# Thin Layer Cap Pilot Project Work Plan

## Orrington Reach Capping Remedy

*Prepared for*

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| BAZ | biologically active zone |
| BMP | best management practice |
| DEP | Department of Environmental Protection |
| Estuary | Penobscot River Estuary |
| Greenfield | Greenfield Penobscot Estuary Remediation Trust LLC |
| Integral | Integral Consulting Inc. |
| NRPA | Natural Resources Protection Act |
| NTU | nephelometric turbidity unit |
| PDI | pre-design investigation |
| RAO | remedial action objective |
| Remediation Trust | Penobscot Estuary Mercury Remediation Trust |
| SPI | sediment-profile imaging |
| TLC | thin layer cap |
| USACE | U.S. Army Corps of Engineers |

# 1 INTRODUCTION

This Thin Layer Cap (TLC) Pilot Project Work Plan has been prepared by Integral Consulting Inc. (Integral) on behalf of the Greenfield Penobscot Estuary Remediation Trust LLC (Greenfield), Trustee of the Penobscot Estuary Mercury Remediation Trust (the Remediation Trust) for Work on the Penobscot River Estuary located in Hancock, Penobscot, and Waldo counties (Figure 1). This TLC Pilot Project Work Plan presents information needed to support regulatory and permitting activities, as well as efforts to secure access needed to place the TLC.

## 1.1 BACKGROUND

As described in the Consent Decree and the TLC Design Work Plan (Integral 2023), the Work in Orrington Reach will consist of capping approximately 130 acres of intertidal sediment, primarily on the east side of Orrington Reach. Orrington Reach is a portion of the Penobscot River immediately downstream of the former HoltraChem Facility in Orrington, Maine, as shown on Figure 1. The overall objectives of the remediation measures described in the Consent Decree are to reduce mercury exposures and accelerate recovery of the Site.

Section 4.1 of the TLC Design Work Plan identified a TLC Pilot Project as the first phase of implementation of Orrington Reach Work. As set forth in Paragraph 7(a) of the Statement of Work (Appendix A to the Consent Decree), the purpose of the pilot project is to provide Site-specific data to address key data gaps and uncertainties related to treatment technologies, remediation techniques, or Site-specific conditions that may affect remediation methods, and to serve as a "proof-of-concept" to demonstrate the effectiveness of a TLC remedy. This TLC Pilot Project Work Plan presents important information about the TLC Pilot Project needed to support initial discussions with Maine Department of Environmental Protection (DEP), U.S. Army Corps of Engineers (USACE), and other agencies. This TLC Pilot Project Work Plan has been prepared in accordance with the Consent Decree and applicable appendices, and meets the requirements for a pilot project specified in Paragraph 7(b) of the Statement of Work, as summarized in Table 1.

## 1.2 REMEDIAL ACTION OBJECTIVES

The overall goal for the remediation measures set forward in the Consent Decree is to accelerate recovery of the Site. The remediation must consider as paramount the interests of the Estuary, including the river itself, its flora and fauna, and its nearby inhabitants.

This section presents an update to the remedial action objectives (RAOs) presented in Section 3.2 of the TLC Design Work Plan based on a refined understanding developed over the course of the design process. In addition, several of the RAOs from the TLC Design Work Plan

have been reclassified as design and implementation considerations. The updated RAOs for the overall project include the following:

- Accelerate recovery of intertidal flat surface sediment.
- Reduce potential exposure to mercury in intertidal flat surface sediments.
- Minimize potential disturbance to critical habitat during and after TLC implementation.

The following RAOs identified in the TLC Design Work Plan have been reclassified as considerations:

- Minimize mixing of contaminated sediments with clean materials in the cap layer resulting from bioturbation by placing a TLC with a thickness equal to or greater than the biological mixing depth.
- Minimize the recovery period for the benthic community following TLC placement limiting cap thickness and using capping materials conducive to benthic recolonization.
- Reduce potential mercury redistribution from contaminated intertidal sediment to surface water and, in turn, other areas of the Estuary by providing cover and erosion protection sufficient to reduce resuspension and remobilization of contaminants into the water column.
- Maximize the area for capping within the Committed Funding.

## 1.3 TLC PILOT PROJECT DESIGN APPROACH

The TLC Pilot Project will be constructed in East Cove 3 (Figure 2), contingent upon receipt of access permission from landowners of the intertidal flats. The preliminary design for the TLC Pilot Project presented in Section 3 of this Work Plan specifies placement of a layer of sand material with an average thickness of 4 in. over a 6-acre area of intertidal sediment in East Cove 3. Alternative TLC materials and thicknesses may be applied in select areas to evaluate the results of differing TLC compositions. These alternatives will be evaluated during the design, and the results of the PDI and input from the permitting agencies and the public will also be considered.

As described in Section 4 of the TLC Design Work Plan and in accordance with Paragraph 9 of the Statement of Work, a Work Design will be prepared that presents the detailed design for the TLC Pilot Project. The Work Design will:

- Incorporate the information from pre-design investigations (PDI) and design evaluations specified in the TLC Design Work Plan, as summarized in Table 2.
- Include the required elements for the Work Design specified in Paragraph 9 of the Statement of Work.

- Provide the information needed to support the Natural Resources Protection Act (NRPA) permit application process.
- Provide information needed to update cost estimates and to perform a constructability review.
- Include Construction Monitoring and Post-Capping Performance Monitoring Plans describing the data collection and analyses that will be undertaken to evaluate the TLC in relation to the TLC Pilot Project objectives presented in Section 2 of this TLC Pilot Project Work Plan and the project RAOs presented in Section 3.2 of the Design Work Plan.

The Work Design may be updated, as needed, based on agency review of the permit applications.

# 2 TLC PILOT PROJECT OBJECTIVES

The TLC Pilot Project will provide Site-specific information and data to support evaluations of the project objectives and demonstrate feasibility of the capping remedy specified for Orrington Reach in the Consent Decree. If successful, the pilot project area itself will also contribute to achieving RAOs as part of the overall remedy for Orrington Reach. The RAOs were presented in Section 3.2 of the TLC Design Work Plan and are updated in Section 1.2 of this TLC Pilot Project Work Plan. The TLC Pilot Project is intended to demonstrate the effectiveness of the TLC on a small scale and provide information to address concerns and questions raised by permitting authorities and the community stakeholders.

Specific objectives of the TLC Pilot Project are summarized below:

- **Cap Stability.** The TLC Pilot Project will provide information to determine if the TLC is sufficiently stable to achieve the RAOs by observing whether the cap material erodes/migrates due to river flow, tidal action, ice scour, or other natural processes.
- **Ecology/Ecological Habitat**. Placement of the TLC has the potential to result in temporary adverse effects on the local ecology and habitat associated with construction activities (e.g., temporary reduction in fish foraging habitat). The expectation is that remediation activities would have a long-term beneficial effect to natural resources by placing a TLC of clean material over contaminated sediment to reduce mercury exposures and accelerate recovery of the Site. In addition to the previously conducted wetland assessment, TLC Pilot Project will establish baseline information regarding the magnitude of the temporal effects on the benthic community (i.e., fish foraging habitat) by assessing the rate of recolonization following placement of the TLC. Other potential ecological impacts resulting from the TLC will be identified in collaboration with the permitting agencies as part of the permit application process, as well as the need for and scope of monitoring during the TLC Pilot Project to evaluate those impacts.
- **Surface Deposition.** Particulates are anticipated to deposit from the water column and accumulate on the surface of the TLC over time. The TLC Pilot Project will provide information to estimate the natural recovery of sediment in the area where the TLC is placed by monitoring the rate of sediment accumulation on the TLC and the concentration of mercury in the accumulated sediment.
- **Future Phases of TLC Implementation.** Information obtained during permitting, construction, and performance monitoring of the TLC Pilot Project will inform future phases of the TLC implementation. The information will be used to update feasibility evaluations (including cost estimates), demonstrate the TLC can be placed in a manner that is protective of habitat (or that any such impacts will be temporary), and provide

design and construction information to support more efficient and effective implementation.

# 3 TLC PILOT PROJECT PRELIMINARY DESIGN

This section presents the preliminary design for the TLC Pilot Project based on the currently available data and analyses completed to date. In addition, this section describes planned data collection and analysis activities that will be incorporated into the TLC Pilot Project Work Design. The preliminary design specifies placement of a layer of sand material with an average thickness of 4 in. over a 6-acre area of intertidal sediment in East Cove 3. As noted previously, alternative TLC materials (non-washed sand, carbon amendments, etc.) and varying TLC thicknesses up to 6 in. may be applied in select areas to evaluate differing TLC compositions. These alternatives will be evaluated during the Work Design, and the results of the PDI and input from the permitting agencies and the public will also be considered.

## 3.1 LOCATION AND EXTENT

The TLC Pilot Project will be located in East Cove 3, contingent on receipt of access permissions. East Cove 3 is on the east side of Orrington Reach approximately 1.2 miles downriver of Southern Cove and the former chlor alkali plant (Figure 2). Selection of East Cove 3 for the TLC Pilot Project considered the following:

- The location of the TLC Pilot Project in East Cove 3 is consistent with the Consent Decree specification that the capped area be primarily on the east side of Orrington Reach.
- Sediment bulk chemistry data available to date indicate that surficial sediments in East Cove 3 contain some of the highest median mercury concentrations in the Orrington Reach. Therefore, selecting East Cove 3 for the TLC Pilot Project will place the TLC in an area consistent with the goal of reducing total mercury in intertidal surface sediment across Orrington Reach.
- East Cove 3 requires access from relatively few property owners who have previously granted access for sediment sampling and wetland surveys.
- East Cove 3 has a range of geomorphologies, including presence of intertidal creeks and marsh areas.

The TLC Pilot Project will cap intertidal sediment at an elevation between the mean lower low water and mean high water elevations. Though the intertidal zone also encompasses the fringing marshes within Orrington Reach, areas defined as marsh (e.g., "low marsh") are anticipated to be excluded from the area to be capped to avoid direct impacts to the marsh. However, as noted in Section 3.3.1 of the Design Work Plan, natural recovery of marsh areas can be enhanced through the placement of a 2- to 3-in. layer of clean material to reduce mercury concentrations at the marsh surface. Potential benefits for placement of a TLC to the low marsh area will be evaluated further during the design and permitting process.

East Cove 3 includes approximately 18 acres of intertidal flats and 2 acres of low marsh. Figure 3 presents the preliminary TLC Pilot Project location, which covers approximately 6 acres of intertidal flats. A 20-ft buffer zone has been incorporated at the outer northern and southern end of the TLC area, as defined by the relevant land-side property boundaries extended and adjacent to low marsh areas. The buffer areas will be monitored to observe whether cap material migrates laterally (Section 3.4.2). Observations of lateral movement, if any, will determine the size of buffer zones needed for future cap construction to minimize the potential for material to migrate to adjacent parcels where access has not been granted or to the low marsh areas.

## 3.2 CAP MATERIAL

Sand has been identified as the preferred material for the TLC Pilot Project based on the following considerations:

- Sand has been used extensively as a successful capping and subaqueous backfill material in similar settings to East Cove 3 (ITRC 2023), including the selection of a gravelly sand as post-dredging backfill material for use at the nearby upriver Southern Cove Corrective Measures Implementation (Anchor QEA, LLC and CDM Smith, Inc. 2017).
- Based on the current understanding of site hydrodynamic conditions, sand is expected to be stable (e.g., will not be eroded by river currents) and will not require an armor layer.
- Sand is readily available and can be placed using available construction technologies. Finer-grained materials, such as silts and clays, settle slowly, thus constraining the ability to reliably place the materials under wet conditions and increasing the likelihood of adverse impacts due to turbidity.
- Sand has been shown to be effectively and rapidly (in as little as 1 year) recolonized by benthic organisms in capping applications across a wide range of conditions, including in estuarine systems (Polayes 1997; Merritt et al. 2009).

The cap material is anticipated to consist of a washed sand, both limiting the maximum material diameter and minimizing the amount of fine material that may contribute to turbidity during cap material placement.

The cap material will be procured from local/regional aggregate suppliers to the extent possible to minimize transportation cost. Five suppliers within approximately 50 miles of Orrington Reach have been identified with advertised products similar to the preferred cap material. The selection of the supplier will be made by the contractor, who will be required to provide pre-construction submittals to document the material meets geotechnical criteria and is free of

contaminants consistent with the Maine DEP Remedial Action Guidelines for Contaminated Sites (Maine DEP 2023). The gradation of the preferred material will be presented to aggregate suppliers prior to the finalization of the design to ensure that the required material, or a substantively similar substitution, is available in the quantities required. Based on the expected cap area of 6 acres (Section 3.1) and nominal thickness of 4 in. (Section 3.3), the volume of cap materials to be placed is estimated to be approximately 3,200 cubic yards.

Specifications for the cap material will be finalized and presented in the TLC Pilot Project Work Design based on the results of hydrodynamic modeling and geotechnical analysis. TLC material specifications will also consider the basis of design factors identified in the TLC Design Work Plan, including cap stability and compatibility with underlying sediment. The results of the hydrodynamic modeling will also be used to confirm if cap armoring layers are required and, if required, inform their material specification and locations.

## 3.3 CAP THICKNESS

The preliminary design for the Pilot Project includes a TLC with a nominal design thickness of 4 in. and a construction tolerance of ±2 in. These preliminary design parameters are based on:

- The current understanding of the biological mixing depth.[1] The biologically active zone (BAZ) is generally anticipated to be approximately 2 to 4 inches in thickness in freshwater systems (ITRC 2023). This expectation of shallow BAZ depth is supported by the limited abundance of benthic infauna and the apparent shallow depth of reduced sediment observed in Orrington Reach and at East Cove 3 during the wetlands assessment (WSP 2023a). Further characterization of the BAZ depth to support this design parameter in the TLC Pilot Project area has been identified as an objective for additional PDI work anticipated to occur in 2024.
- Preliminary discussions with remediation contractors regarding the precision that can be achieved using available placement technologies/techniques and the effects of precision specifications on placement time and cost. In general, allowing greater tolerances on the measurements of placed material will reduce placement time and cost.

As summarized in Table 2, the design thickness will be finalized based on information from the hydrodynamic modeling, PDI geotechnical analysis, and CapSim modeling, as well as further discussions with remediation contractors regarding placement equipment capabilities and construction means and methods. The final TLC Pilot Project cap thickness will be presented in the TLC Pilot Project Work Design.

[1] The depth of the BAZ can be reasonably expected to change following the TLC Pilot Project construction, which will involve the introduction of a new sediment substrate over a relatively short period of time. The resulting effects of the TLC Pilot Project placement on the BAZ depth will be documented as part of the proposed post-capping performance monitoring (Section 3.5.2).

## 3.4 CAP PLACEMENT

The TLC Pilot Project material placement will be performed from the water side of the intertidal flats. Technologies and methods currently under consideration for the placement of the TLC material include conveyor belt systems (e.g., Telebelt®), mechanical placement with excavators or similar equipment, and hydraulic casting. Based on conversations with experienced sediment remediation contractors, on-water work platforms and barge support for placement equipment and material conveyance are expected to be required. Determination of the equipment used for TLC placement will be the responsibility of the remediation contractor, subject to performance specifications, permit conditions, and controls that may be required to minimize negative impacts to adjacent properties.

Production rates for cap material placement will depend on daily work hours and seasonal work windows and will be subject to conditions negotiated with property owners, as well as permit conditions, weather, and tidal cycles. The work window will have a significant impact on construction cost and therefore feasibility of the TLC Pilot Project, as well as the full-scale TLC placement within Orrington Reach. The Remediation Trust has had preliminary discussions with regulatory agencies regarding requirements to protect fish habitat that limit certain types of work in the river to the period between November and April unless a time of year exemption is granted. If it is necessary to implement the construction in a time period with conditions more favorable for safety and efficiency (longer daylight hours, no ice, lower river currents, etc.), the permit application will include a request for a time of year exemption to expand the work window to a time period within July to October. It is anticipated that additional conditions will be required as part of the permit should the time of year exemption be granted.

Specifications for TLC material placement will include accuracy and tolerance limits. During construction of the pilot area, the thickness of the cap material will be measured using push cores, sediment profile imaging (SPI) survey, or other approaches allowing visual inspection of the placed material following the completion of individual cells within the capping extent. Measured results will be compared to the thickness requirements outlined in Section 3.3. The remediation contractor will perform a pre-construction survey of the TLC Pilot Project area to establish lateral control and document baseline elevations and the elevation within this area prior to the start of construction activities. This survey will serve as the baseline for identifying changes to elevations of the intertidal flat during performance monitoring (Section 3.5.2). The specifications for this survey, including the areas to be surveyed, survey tolerances, and timeline for the completion of the survey will be included in the TLC Pilot Project Work Design.

At least one landside support area is anticipated to be required for construction support activities, equipment staging, material stockpiling, and potentially as a point of access to the river. The determination of the need for and requirements of upland support areas (e.g., size, utility access) will be the responsibility of the remediation contractor. It is anticipated that the

remediation contractor will also be responsible for obtaining necessary access to meet their needs.

## 3.5 MONITORING

TLC construction monitoring and post-construction performance monitoring will be performed as part of the TLC Pilot Project.

The construction monitoring program will be designed to document compliance with permit conditions and demonstrate the TLC can be feasibly placed in a manner to minimize potential impacts to people and protect the environment, with minimal, short-term impacts to the surrounding ecosystem during construction activities. Given the nature of the anticipated TLC Pilot Project construction (i.e., subaqueous placement of washed sand material without dredging or substantial land-side disturbances), this monitoring program is expected to consist primarily of water quality monitoring in the form of turbidity monitoring. Monitoring for additional parameters will be performed if required by regulatory authorities to obtain permits for the TLC Pilot Project construction.

The performance monitoring program will be designed to document continued compliance with permit conditions following construction (as needed), demonstrate that the TLC is sufficiently stable following placement to contribute to achieving RAOs, and demonstrate the recovery of ecosystems that may be affected by the placement of the TLC. This monitoring program will achieve these requirements by generating data to evaluate TLC physical stability, evaluate the effects of the TLC on habitat, and monitor the overall ecosystem response and benthic recovery to the TLC placement. If alternative TLC compositions (i.e., materials, thickness) are included in the TLC Pilot Project, the performance monitoring program will include monitoring to evaluate the effectiveness of each alternative TLC composition.

TLC Pilot Project Construction Monitoring and Performance Monitoring Plans will present the monitoring objectives, scope, methods, and schedules, and include a Field Sampling Plan and Quality Assurance Project Plan. For each monitoring program, the scope of monitoring will be focused specifically on gathering the necessary information to address these objectives and will be developed based on the results of ongoing basis of design evaluations, data gathered during the PDI activities, and preliminary feedback from permitting agencies regarding permit conditions. The methods and tools to be used in these programs will be selected based on the scope and objectives of the monitoring plans.

Implementation details and quality control documentation will be provided in the TLC Pilot Project Work Design upon finalization of the monitoring plans. The monitoring plans will be submitted as part of the NRPA permit application.

## 3.5.1 Construction Monitoring

Environmental conditions will be monitored throughout construction of the TLC Pilot Project. Compliance with all permit conditions is the responsibility of the Remediation Trust and the requirements for monitoring and maintaining compliance will be incorporated into the construction contract as performance specifications. The Engineer of Record will verify if the contractor adhered to BMPs, all contract specifications, and complied with monitoring limits and thresholds during placement of the TLC.

### 3.5.1.1 Turbidity Monitoring

Continuous monitoring of turbidity during active construction periods is expected to be required to demonstrate TLC construction is not degrading water quality and to satisfy permit requirements consistent with the Clean Water Act Section 401 Water Quality Certificate discussed in Section 4.1. Monitoring for other water quality parameters is not anticipated as part of the TLC Pilot Project construction; however, should monitoring of other water quality parameters be required to fulfill permit requirements, these parameters and limits will also be determined as part of the permitting process.

Turbidity will be measured by fixed turbidity monitoring buoys at locations outside of the cap placement area positioned upstream and downstream of the area. Background turbidity will be established by the collection of baseline data at each location prior to construction activities. Turbidity monitoring data will be evaluated against turbidity limits established as part of the permitting process. Turbidity monitoring locations are typically within 150 to 300 ft of the work areas.

Previous work in the Penobscot River at Southern Cove included turbidity monitoring with limits not-to-exceed 35 nephelometric turbidity units (NTU) above an established reference value. This reference value was the higher of the daily up-current (i.e., accounting for tidal flow direction) or the 90th percentile of an ongoing data set populated with data from both pre-construction sampling events and up-current data collected during in-water work; this reference value was typically between approximately 10 and 15 NTU (Anchor QEA, LLC and CDM Smith 2018). This process resulted in an effective turbidity limit of approximately 45 to 50 NTU. Turbidity limits for the TLC Pilot Project, or a method to establish these limits similar to the work at Southern Cove, will be determined as part of the permitting process.

Potential impacts to water quality of the Penobscot River will be managed by strict adherence to permitted turbidity limits. The impact of the TLC Pilot Project construction on turbidity in the Penobscot River will be minimized through the specification of capping materials with low fines content (Section 3.2) and through the use of best management practices (BMPs) to be identified by the remediation contractor. BMPs and other control measures to maintain turbidity within established limits will be finalized during the permitting process. In addition,

potential water quality impacts will be managed by contractor maintenance of equipment and vessels used to place the cap to ensure there are no spills or releases of fuel, oil, or other hazardous materials.

#### 3.5.1.2 Additional Construction Monitoring

Any additional TLC Pilot Project construction monitoring required by the reviewing regulatory agencies (e.g., Maine DEP, NOAA Fisheries), beyond turbidity monitoring, will be identified through agency consultation or during permit application review. Examples of such additional monitoring could include air quality, noise, and additional measures to protect sensitive species or habitats. A final Construction Monitoring Plan, required prior to completion of the NRPA permit, will identify required monitoring and will document compliance requirements.

### 3.5.2 Performance Monitoring

The information necessary for performance monitoring evaluations includes but may not be limited to the following:

- **TLC Cap Material Erosion/Migration.** Erosion/migration of cap material will be evaluated by measuring cap thickness over time; recording visual evidence of scour from currents, ice, or other processes; and monitoring the lateral migration of TLC material into designated buffer zones, as described in Section 3.1.
- **Benthic Community Recolonization.** Placement of the TLC will temporarily disrupt the benthic community in the area being capped. Experience at similar sites indicates that the benthic community will rapidly recolonize a sand cap, typically within 1 to 2 years of the cap placement. Pre- and post-construction monitoring will be performed to evaluate benthic recolonization over time following placement. The benthic community monitoring will include surveys conducted at regular intervals to evaluate the progression of the benthic community succession. Results of this monitoring will be compared to baseline surveys conducted in 2023 and planned for 2024 prior to construction to demonstrate recolonization of the benthic community relative to the baseline conditions.
- **BAZ Thickness.** The BAZ is a measure of the depth of sediment in which the majority of benthic exposure occurs and over which biological mixing takes place. As discussed in Section 3.3, the BAZ thickness is a primary factor in the selection of a minimum TLC thickness. The baseline BAZ thickness in East Cove 3 will be evaluated during PDI work scheduled for 2024 but is expected to be approximately 2 to 4 in. or thinner based on general freshwater BAZ observations and previous work within the Orrington Reach (Section 3.3). The post-construction BAZ thickness will be measured at various time intervals following the TLC placement, and the information will be used to determine the recovery of the benthic community and to estimate the mixing depth if modeling is

used in the future to update projections of recovery rates in the capped area over time as sediment accumulates on the TLC.

- **Sediment Accumulation.** Sediment will accumulate on the surface of the TLC over time and will be an important factor in the long-term natural recovery in the TLC area and the broader Estuary. Following TLC placement, sediment accumulation will be qualitatively monitored through inspection of the TLC area for differences in the visual appearance of the TLC material (lighter color, sand texture) and the accumulated sediment (darker color, silt texture). Once it has been determined that sediment has accumulated and covered the majority of the TLC surface, the thickness of the accumulated sediment will be measured, and sampling will be performed to measure the mercury concentrations associated with the accumulated sediment. The sediment accumulation rates and mercury concentration data will support evaluation of the TLC performance and model projections of natural recovery of the TLC capped area over time. The scope and frequency of this monitoring will be determined based on observations of surface accumulation.

Additional information and performance metrics may be identified as part of the permitting process.

The methods and tools to be used during performance monitoring will be selected based on the scope and objectives of the Performance Monitoring Plan. Implementation details and quality control documentation will be provided in the TLC Pilot Project Work Design upon finalization of the Performance Monitoring Plan and will incorporate finalized permit requirements. Table 3 presents the monitoring tools that are being considered for use during the monitoring program.

As described in Section 5.1.4.4 of the TLC Design Work Plan, SPI will be a key tool for the performance monitoring. SPI technology was specifically developed to evaluate benthic community responses to disturbance in fine sedimentary habitats. SPI survey uses a camera prism system to collect a high-resolution plan view image of the sediment surface and a high-resolution profile image of the near-surface sediment. These images provide direct observational and quantifiable data of *in situ* benthic conditions, including, but not limited to:

- Thickness of the BAZ
- Presence/abundance of biogenic features (e.g., organisms, burrows, feeding voids)
- Sediment grain size
- Evidence of degraded habitat/impairment (e.g., reduced sediment conditions, methane pockets, presence of non-native materials, such as wood chips)
- Post-TLC accumulated sediment thickness, extent of mixing of accumulated sediment into the TLC, and the presence of TLC material.

Because SPI can be rapidly deployed from a vessel, does not require laboratory analyses, and can be preliminarily interpreted in real time, it allows for efficient and cost-effective mapping of benthic conditions (e.g., estimated 30–40 images per day) across large areas. The SPI survey will be supplemented, as appropriate, with sediment coring and benthic community characterization.

## 3.6 REPORTING

Reports will be prepared in accordance with the Consent Decree to document the construction of the TLC Pilot Project and the results of the monitoring to evaluate the TLC performance relative to the objectives presented in Section 2.

### 3.6.1 Implementation Work Report

Following the implementation of the TLC Pilot Project and the Work Completion Inspection, as specified in Paragraph 16.a of the Statement of Work, an Implementation Work (Construction Completion) Report will be prepared. This report will include the applicable elements specified in Paragraph 16.b of the Statement of Work, including the following:

- Statements by a registered professional engineer and by the Trustees that construction of the Implementation Work is complete and is consistent with the Work Design(s) and Work Implementation Plan(s) and all contract documents and specifications
- Supporting documentation that construction of the Implementation Work is complete and that the Implementation Work was constructed consistent with the Work Design(s) and Work Implementation Plan(s) (and all contract documents and specifications)
- Record drawings signed and stamped by a registered professional engineer
- A description of any deviations from the Work Design(s) and Work Implementation Plan(s) and how they were corrected
- A certification in accordance with Paragraph 28 (Certification). The Trustees shall also prepare and submit any completion report(s) required by a regulatory agency or other permitting authority as a condition of any permit or other authorization.

### 3.6.2 TLC Pilot Project Evaluation Reports

Pilot Project Evaluation Reports will be prepared annually to document the results of the post-TLC placement monitoring and to present the findings of evaluations of how the objectives were or were not met. The Pilot Project Evaluation Reports will include the applicable elements specified in Paragraph 7.b of the Statement of Work including the following:

- A summary of the pilot test performed, referencing consistency with the TLC Pilot Project Work Designs, and noting key deviations therefrom, if any
- A summary of the pilot test results, including a description of whether the design objectives were met
- Summaries of validated data (i.e., tables and graphics)
- Summaries of data validation reports and laboratory data reports
- Narrative interpretation of data and results, including an evaluation of the results with respect to the performance criteria identified in the TLC Pilot Project Work Designs
- Results of statistical and modeling analyses
- Summary photographs documenting the work conducted
- Conclusions and recommendations for future Work Designs, including design parameters and criteria.

# 4 PERMITTING AND REGULATORY APPROVALS

Implementation of the TLC Pilot Project will require permitting and regulatory approvals as outlined within Section 4.1. A Permitting Plan was prepared by WSP USA Environment & Infrastructure, Inc. in February 2023 (WSP 2023b) based on the information available at that time. A permitting plan specific to the TLC Pilot Project, the TLC Pilot Project Permitting Plan, is being prepared and will be submitted as an addendum to the 2023 Permitting Plan for Beneficiary review. The following summarizes the permitting and regulatory approvals and property access identified in the TLC Pilot Project Permitting Plan that are anticipated to be required for the TLC Pilot Project.

## 4.1 PERMITTING AND REGULATORY APPROVALS

As part of the permitting process, the Remediation Trust will review the following permits and approvals with the appropriate regulatory agencies and confirm all authorizations required for the TLC Pilot Project. Authorizations include, but may not be limited to the following:

**Federal**

- **USACE Permit**: Placement of fill will require Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899 authorization. USACE authorization will require Section 7 Endangered Species Act consultations with National Marine Fisheries Service and U.S. Fish and Wildlife Service for Endangered Species Act and essential fish habitat. In addition, a Section 106 National Historic Preservation Act consultation will be necessary.

**State**

- **Shoreland Protection Act Permit**: A permit application may be required by the Town of Orrington, in the Town's role to administer local ordinances that regulate land use activities in the shoreland zone.
- **Maine NRPA**: An NRPA application provided to Maine DEP will be required. Maine DEP will provide the application to the Departments of Marine Resources, Inland Fisheries & Wildlife to review and provide comments. The NRPA application will require 1) title, right or interest documentation; 2) a topographic map; 3) copies of public notice/public information meeting documentation; 4) a wetlands delineation report; 5) alternatives analysis with avoidance and minimization statements; and 6) an erosion control/construction plan. Additional potential required documents could include a functional assessment and compensation plan.

- **Clean Water Act Section 401 Water Quality Certificate**: A Maine DEP permit will constitute a 401 Water Quality Certification.
- **Maine Department of Agriculture, Conservation and Forestry Submerged Lands Lease**: A Submerged Lands Lease must also be submitted to Maine DEP.

The USACE and Maine NRPA permit applications can be submitted through a joint application.

Depending on the method and means for implementation of the TLC Pilot Project, other authorizations that may be required include, but may not be limited to:

- Construction Stormwater Management Permit (shore construction activities, as applicable)
- Post-construction Stormwater Permit (stormwater management at land-based support area)
- Town of Orrington Flood Hazard Development Permit (work in flood zone).

Additional review and approvals may be required if work is requested to be completed outside of the traditional in-water work window as discussed in Section 3.4.

## 4.2 PUBLIC APPROVAL

Public approval and support for the remedy is paramount to the success of the TLC project. Community involvement activities will occur throughout all phases of work to ensure communities are well informed of remediation activities, to support grants of access from landowners, and to understand community concerns. The Remediation Trust has been in contact with community members and public officials in Orrington, Bucksport, and Winterport in 2023 to present the proposed Work, get input on community interests and concerns, and identify key issues. The Remediation Trust will make information available and solicit feedback in several ways, including hosting Town Hall meetings, preparing fact sheets, and posting materials to a public website.

## 4.3 PROPERTY ACCESS

In addition to the community outreach described above, the Remediation Trust has been in contact with community members and public officials to request access from landowners for activities on the intertidal flats that are not allowed as part of the public's right of access for fishing, fowling, and navigation.

Maine's NRPA permitting process requires the permit applicant to provide documentation of access permission in the application. The Remediation Trust intends to seek access permission for the TLC Pilot Project as follows:

- An appropriately qualified third party has been engaged to perform a limited review of publicly available records to identify whether ownership of land below the mean high water line is included in deeds.
- The Remediation Trust received permission from eight East Cove 3 landowners in 2023 to perform sediment sampling and coastal wetland surveys. All landowners will be contacted in Quarter 1 of 2024 to provide information on the planned design and permitting activities (e.g., sediment sampling and wetlands assessment surveys) for the TLC Pilot Project and to request access for investigations and implementation.

The standard form of access agreement used in 2023 will be modified to acknowledge the TLC is intended to remain on the intertidal flat and to grant access for post-construction monitoring and potential maintenance. The ability to secure access for the TLC Pilot Project will inform the feasibility of capping intertidal flats in Orrington Reach. In the event that sufficient access cannot be secured for the planned TLC Pilot Project location, the pilot area may be adjusted to an alternative area within East Cove 3 or to a secondary location within Orrington Reach to be determined at that time. However, if access permission is granted for only a very limited area, such that the objectives of the Pilot Project cannot be met, work on the TLC Pilot Project will be suspended to evaluate the feasibility and effectiveness of both the TLC Pilot Project and the Orrington Reach capping remedy.

# 5 SCHEDULE

An estimated schedule for design is included as Figure 4. Note that several activities will occur concurrently to complete the remedial design and permit application development in an efficient and timely manner.

The TLC Pilot Project PDI is currently planned for Quarter 2 of 2024 and is contingent on the ability to secure access for the TLC Pilot Project. Following the PDI, a Work Design will be prepared that presents the detailed design for the TLC Pilot Project based on anticipated permit requirements, planned for Quarter 3 of 2024.

A Final Work Design will be prepared prior to construction that will include Supporting Deliverables for design activities, as necessary, in accordance with Paragraph 31 of the Statement of Work and to incorporate any revisions due to updated permit requirements.

Submittal of permit applications for the TLC Pilot Project in Quarter 3 of 2024 is contingent upon the ability to secure access and complete PDI work in Quarter 2 of 2024. The timeframe for review by regulatory agencies and potential response to public comments is uncertain. For planning purposes, the Remediation Trust has assumed applications could be approved in Quarter 3 of 2025. Mobilization for the TLC Pilot Project is anticipated to begin shortly after the permit approvals, and in-water construction will begin as early as possible following mobilization in 2025. The duration of the TLC Pilot Project in-water construction will be subject to the selection of placement methods by the remediation contractor, weather, tidal cycles, and permit conditions, but is expected to be completed within approximately 1 month.

Additional work completing post-construction monitoring is anticipated to be performed following the TLC Pilot Project construction for 2 years during 2026 and 2027 but may continue for up to 5 years depending on permit conditions.

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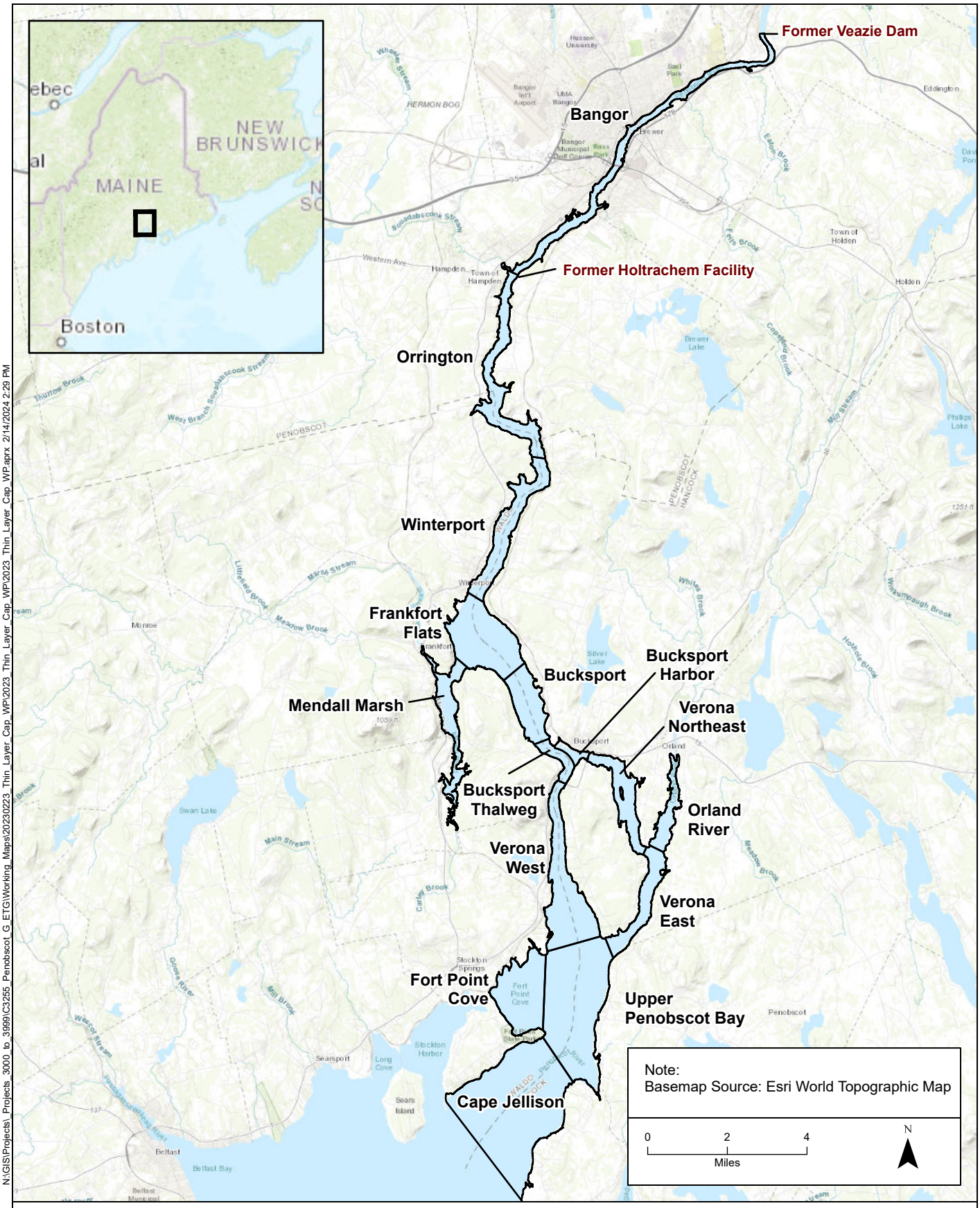
# Figures

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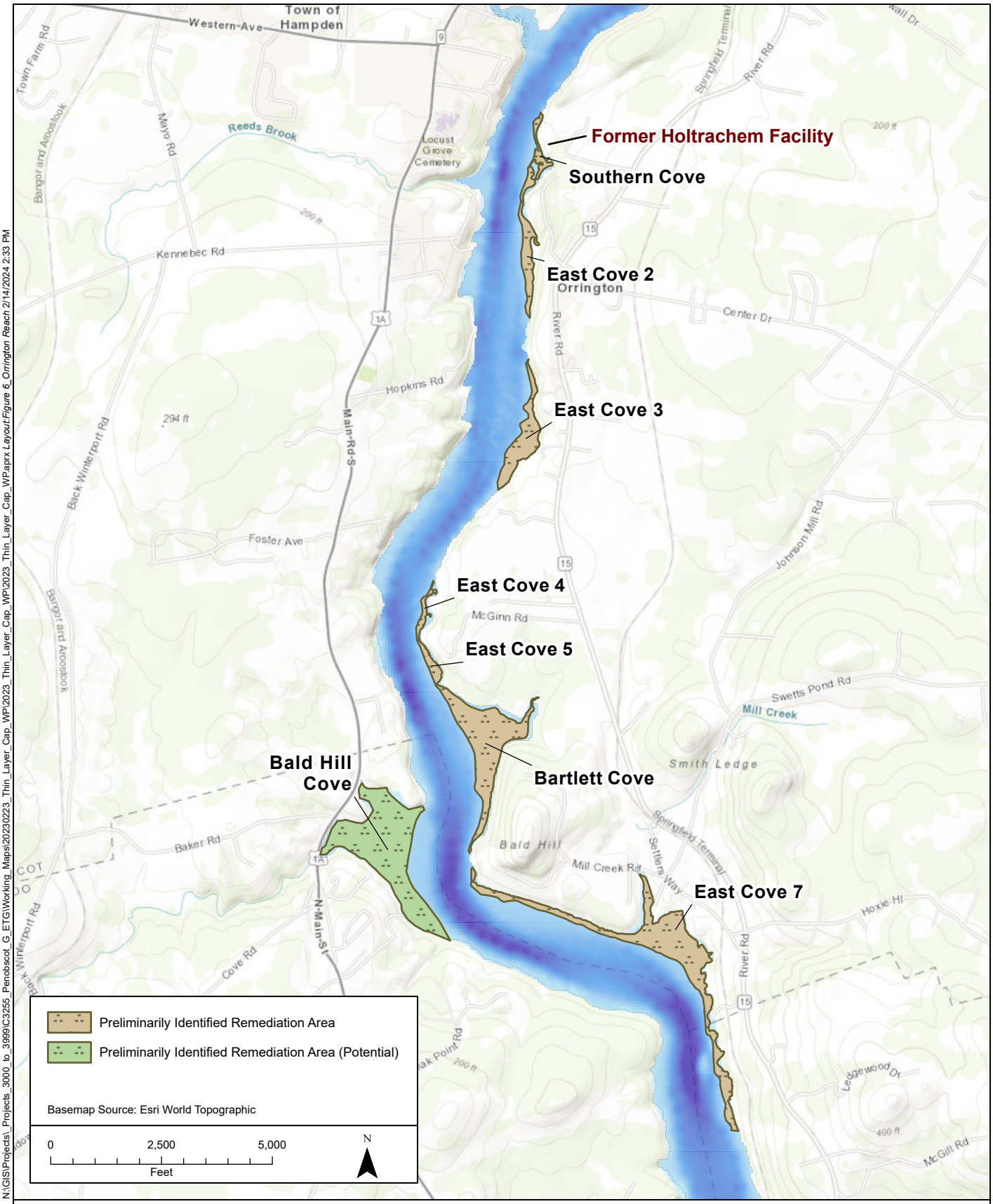
Prepared for: Greenfield Penobscot Estuary Remediation Trust LLC
Trustee of the Penobscot Estuary Mercury Remediation Trust

Prepared by: integral consulting inc.

**Figure 1.**
Penobscot River Reaches
TLC Pilot Project Work Plan
Orrington Reach Capping Remedy
May 2024

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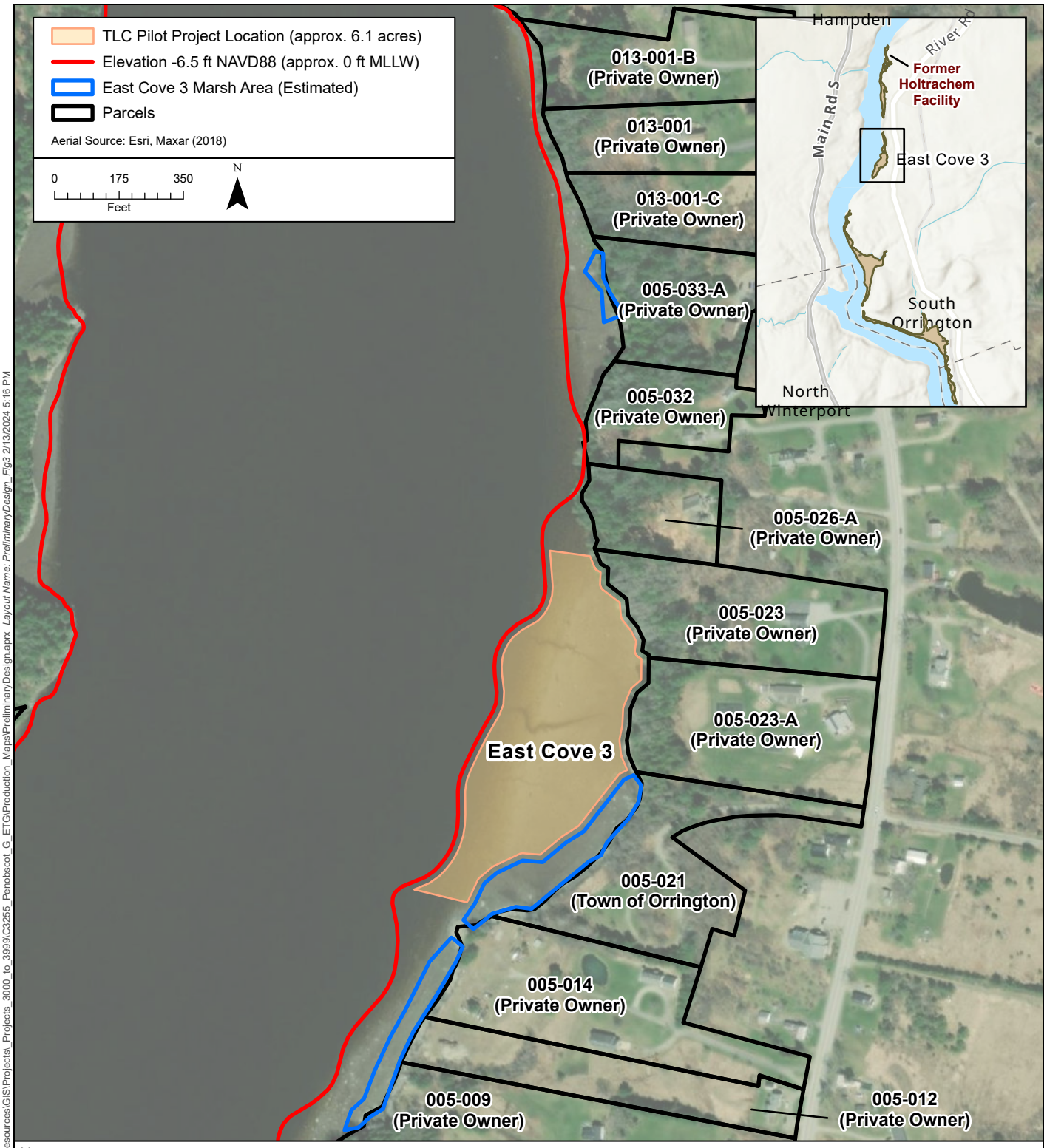
Prepared for: Greenfield Penobscot Estuary Remediation Trust LLC
Trustee of the Penobscot Estuary Mercury Remediation Trust

Prepared by: integral consulting inc.

**Figure 2.**
Coves Preliminarily Identified as the Remediation Area for Orrington Reach
TLC Pilot Project Work Plan
Orrington Reach Capping Remedy
May 2024

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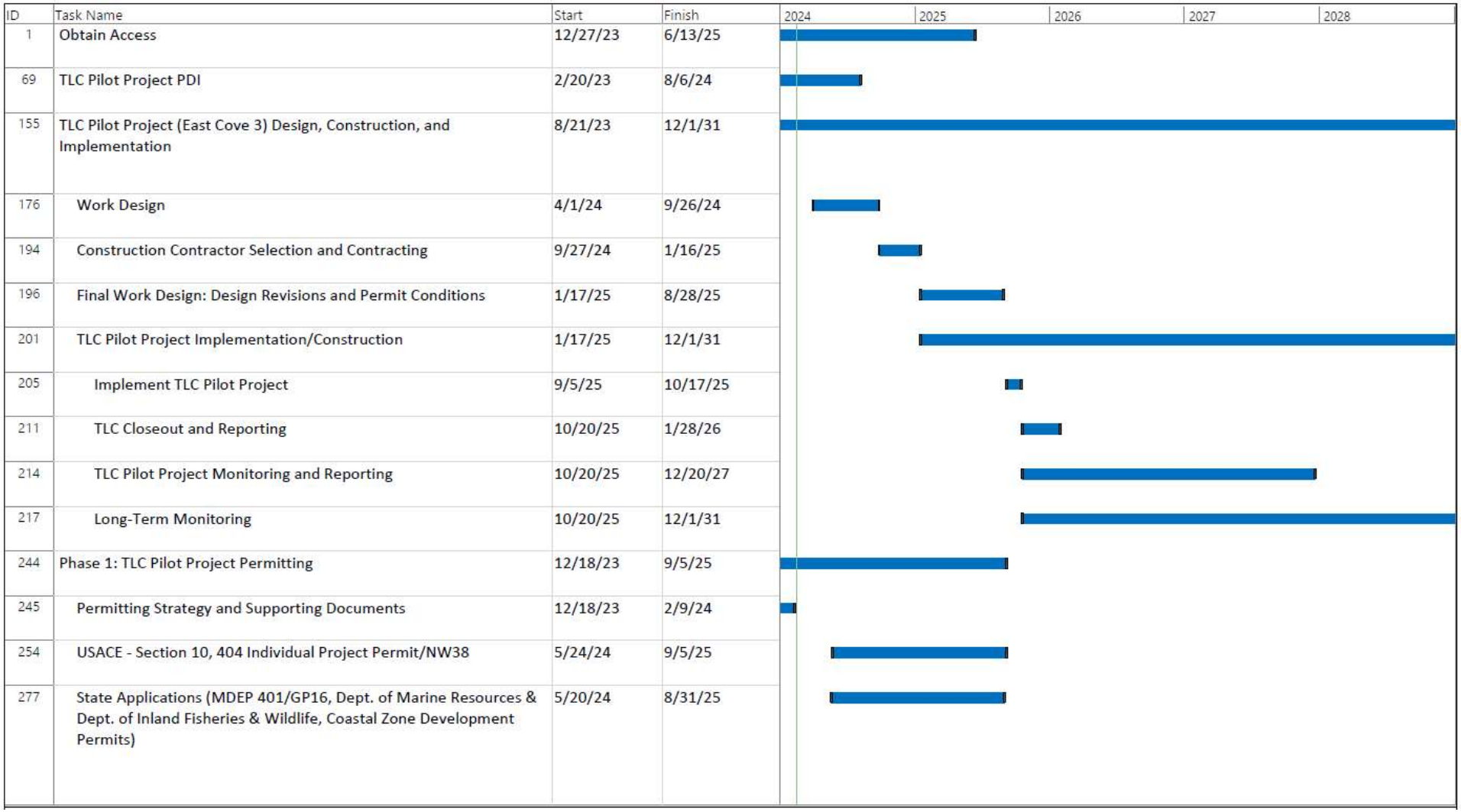
Notes:
Marsh areas approximated based on delineation provided in the Draft Coastal Wetland Assessment Report (WSP 2023a).
Extent of TLC Pilot Project Location is approximate and based on extended property boundaries for the adjacent upland properties. This extent includes a 20-ft buffer from identified marsh areas, adjacent property boundaries, and the -6.5 ft NAVD88 (approx. 0 ft MLLW) elevation line.
Parcel boundaries, lot numbers, and ownership details are based on publicly available municipal tax maps (Town of Orrington 2022a, Town of Orrington 2022b) and 2023 tax commitment book (Town of Orrington 2023) from the Town of Orrington Assessing Department.

Prepared for: Greenfield Penobscot Estuary Remediation Trust LLC
Trustee of the Penobscot Estuary Mercury Remediation Trust

Prepared by: integral consulting inc.

**Figure 3.**
TLC Pilot Project Proposed Location
TLC Pilot Project Work Plan
Orrington Reach Capping Remedy
May 2024



| ID | Task Name | Start | Finish |
|---|---|---|---|
| 1 | Obtain Access | 12/27/23 | 6/13/25 |
| 69 | TLC Pilot Project PDI | 2/20/23 | 8/6/24 |
| 155 | TLC Pilot Project (East Cove 3) Design, Construction, and Implementation | 8/21/23 | 12/1/31 |
| 176 | Work Design | 4/1/24 | 9/26/24 |
| 194 | Construction Contractor Selection and Contracting | 9/27/24 | 1/16/25 |
| 196 | Final Work Design: Design Revisions and Permit Conditions | 1/17/25 | 8/28/25 |
| 201 | TLC Pilot Project Implementation/Construction | 1/17/25 | 12/1/31 |
| 205 | Implement TLC Pilot Project | 9/5/25 | 10/17/25 |
| 211 | TLC Closeout and Reporting | 10/20/25 | 1/28/26 |
| 214 | TLC Pilot Project Monitoring and Reporting | 10/20/25 | 12/20/27 |
| 217 | Long-Term Monitoring | 10/20/25 | 12/1/31 |
| 244 | Phase 1: TLC Pilot Project Permitting | 12/18/23 | 9/5/25 |
| 245 | Permitting Strategy and Supporting Documents | 12/18/23 | 2/9/24 |
| 254 | USACE - Section 10, 404 Individual Project Permit/NW38 | 5/24/24 | 9/5/25 |
| 277 | State Applications (MDEP 401/GP16, Dept. of Marine Resources & Dept. of Inland Fisheries & Wildlife, Coastal Zone Development Permits) | 5/20/24 | 8/31/25 |



Prepared for: Greenfield Penobscot Estuary Remediation Trust LLC
Trustee of the Penobscot Estuary Mercury Remediation Trust

Prepared by: integral consulting inc.

**Figure 4**
TLC Pilot Project Schedule
TLC Pilot Project Work Plan
Orrington Reach Capping Remedy
May 2024

# Tables

Table 1. Statement of Work Compliance

| Statement of Work Requirement | | Work Plan Section |
|---|---|---|
| **¶ 7(b)(i)** An evaluation and summary of existing data and a description of the data gaps to be addressed by the treatability study or pilot test | ✓ | Section 2, Design Work Plan Section 5 |
| **¶ 7(b)(ii)** A description of the treatability study or pilot test objectives, including the criteria by which the resulting data will be evaluated | ✓ | Section 2 |
| **¶ 7(b)(iii)** A sampling, analysis, and/or testing plan including media to be evaluated, analyses to be conducted, contaminants or parameters to be analyzed, number of samples, and pilot test plans | Pending | To be included in Construction Monitoring and Performance Monitoring Plans |
| **¶ 7(b)(iv)** A schedule for the treatability study or pilot test | ✓ | Section 5 |
| **¶ 7(b)(v)** Cross references to QA/QC requirements set forth in the QAPP as described in Paragraph 31(d). | Pending | To be included in Construction Monitoring and Performance Monitoring Plans |

Notes:
QAPP = quality assurance project plan
QA/QC = quality assurance and quality control

Table 2. Summary of Basis of Design Factors and Ongoing/Planned Activities and Evaluations Specified in the TLC Design Work Plan

| Parameter | Basis | Considerations | Ongoing / Planned Design Activities and Evaluations |
|---|---|---|---|
| **Cap Location / Extent** | | | |
| Elevation Range of Sediment to Be Capped | Intertidal zone defined as elevations between the MLLW and MHW lines (6.69 to −7.04 ft mean sea level)[a] | Intertidal sediment as stipulated in the Consent Decree | Ongoing analysis of bathymetric and LiDAR elevation survey data to be completed in early 2024 will support refined estimates of MLLW and MHW elevation contours. |
| Cap Stability | Physical stability of cap | Place the cap in intertidal flats areas where erosion potential is low and design the cap material to be remain in place for up to a 100-year storm event. | Hydrodynamic modeling will be completed to confirm understanding of shear stress in planned TLC placement areas |
| | | Cap material has the potential to be unstable at slopes greater than 3H:1V or 33% grade. | Ongoing analysis of bathymetric and LiDAR elevation survey data to be completed in early 2024 will support refined understanding of slope of intertidal flats. |
| | | Place the cap in areas where potential ice scour has been observed to be limited and/or include provisions (e.g., armoring) to minimize impacts of ice scour on the TLC. | Ongoing ice scour monitoring |
| Total Mercury Concentration | Reduce total mercury concentration to as low as practicable | Cap areas of highest concentration (to the extent Feasible) | -- |
| Property Access | Written permission to access the properties, place the cap, and monitor performance over time | Permission required by each property owner to place cap | Access requests to be sent to property owners in 2024 |
| **Cap Material** | | | |
| Cap Stability | Physical stability for a 100-year storm event | Select grain size and/or armoring for a “no movement” condition under a modeled 100-year storm event | Hydrodynamic modeling will be completed to confirm understanding of shear stress in planned TLC placement areas |
| Compatibility with Underlying Sediment | Minimize intermixing of underlying sediments into clean cap material | Maximum size ratio of 5:1 between the smallest (<15%) particles of the cap media and the largest (>85%) particles of the sediment layer (Palermo et al. 1996) | Additional sediment geotechnical data to be collected as part of spring 2024 PDI |
| Suitability for Benthic Habitat | Minimize duration for recolonization of the benthic community | To the extent practicable, select material to be similar to the underlying sediment to mimic existing benthic habitat | Baseline benthic invertebrate survey collected in 2023 and additional data to be collected as part of spring 2024 PDI |
| Borrow Material Availability | Sufficient material to implement capping | 3,200 CY of capping material is estimated to be necessary | Preliminary inquiries indicate that sufficient material meeting project specifications will be available from local suppliers |

Table 2. Summary of Basis of Design Factors and Ongoing/Planned Activities and Evaluations Specified in the TLC Design Work Plan

| Parameter | Basis | Considerations | Ongoing / Planned Design Activities and Evaluations |
|---|---|---|---|
| **Cap Thickness** | | | |
| Provide Minimum Protective Thickness | Limit migration of mercury into and through the cap material through bioturbation and physical transport mechanisms, such as advection, dispersion, and diffusion<br><br>Place sufficient thickness of clean cap material to bury peak mercury concentrations below the redox zone where methylation is greatest | General BAZ observations in freshwater systems combined with observations from the Coastal Wetlands Assessment suggest a BAZ thickness of approximately 2 to 4 in. | SPI investigation during the 2024 PDI will support a site-specific quantification of BAZ thickness and redox potential depth under baseline (pre-TLC placement) conditions. |
| Prevent Destabilization of Underlying Sediment | Minimize mud wave formation during cap placement | Evaluation of sediment geotechnical properties, including shear strength | Geotechnical properties to be evaluated as part of the 2024 PDI |
| Minimize Volume of Fill | Minimize potential impacts to intertidal habitat, flood risk, and potential need for mitigation by minimizing the volume of fill | Hydrodynamic modeling to evaluate the influence of cap placement on water depths and inundation frequency of intertidal flats and marshes, and on flood risk of intertidal and upland areas<br><br>Acceptable fill quantities (area, volume, thickness) and potential mitigation requirements will be established through negotiation with permitting agencies | Hydrodynamic modeling will be completed<br><br>Remediation Trust is coordinating with permitting agencies |

Notes:
-- = No activities or evaluations are currently ongoing or planned for this consideration.
BAZ = biologically active zone
MHW = mean high water
MLLW = mean lower low water
PDI = pre-design investigation
SPI = sediment profile imaging
TLC = thin layer cap

[a] Tidal datum from NOAA Station 8414612 in Bangor, Maine (https://tidesandcurrents.noaa.gov/datums.html?id=8414612)

Table 3. Monitoring Tools Preliminarily Identified for TLC Performance Monitoring

| Monitoring Metric | Performance Metric | Monitoring Tool | General Approach |
|---|---|---|---|
| Cap Material Erosion/Migration | Minimal loss or migration of TLC material | - Visual reconnaissance | Qualitative inspection of TLC surface at low tide for presence of sand cap, migration into buffer zones, evidence of scour |
| | | - Drone-based survey | Aerial based photography (ortho-rectified and in conjunction with survey points, as appropriate) to document presence of sand cap, migration into buffer zones, and/or evidence of scour |
| | | - SPI | Positive identification of cap material presence and, if sufficient camera penetration, measurement of thickness |
| | | - Sediment coring | Collection of cap thickness data at representative locations over time following TLC placement |
| Benthic Community Recolonization | Return to baseline condition or better | - SPI | Collection of images documenting *in situ* conditions to characterize benthic community/habitat |
| | | - Benthic community survey | Collection of sediment samples to characterize benthic fauna species abundance, richness, and diversity |
| BAZ Thickness / Mixing | NA - Parameter for evaluation of natural recovery following TLC placement | - SPI | Collection of images to document the redox potential depth (indicative of the depth of biogenic mixing) and to visually evaluate the degree of mixing of sediment into the TLC material |
| | | - Sediment coring | Quantification of mercury concentrations in capped area to assess the extent of mixing |
| Sediment Accumulation | NA - Parameter for evaluation of natural recovery following TLC placement | - SPI | Collection of images to document the presence and thickness of accumulated sediment on the TLC, and to visually evaluate the degree of mixing of accumulated sediment into the TLC material |
| | | - Sediment coring | Quantification of mercury concentrations in sediment accumulated on the TLC |

Notes:
BAZ = biologically active zone
NA = not applicable
SPI = sediment profile imaging
TLC = thin layer cap