictions and Methodology. Unless occurring within a marine enclosure, dredging will be restricted to the approved winter excavation window (December and January) and will be conducted within a turbidity curtain. Sediment will be mechanically dredged from a crane on a spudded crane barge using a clamshell bucket. Vessels, whether unloaded or loaded, will avoid contact with the bottom of the channel. The dredging equipment will be required to operate efficiently for the depths of dredging and the volume of dredged material to be generated and will not generate excessive turbidity or create excessive noise. The excavated sediment will be loaded onto material barges, modified to include side boards and containment fabric as a holding area. Water will be contained in the holding area and pumped into a sedimentation tank. When the barge is fully loaded, it will be moved off-site and off-loaded with an onshore crane or excavator. The excavated material and dewatered wastewater will be managed per the requirements of the CTDEEP General Permit for the Discharge of Groundwater Remediation Wastewater (General Permit), as further described in B. Disposal of Dredged Material. The work will be scheduled so that one existing channel will remain open to navigation. The turbidity curtains will remain in place until that portion of the project is complete and the turbidity has settled to no more than pre-construction conditions.

Initially, the eastern construction work platforms will be used for loading of dredged material from the barges. The Marine Staging Yard (68-90 Water Street; Parcels 2/84/19, 2/84/63, and 2/84/33) and the construction yard at the bridge site (1 Goldstein Place; Parcel 3/1/25) will be used for off-loading of materials from the construction barges. Additional potential off-site locations include two upstream locations at Devine Brothers, Inc. (38 Commerce Street) and King Industries Inc. (1 Science Road). CTDOT is continuing to coordinate with the upstream businesses for use of the sites during project construction.

Dredging Impacts – Water Velocities. The hydraulic model developed for the project indicates that the velocities through the bridge will be lower post-dredging than existing conditions. Except for the larger design storms (200-year and 500-year floods) the proposed velocities through the bridge will be less than 2 feet/second. The average decrease in velocity is 0.30 feet/second. The existing very low velocities (between 0.6 and 1.6 feet/second) are less than the critical velocity of most materials that contribute to sedimentation. Although the velocities will be lower, the removal of the center pivot pier will reduce the likelihood of vortices that may trap debris, while allowing more efficient flushing during the tide cycle.

Dredging Impacts – Aquatic Habitats. The waters in and around the project site, consisting of the Norwalk River and Norwalk Inner Harbor, serve as habitat for several benthic species, further described in **Part III, Question 4**. Dredging will impact subtidal habitat, by removing benthic communities and increasing water depths. The changes in water depths due to the dredging are not expected to alter use of the areas by the Endangered Species Act (ESA)-listed sturgeon or sea turtle species, and the underlying substrates will allow for recolonization by algae and benthic organisms from adjacent communities, given

the proximity to colonizing biota nearby in the river and harbor.[1] Recruitment rates by algae and benthic fauna are tied to light penetration into the water column, water chemistry and temperature, substrate characteristics, and other factors such as wave or tidal energy, and bathymetry. Habitat disturbance from project dredging will result in a change in depth for select portions of the river and temporary alteration of the shadow pattern; however, dredging will not change the use of the areas by ESA-listed species nor diminish water quality such that there will be effects on an individual that can be meaningfully measured, detected, or evaluated.

With respect to encountering species, dredging activities will only occupy small fractions of the width of the river in their respective locations, allowing ample room for avoidance. Dredging will be conducted using a mechanical dredge (clamshell bucket) and interactions with the ESA-listed species are extremely unlikely to occur. For an individual to be impacted by a clamshell bucket, it would likely need to be directly below the bucket as it reaches the riverbed and remain motionless as the bucket closes. Capture incidents due to dredging are discountable due to the river extents available for avoidance and passage, and the time of year that dredging will likely take place (December and January), when ESA-listed species are expected to be absent.

The dredging will cause temporary localized increases in turbidity/suspended sediment. The turbidity-producing work will take place within turbidity curtains and during the winter months (December and January), and also within marine enclosures if it is necessary to dredge from February through November, such that no impairment of movement of ESA-listed species will be expected. Further, the restrictive work window will protect winter flounder, diadromous fish passage, and shellfish resources. Any effects resulting from a change in water quality due to dredging will not be measurable, or detectable when added to the baseline conditions, and are therefore deemed to be insignificant.

B. Disposal of Dredged Material

CTDOT conducted subsurface site investigations within the Norwalk River in the vicinity of the project to determine whether dredging and other work within the river would require management of contaminated sediment. In June 2018, 19 borings were advanced in the Norwalk River and a total of 70 sediment samples were collected for laboratory analysis.

The sediment analytical results were compared to the numeric criteria listed in the CTDEEP Remediation Standard Regulations (RSRs), Sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies, dated June 2013, and compared to the published 2015 numeric criteria for additional polluting substances not promulgated in the June 2013 RSRs. While the RSRs apply specifically to sites at which remedial actions are required by CTDEEP, which is not applicable to the Walk Bridge Replacement Project, the RSR numeric criteria were used as guidelines to evaluate concentrations of regulated compounds detected in sediment regarding handling and management of material during excavation. Polluted soil is defined as containing any substance at a concentration above the analytical detection limit. Contaminated soil is defined as any substance whose concentration exceeds the numeric criteria of the RSRs.

[1] Rhoads, Donald C., and Joseph D. Germano. (1982) Characterization of Organism-Sediment Relations Using Sediment Profile Imaging: An Efficient Method of Remote Ecological Monitoring of the Seafloor (REMOTS super (TM) System). Marine ecology progress series. Oldendorf 8.2 (1982): 115-128.

Based on the testing results, the Norwalk River is identified as a preliminary Area of Environmental Concern (AOEC). The sediment contains Extractable Total Petroleum Hydrocarbons (ETPH), Semi-Volatile Organic Compounds (SVOCs), pesticides, and/or metals (arsenic and/or chromium) at concentrations exceeding the RSR criteria; and is therefore classified as contaminated material. Any sediment removed from the Norwalk River will therefore be handled as controlled material.

Excavated sediments will be managed in accordance with the CTDEEP General Permit for Contaminated Soil and/or Sediment Management (Staging and Transfer) and the General Permit for the Discharge of Groundwater Remediation Wastewater. The project includes specifications for the proper management and disposal of contaminated materials, including removal, handling, transporting and disposal during construction activities and for establishment of appropriate worker health and safety protocols. The controlled material will be de-watered, solidified, and managed on a temporary basis at a CTDOT-designated Waste Stockpile Area (WSA). CTDOT has identified the WSA in the Route 7/I-95 intersection for the Walk Bridge Replacement Project, shown in Figure 2. The groundwater in the WSA is classified as GB, which indicates that the area is designated for industrial process water and the groundwater is not suitable for human consumption. The WSA is located in a zoning classification of AAA Residence Zone, indicating that the area may be used as a stockpile area as long as all material is stored in an environmentally safe manner and the stockpiles are not more than 10 feet high.

The WSA will be used exclusively for temporary stockpiling of excavated materials from within the project AOECs for determination of disposal classification. Soil stockpiles will be placed on an impervious surface to prevent the transfer or infiltration of contaminants from the soil stockpile to the ground. Anti-tracking measures will be implemented at the WSA to minimize vehicle tracking of soil from the WSA onto the public roadways. Run-on and run-off controls will be consistent with the 2002 Connecticut Guidelines for Soil Erosion and Sediment Control. The stockpiles will be protected from wind erosion and dust transport by tarps and dust suppressants, and the area will be regularly maintained through the completion of the project. Following the removal of all stockpiled material, the contractor will be responsible for decontaminating the area using dry decontamination procedures. Following decontamination, the WSA will be dismantled.

Following the determination of disposal classification, the controlled material will be loaded, transported to, and disposed of at a CTDOT-approved facility for the disposal/ recycling/treatment of non-hazardous sediments. CTDOT has identified a list of allowable disposal facilities for Connecticut regulated wastes from which the contractor may use; no other facility can be used without approval. The list of allowable disposal facilities is included in the contract specifications.

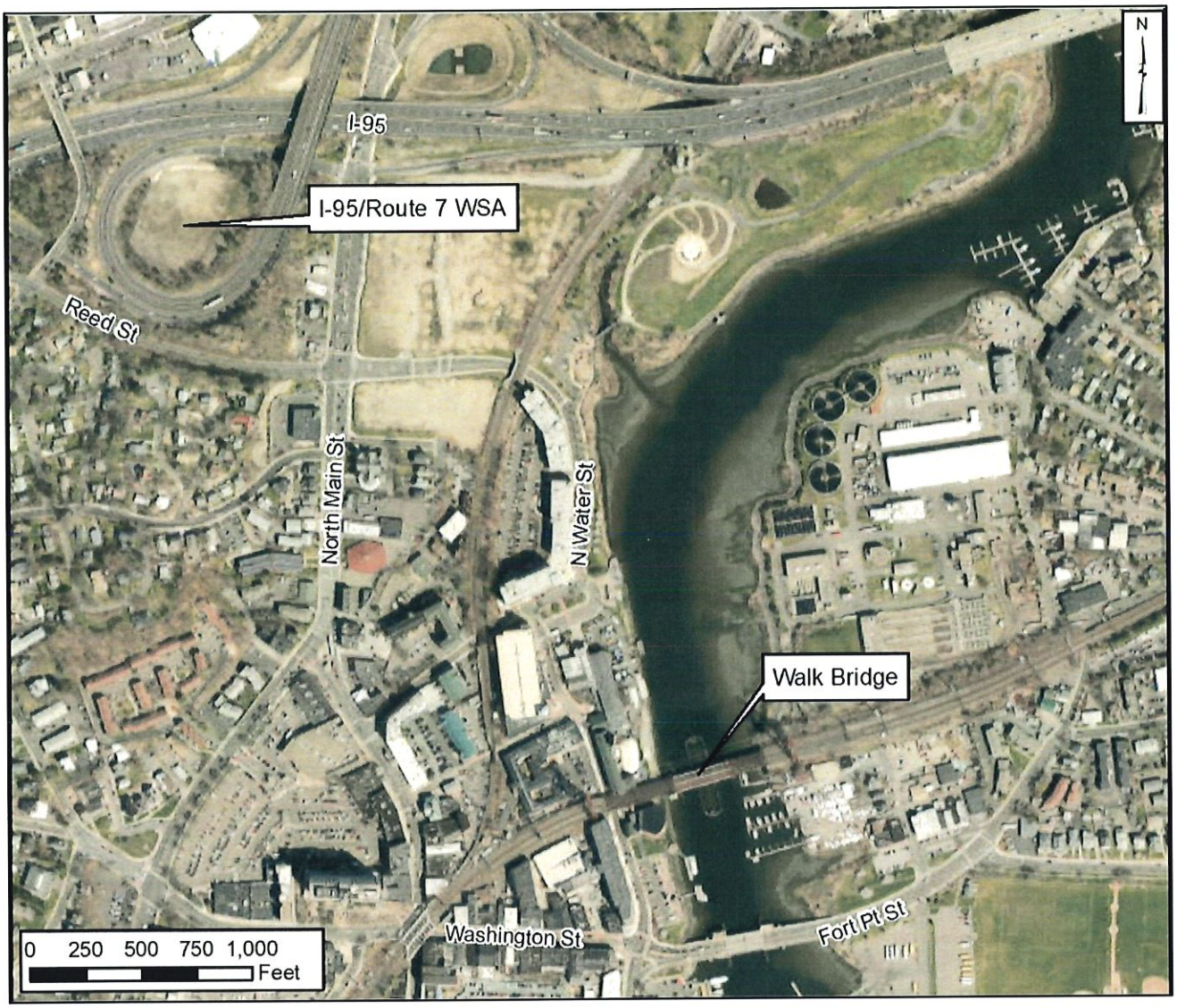

Figure 2 – Location of Project Waste Stockpile Area

II. Shoreline Erosion or Stabilization Structures

The Walk Bridge Replacement Project will include construction of three shoreline erosion or stabilization structures: a permanent bulkhead at the Marine Staging Yard, 68-90 Water Street; and a living shoreline at two wetland mitigation areas.

Permanent Bulkhead at the Marine Staging Yard

A. Alternatives Analysis

CTDOT conducted an alternatives analysis for the permanent bulkhead to be constructed at the Marine Staging Yard. Two alternatives for the bulkhead structural systems were evaluated: an anchored sheet pile bulkhead and a non-gravity cantilever combination pile bulkhead. CTDOT determined that the Marine Staging Yard bulkhead will be constructed as a combination pile bulkhead (CA4-1 through CA4-4). The

combination pile bulkhead will result in less environmental impacts and future land use restrictions than the anchored sheet pile bulkhead.

A combination pile bulkhead consists of a system that uses sheet piles reinforced with pipe or W-shape piles. A typical combination pile section is shown in Figure 3 and a typical section is shown in Figure 4.

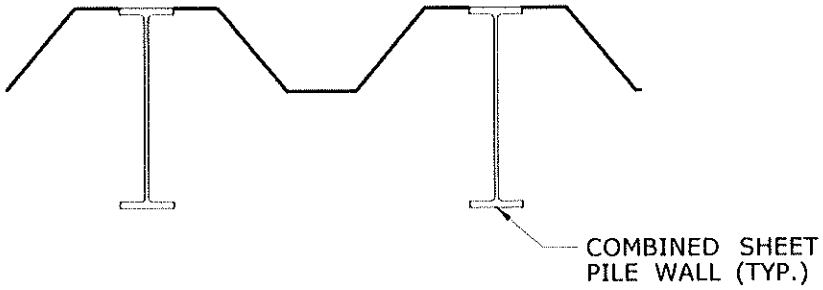

Figure 3 – Combination Pile Section

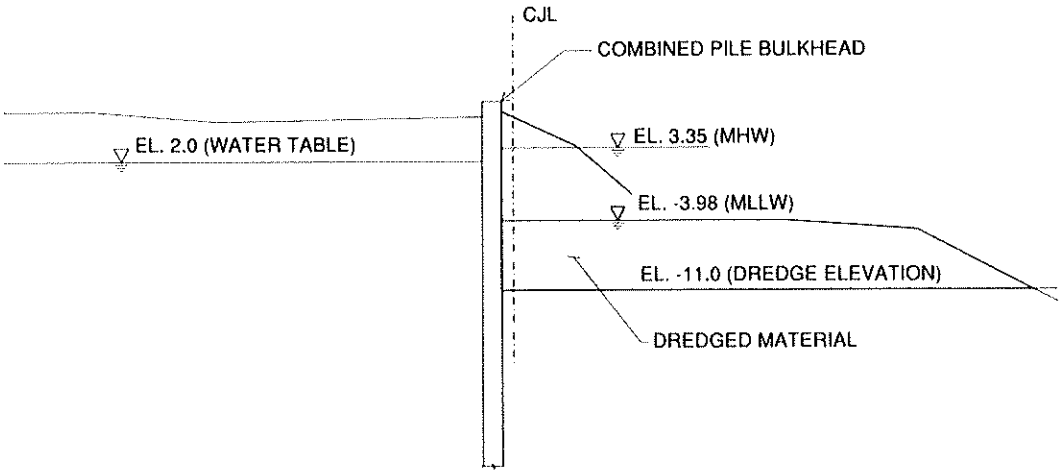

Figure 4 - Typical Combined Pile Bulkhead

An anchored sheet pile bulkhead system uses two rows of wales and anchors as shown in Figure 5. The lower anchor force would be approximately 20 kip / foot along the wall. A second sheet pile wall would be installed 30 feet inland from the bulkhead to act as a dead man (support) for the anchors.

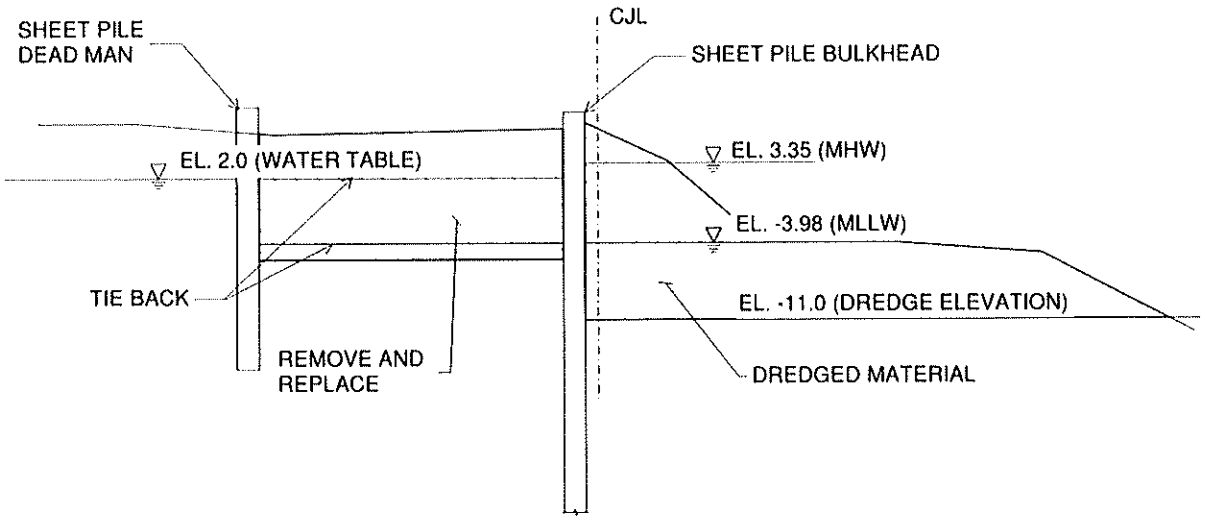

Figure 5 - Typical Sheet Pile Bulkhead Section

The reinforcing piles of the combination bulk head provide greater stiffness and bending capacity of the system compared to a sheet pile bulkhead. This allows for a cantilevered bulkhead without anchors. Reinforcing piles must be driven deeper than the sheet piles to ensure adequate embedment to develop the full pile capacity. While this design has a larger steel quantity in the bulkhead in comparison to the anchored sheet pile bulkhead, it does not require anchors, wales, or dead man sheet piles. Further, with the anchored sheet pile bulkhead, the material between the two sheet piles must be removed and replaced to allow for construction and installation of the anchors and wales. Soil in this area of the Marine Staging Yard is considered hazardous and would require additional environmental procedures for material excavation, handling and disposal.

B. Level of Protection

The bulkhead at the Marine Staging Yard will be designed to remain stable during the 200-year scour design event as outlined by CTDOT requirements.

C. Erosion and Sediment Control

The bulkhead is in a VE flood zone subject to significant wave action; however, due to the low velocities in this section of the Norwalk River (1 to 1.2 feet/second), a conservative rate of two feet of scour is estimated. The bulkhead will not result in any adverse erosion or sedimentation of adjacent properties, lands, wetlands, or waters, nor will it result in any increased transport of sediment.

D. Toe and Flank Protection

The combination pile bulkhead has a larger steel quantity in the bulkhead than the anchored steel pile bulkhead, but it does not require anchors, wales, or dead man sheet piles. Reinforcing piles must be driven deeper than the sheet piles to ensure adequate embedment to develop the full pile capacity. The reinforcing piles provide greater stiffness and bending capacity of the system compared to a sheet pile. This allowed for a cantilevered bulkhead without anchors.

E. Drainage Measures

Upland stormwater will be diverted away from the structures via stormwater drainage systems that will discharge directly into the Norwalk River. The new and reconstructed outfalls will be properly stabilized with outlet protection such as riprap aprons or riprap-lined preformed scour holes.

F. Impacts on Adjoining Properties

The bulkhead will be located waterfront of 68-90 Water Street, following the natural shoreline, and will terminate approximately 10 feet inside each property line on the northern and southern limits of the bulkhead. CTDOT is obtaining a temporary easement at 68 Water Street for the construction of the bulkhead. CTDOT is acquiring 90 Water Street (and 70 Water Street) for the construction of the Marine Staging Yard, including the bulkhead.

G. Impacts on Sediment and Water Quality

The project will not result in adverse impacts to sediment or water quality/habitats. Construction of the bulkhead will be completed inside a marine enclosure and turbidity curtain around its outside perimeter, which will be installed prior to work start.

Underwater noise associated with the bulkhead's pile driving activities exceed behavioral and physiological thresholds. Impacts associated with underwater noise will be mitigated for by starting each shift with a soft start for all pile driving activities that are conducted outside the November 1st – March 15th timeframe, per U.S. Army Corps of Engineers (USACE) guidance.

Living Shoreline at Wetland Mitigation Areas

Wetland mitigation proposed for the Walk Bridge Replacement Project will include restoration of degraded tidal salt marsh wetlands. At Wetland Mitigation Areas 2 and 6, the proposed mitigation includes developing "Living Shorelines," the components of which are a rock riprap sill/berm with establishment of salt marsh vegetation on the landward side of the sill. Oyster cultch will be placed among the exposed rocks on the waterward side of the riprap sill, in accordance with CTDOT's Tidal Wetland Creation Specification Item # 0948013A found in **ATT M6**. As such, the rock riprap component is a shoreline erosion control "structure." The purpose and benefits of Living Shoreline development for this project include the following:

- Restoring and enhancing habitat to support fish and other aquatic species;
- Maintaining aquatic/terrestrial interface and connectivity;
- Providing shoreline access for wildlife;
- Improving water quality by settling or trapping sediment and filtering pollution;
- Implementing erosion control and shoreline stabilization by absorbing wave energy so that reflected waves do not scour the shallow sub-tidal zone;
- Enhancing community enjoyment; and
- Providing opportunities for community education.

A desktop analysis was conducted to assess various applicable factors involved in the development of the Living Shoreline, with a rock sill/berm structure, for restoration of the tidal marsh wetlands as follows:

Erosion History. The current erosion rate appears to be low or very low. A review of historical aerial photographs (available on www.historicalaerials.com and Google Earth) indicated minimal shoreline erosion, if any, based on shoreline conditions in 2006 aerials compared to conditions visible in subsequent years (up to 2019, a 13-year span).

Wind Wave Energy. The wave energy at each mitigation area was determined by measuring the distances to the far shore (fetch) and calculating the "average fetch" and the "longest fetch":

- Mitigation Area 2 – Average Fetch = 0.2 mile; Longest Fetch = 0.6 mile
- Mitigation Area 6 – Average Fetch = 0.1 mile; Longest Fetch = 0.3 mile

Wave energy levels, based on fetch, are categorized in the document *Living Shorelines Engineering Guidelines*.[2] Based on the resulting distances for the areas, the wave energy regarding average fetch is in the "Very Low" category for both mitigation areas. The wave energy for the longest fetch distances is in the "Low" category for Area 2 and in the "Very Low" category for Area 6. According to the *Guidelines*, developing Living Shorelines by using "Sill/Marsh" techniques is suitable for areas in the Low and Very Low wave energy categories. The *Guidelines* also recommend that rock size for berm/sill structures in the low and very low wave energy environments should be 17-inches to 24-inches in diameter, with a weight ranging from 300 to 900 pounds.

Storm Surge. For Living Shorelines, the storm surge is mostly insignificant. The rock riprap sill structures are not intended to provide protection from storm events, as they are low-lying and will be overtopped during storms.

A. Alternatives Analysis

CTDOT considered two non-structural alternatives to a Living Shoreline, consisting of tidal marsh planting and coir logs with tidal marsh planting, as follows:

- Tidal Marsh Planting Alternative. Wetland Mitigation Area 2 would require *Phragmites* removal, regrading, topsoil placement, and marsh planting. Wetland Mitigation Area 6 would require removals of existing rock riprap, topsoil placement, regrading, and marsh planting.

  Although this alternative is feasible and would provide most of the previously listed benefits of Living Shorelines, it would not provide the same level of wave absorption, sediment trapping, and wetland edge erosion protection as a rock riprap sill/berm at the edge of the marsh planting. However, the proposed tidal marsh restoration areas are in locations that experience low and very low wave energy, and shoreline erosion is likely to be minimal with this alternative.

- Coir Logs with Tidal Marsh Planting Alternative. Wetland Mitigation Areas 2 and 6 would require the same measures used in the Tidal Marsh Planting Alternative, with the addition of coir logs at the waterward edge of the marsh planted area. The coir logs are considered temporary protection and are

[2] Miller, J. K., Rella, A., Williams, A., & Sproule, E. (2016). Living Shorelines Engineering Guidelines. Report prepared for the New Jersey Department of Environmental Protection. Stevens Institute of Technology. Report No. SIT-DL-14-9-2942. Revised February 2016.

bio-degradable. They will gradually decay within three to five years of their initial placement in a tidal environment. While the coir logs are undergoing decay, the adjacent planted vegetation becomes an established marsh and provides some shoreline protection over time.

Although this alternative is feasible and would provide most of the previously listed benefits of Living Shorelines, coir logs are considered temporary components regarding absorbing wave energy because they decay over a period of three to five years. The adjacent planted vegetation becomes an established marsh and provides a moderate level of shoreline protection over time, in the low and very low wave energy environment. However, this alternative would not provide the same level of wave absorption, sediment trapping, and wetland edge erosion protection over time as a rock riprap sill/berm at the edge of the marsh planting.

The two alternatives to the Living Shoreline would have less environmental impact than the proposed structural alternative of placing a rock riprap sill/berm on the mud substrate of the Norwalk River, as proposed for Mitigation Areas 2 and 6. However, the marsh edge may still be subject to somewhat more potential erosion with those alternatives than the potential erosion that could occur with the rock riprap structure. In addition, the long-term level of wave absorption and sediment trapping benefits provided by the proposed rock riprap structure would not be realized with either of the two alternatives.

Based on the alternatives analysis, CTDOT determined that development of a Living Shoreline, comprised of rock riprap sill/berm with establishment of salt marsh vegetation on the landward side of the sill/berm, is the preferred alternative for Wetland Mitigation Areas 2 and 6 in restoring the existing degraded and low-functioning tidal salt marsh wetlands.

The Living Shoreline at the two mitigation areas will not impair access to or along the public lands and waters waterward of mean high water (MHW), Elevation 3.35.' The proposed rock structures will vary in height from approximately 18 inches to three feet. The proposed top elevation of the rock structures will be approximately 0.0' at Mitigation Area 2 (an approximate 18" to 24" height at or slightly above the proposed final grade of the low marsh area), and 1.0' at Mitigation Area 6 (an approximate 2-foot to 3-foot height at or slightly above the proposed final grade of the low marsh area). Therefore, the proposed structures will be lower than the MHW elevation, and there will be no unreasonable impairment of access to or along the public lands and waters waterward of MHW. In addition, openings in the structures will allow for aquatic wildlife access to and from the marsh area.

B. Level of Protection

The proposed rock riprap sill/berm structures are not intended to provide protection from storm events, as they are low-lying and will be overtopped during storms. Being in low/very low wave energy environments, and consisting of rock riprap, they are anticipated to remain in place for the life of the rock material.

C. Erosion and Sediment Control

The erosion level of the existing shoreline at adjacent properties is currently low or very low. A review of historical aerial photographs indicated minimal shoreline erosion, if any, based on shoreline conditions in

2006 aerials compared to conditions visible in subsequent years (up to 2019, a 13-year span). The proposed rock riprap structure will continue to minimize erosion and will likely reduce current erosion rates.

The areas seaward of the proposed rock structure consist of open water at high tide and intertidal mudflats at low tide. The existing erosion or sedimentation processes along these environments will continue at the same rate. The rock structures are low-lying and extend only along the two mitigation areas. Therefore, they are not likely to adversely affect those processes on the seaward side.

As the tide fluctuates in the mitigation areas, the proposed rock structure will function to trap sediment in the marsh area on the landward side of the structure. However, transport of sediment will continue to occur along the shoreline areas outside of the mitigation areas.

D. Toe and Flank Protection

Due to the low and very low wave energy ratings at the two mitigation areas, toe protection of the proposed rock riprap structure is not necessary However, the rock structure at Mitigation Area 2 will utilize 24-inch to 30-inch diameter rock, with the larger 30-inch rock placed at the toe of the structure and anchored by pressing the rock into the mud substrate 6 inches to 12 inches in depth, or by placing the rock in a trench 6 inches to 12 inches deep. The base of the structure will be a minimum width of 3 feet and the height will be approximately 18-inches to 24inches. At Mitigation Area 6, existing rock riprap at the site will be excavated and reused to construct the rock sill/berm with a 1:1 side slope on the landward side and 1.5:1 side slope on the waterward side. The base of the structure will vary from 7 feet to 9.5 feet, with the height varying from 2 feet to 3feet. The rock used for the structure will be an average size of 18-inches in diameter, although some rock could be as small as 12-inches or as large as 24-inches in diameter. The reused rock will be placed on the existing rock riprap substrate base, which is already anchored in the substrate and will function as toe protection.

Note that the *Guidelines* recommends that rock size for sill/berm structures in the low and very low wave energy environments should be 17-inches to 24-inches in diameter, with a weight ranging from 300 to 900 pounds.

E. Impacts on Adjoining Properties

The potential for adverse impacts from the proposed rock structure to adjoining properties and structures is very low. The low-profile rock structures and restored tidal wetlands will enhance the protection of the shoreline of adjacent properties.

F. Impacts on Sediment and Water Quality

The Norwalk River currently receives contaminants via stormwater runoff from streets, roofs, parking lots, and other typical urban sources, as well as the railroad right-of-way, without treatment before it enters the river. Water impairments in this stretch of the Norwalk River are due to pathogens (*Enterococcus Bacteria* and *Fecal Coliform*) and nutrients (Total Nitrogen and Nutrient/Eutrophication biological indicators). In addition, CTDEEP's water testing of the Norwalk River indicates that bacteria (*Escherichia coli*) exceeds the CTDEEP criterion for a Class B river, and every sampling station exceeds CTDEEP's single sampling maximum. Nutrient concentrations for both nitrogen and phosphorus exceed CTDEEP's water quality standards.

During construction of the Living Shoreline, temporary impacts to sediment quality and water quality may occur as a result of turbidity and suspended solids. To minimize water quality impacts, turbidity curtains will be installed around the perimeters of the mitigation areas prior to the start of construction. The turbidity curtains will extend from the surface to the bottom of the river to minimize potential sediment release to the river. In addition, excavation and grading will be performed at low tide. The turbidity curtains will remain in place until the river bottom has been stabilized.

The river substrate has been determined to be contaminated; therefore, excavated material will be transported off-site, managed at a CTDOT-designated WSA, and disposed of off-site (as described in B. Disposal of Dredged Material).

Best Management Practices (BMPs) will be incorporated during construction to minimize impacts to water quality and sediment quality. For discharges into waters of the U.S., a Section 401 Water Quality Certification will be required from CTDEEP and a Section 404 General Permit will be required from the USACE. These permits will stipulate that this work is consistent with the federal Clean Water Act and Connecticut Water Quality Standards. A National Pollutant Discharge Elimination System (NPDES) permit will also be required as administered by the State of Connecticut via a General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities.

Water quality will be improved following development of the Living Shoreline. After the proposed rock structure is complete, one of its functions will be to trap sediment in the marsh area on the landward side of the structure. The settling and trapping of sediments and filtering of pollutants in the marsh areas will improve water quality in this portion of the Norwalk River.