Phase III Remedial Action Plan
Phase IV Remedy Implementation Plan

Sediment Portion of the Former Everett Staging Yard Disposal Site

1 Horizon Way, Everett, Massachusetts

Release Tracking Number (RTN) 3-13341

Prepared by:

AMEC Massachusetts, Inc.
Chelmsford, MA 01824

June 2017

Project No. 3651160042

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PHASE IV REMEDY IMPLEMENTATION PLAN

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271 Mill Road, 3rd Floor
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EXECUTIVE SUMMARY

The sediment portion of the Former Everett Staging Yard Disposal Site (the Disposal Site, Release Tracking Number 3-13341) has been impacted by:

- Metals (arsenic, lead, mercury and vanadium) from historical chemical manufacturing processes and operations on the upland portions of the property,
- Phthalates and polychlorinated biphenyls associated with historical operations on the adjacent Monsanto West property, and
- Low levels of polycyclic aromatic hydrocarbons and petroleum hydrocarbons attributed to other industrial and anthropogenic sources (e.g., stormwater runoff, industrial releases, and shipping-related impacts).

Method 3 Risk Assessments performed for the sediment portion of the Disposal Site as part of previous Massachusetts Contingency Plan investigations concluded:

- No Significant Risk to human health, public welfare, and safety
- No Significant Risk for wildlife exposed to surface water, and
- No Significant Risk for birds and mammals exposed to shoreline sediment.

However, the current Stage I Environmental Screening concluded there are potentially significant exposure pathways for benthic invertebrates exposed to sediment. A Stage II Ecological Risk Characterization based on a comparison of maximum sediment concentrations to measurement endpoints concluded a condition of No Significant Risk does not exist for benthic organisms which are exposed to sediment. Therefore, remedial actions are necessary to achieve a condition of No Significant Risk.

The Phase III Remedial Action Plan (RAP) portion of this report documents the identification, evaluation and selection of Comprehensive Response Action Alternatives. Following an initial screening of technologies, five remedial action alternatives were chosen for detailed evaluation. The alternatives included:

- Alternative 1 - Full Dredge and Cap
- Alternative 2 - Partial Dredge and Cap
- Alternative 3 - Partial Dredge, Cap, and Monitored Natural Recovery (MNR)
- Alternative 4 - Navigation Dredge, Cap, and MNR
- Alternative 5 - No Further Action

The remedial action alternative selected was Alternative 2 – Partial Dredge and Cap. This remedial alternative represents the best combination of time to achieve a Permanent Solution, certainty of success (i.e., achieving a Permanent Solution), reliability, and cost.

The Phase IV Remedy Implementation Plan (RIP) addresses the design, construction and implementation of the selected remedial action alternative to be implemented at the Site.

AMEC Massachusetts, Inc. has prepared this combined Phase III RAP and Phase IV RIP for Wynn MA, LLC and Everett Property, LLC, the current owners of the property on which the Site is located.

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1.0 INTRODUCTION

1.1 Purpose and Scope

AMEC Massachusetts, Inc. (AMEC) has prepared this combined Phase III Remedial Action Plan (Phase III RAP) and Phase IV Remedy Implementation Plan (Phase IV RIP) for the sediment portion the Former Everett Staging Yard Disposal Site (the Disposal Site, **Figure 1-1**). The Disposal Site, which includes both uplands and a portion of an embayment of the Mystic River (**Figure 1-2**), is identified by Release Tracking Number (RTN) 3-13341. This Phase III RAP and Phase IV RIP Report was completed for Wynn MA, LLC and Everett Property, LLC (collectively, Wynn) the current owners of the property on which the Site is located.

This Phase III RAP has been prepared in accordance with 310 CMR 40.0850. The purpose and scope of the Phase III RAP is to establish remedial objectives, identify and evaluate remedial technologies, formulate and evaluate remedial action alternatives, and select a remedial action alternative for the sediment portion of the Disposal Site. The objective of the Phase III RAP is to select a remedial action alternative that is a Permanent Solution and will reduce, to the extent feasible, the concentrations of oil and hazardous materials (OHM) in the environment to levels that achieve or approach background.

The Phase IV RIP has been prepared in accordance with 310 CMR 40.0870. The Phase IV RIP addresses the design, construction and implementation of the Comprehensive Remedial Action (CRA) to be implemented for the sediment portion of the Disposal Site. The purpose of the CRA is to achieve a condition of No Significant Risk and a Permanent Solution for the Remediation Area (the portion of the Disposal Site to be dredged and/or capped). A Downgradient Property Status submittal will be prepared to address contamination on the Wynn property for which Wynn is not responsible.

1.2 Report Organization

The content and format of the report meet the specific requirements for Phase III and Phase IV Reports outlined in the Massachusetts Contingency Plan (MCP) at 310 CMR 40.0861 and 40.0874, respectively.

The remainder of this combined Phase III and Phase IV Report consists of the following sections:

- Section 2: Background – Presents the Disposal Site description, a brief summary of the Disposal Site history, and a discussion of regulatory history and status.
- Section 3: Conceptual Site Model – Summarizes the sources and release mechanisms, migrations pathways, and potential exposure routes presented in the Revised Phase II Report.
- Section 4: Updated Method 3 Ecological Risk Assessment – Updates the previously completed Risk Assessment to more closely follow the format of a Stage II Ecological Risk Characterization.
- Section 5: Remedial Action Objectives – Identifies the clean-up requirements to achieve a Permanent Solution for the sediment portion of the Disposal Site.

- Section 6: Identification and Evaluation of Remedial Action Alternatives – Presents several alternatives to achieve a Permanent Solution for the sediment portion of the Disposal Site.
- Section 7: Feasibility Evaluations – Outlines and evaluates alternatives through a screening process which allows one alternative to be selected and used for the Engineering Design.
- Section 8: Engineering Design – Presents the approach and engineering design of the selected remedy for the sediment portion of the Disposal Site.
- Section 9: Construction Plans and Technical Specifications – Presents the design approach to implement the remedial action alternative selected.
- Section 10: Operation, Maintenance and/or Monitoring – Identifies the operation, maintenance and monitoring plan to maintain the remedial action alternative implemented.
- Section 11: Health and Safety Plan – Identifies the health and safety protocol identified for implementation of the remedial action alternative selected.
- Section 12: Permits, Licenses, and/or Approvals – Identifies the permits licenses and approvals required for implementation of the remedial action alternative selected.
- Section 13: Property Access Issues – Identifies property access issues at the Disposal Site.

Supporting data are provided in figures, tables, and appendices referenced throughout the report.

Sections 5 through 7 meet the specific requirements of a Phase III RAP. Sections 8 through 13 meet the specific requirements of a Phase IV RIP.

2.0 BACKGROUND

2.1 Site Location and Locus Map

For the purposes of this report, the "property" refers to the combined areas of land and water which are currently owned by Wynn and are located at 1 Horizon Way in Everett and an unnumbered parcel on Alford Street in Boston (**Figure 1-1**). The Wynn property encompasses approximately 35 acres, which includes an upland portion (approximately 22 acres) and a portion of the adjacent Mystic River to the southwest (approximately 13 acres). The approximate latitude and longitude for the Site are 42.39 degrees north and 71.07 degrees west, respectively. The Universal Transverse Mercator (UTM) coordinates are approximately 4,695,650 meters north and 329,600 meters east.

The upland portion of the property is an irregularly shaped, approximately 22-acre parcel of land roughly bounded by Alford Street/Broadway (Route 99) to the east, Massachusetts Bay Transit Authority (MBTA) railroad tracks to the west, an MBTA bus repair and maintenance facility to the north, and the Mystic River to the south. The sediment portion of the property consists of an approximately 13-acre embayment of the Mystic River which is bounded to the northwest and north by the upland portion of the property and to the northeast and east by the Boston Water and Sewer Commission's Material Handling Facility (180-220 Alford Street).

For the purposes of this report, the Disposal Site, or more formally the Former Everett Staging Yard Disposal Site, includes the uplands where chemical manufacturing occurred and the portion of Mystic River sediment which has been impacted by chemicals from the uplands. **Figure 1-2** is a detailed plan for the sediment portion of the property, and depicts physical features, and sampling locations. The disposal site boundary for the sediment portion of the property depicted on **Figure 1-2** was drawn to separate areas where concentrations of Disposal Site-related chemicals are above "local conditions"[1] from areas where concentrations are generally at or local conditions. The disposal boundary was also drawn considering the Conceptual Site Model ("CSM", see Section 3) and principles of sediment transport dynamics. Delineating the extent of Site-related chemicals in sediment based on local conditions indicates the maximum potential extent of the aquatic boundary. Given the many historical and ongoing sources of contamination to the Mystic River (as well as natural sources of the same chemicals) this may still be an over-estimate of the impacts directly associated with chemical manufacturing on the upland portion of the property.

The Disposal Site boundary encompasses approximately 7.8 acres of sediment. The main portion in the embayment encompasses approximately 7.3 acres and a smaller intertidal area to the west is approximately 0.5 acres. The total area within the Disposal Site boundary which poses a risk

[1] The MassDEP's Guidance for Disposal Site Risk Characterization in Support of the Massachusetts Contingency Plan (MassDEP, 1996) defines "local conditions" as "…levels of OHM present consistently and uniformly throughout the surface water body, or throughout a larger section of a river that contains the area potentially affected by contamination at or from the site." The "local conditions" concept acknowledges that sediments in certain water bodies, particularly those located in industrial urban areas, contain constituents from sources such as other disposal sites, permitted discharges, and non-point sources. The data and method for establishing local conditions for the Site are described full in the Revised Supplemental Phase II Comprehensive Site Assessment Report dated December 2016.

to benthic communities (the Remediation Area) is approximately 7.4 acres. This includes 7.3 acres in the main embayment and 0.1 acres in the smaller area to the west (**Figure 1-2**).

2.2 Regulatory History and Status

O'Donnell Sand & Gravel, Inc. (O'Donnell) submitted the initial notification of a release to the Massachusetts Department of Environmental Protection (MassDEP) in January 1996 based on the presence of elevated concentrations of certain metals and petroleum hydrocarbons in soil as well as areas of low pH. Consulting Engineers & Scientists (CES) filed a Phase I Initial Site Investigation and Tier Classification (classifying the Site as Tier II) on behalf of O'Donnell in January 1997 (CES, 1997). Following the 2001 purchase of the property by Mystic Landing, LLC (Mystic Landing), additional subsurface and sediment investigations were completed under Tetra Tech Rizzo (formerly Rizzo Associates) and a Phase II Comprehensive Site Assessment (Phase II CSA) Report was submitted in December 2007. FBT Everett Realty, LLC (FBT) purchased the property from Mystic Landing in 2009. In February 2012, GEI Consultants, Inc. ("GEI") submitted a Phase II CSA along with a Notice of Delay for the Phase III and IV reports which attributed the delays to a property access dispute (GEI, 2012). FBT subsequently submitted additional Notices of Delay as the selected remedial approach could vary depending on whether the construction of casino on the property was approved.

Wynn purchased the property in January 2015 and in February 2015 an Eligible Person Certification and Revised Tier II Classification were submitted by GZA GeoEnvironmental (GZA) on Wynn's behalf (GZA, 2015a). This document included a "Supplemental Sampling and Analysis Plan" outlining an extensive sampling program to refine the Site boundary (GZA, 2015a). MassDEP issued a Notice of Responsibility ("NOR") in March 2015 which established interim deadlines for supplemental Phase II and Phase III reports for the Mystic River portion of the property.[2] In December 2015, GZA submitted a Supplemental Phase II Report which contained the results from the sediment sampling program as well as an updated Site boundary and risk characterization. In May 2016, MassDEP issued a letter containing questions they had with the Supplemental Phase II Report and requesting additional assessment and/or data review (MassDEP, 2016b and c). This letter also established interim deadlines for submittal of a Revised Phase II Report, Phase III and Phase IV reports, and a Permanent or Temporary Solution or Remedy Operation Status (ROS). MassDEP supplied additional comments via email (MassDEP, 2016d) in June 2016 subsequent to GZA's submittal of a sediment CSM (GZA, 2016a).

In September 2016, Wynn proposed an alternative approach to characterizing the Site and potential risks and supplied additional information requested by MassDEP (Wynn, 2016). In November 2016, MassDEP and Wynn agreed upon an approach which would allow the project to move forward (MassDEP, 2016e). On December 30, 2016, a revised Supplemental Phase II CSA Report was submitted to MassDEP. This report responded to MassDEP comments and provided an alternate approach to Site assessment and closure (AMEC, 2016). On March 31, 2017, MassDEP issued a letter identifying new interim deadlines for the sediment portion of the Site:

[2] As well as a deadline for either a Permanent Solution, Temporary Solution, or Remedy Operation Status. See MassDEP, 2015 p. 2.

- Supplemental Phase III RAP and Phase IV RIP to be submitted by September 15, 2017; and
- A Permanent Solution, Temporary Solution, or ROS by June 30, 2019.

Submittal of this report satisfies the first of the two interim deadlines.

2.3 Relevant Contacts

The following is a list of relevant contacts for the proposed remediation as required by 310 CMR 40.0874(3)(a):

Potentially Responsible Party/Site Owner:	Wynn MA, LLC Everett Property, LLC 101 Station Landing, Suite 2200 Medford, MA 02155 Contact: Robert DeSalvio Jacqui Krum Telephone: 857-770-7000 E-mail: robert.desalvio@wynnmass.com, jacqui.krum@wynnmass.com
Licensed Site Professional (LSP):	Matthew J. Grove, PhD, LSP LSP No. 9932 Amec Foster Wheeler (AMEC Massachusetts, Inc.) 271 Mill Rd., 3rd Floor Chelmsford, MA 01824 Telephone: 978-392-5398 Fax: 978-692-6633 E-mail: matt.grove@amecfw.com
Remedy Design and Implementation Engineer:	Danielle Ahern, P.E. Amec Foster Wheeler 271 Mill Rd., 3rd Floor Chelmsford, MA 01824

Wynn will enter into a construction contract with a Remedial Contractor, thus Wynn will “own, operate, and/or maintain” the remedial action during construction. Wynn will also be responsible for post-construction maintenance and monitoring as further discussed in the Phase IV RIP portion of this report.

3.0 CONCEPTUAL SITE MODEL

3.1 Potential Sources and Release Mechanisms

3.1.1 Site-Related Sources

The Disposal Site includes both an upland area and sediments in an embayment of the Mystic River. The upland portion consists of approximately 22 acres above mean high water (MHW). This area was the location of chemical manufacturing facilities (primarily sulfuric acid and alcohols) for over 100 years. Portions of the upland property were also filled at various times with dredged materials (and potentially manufacturing wastes) which resulted in the current configuration.[3] Chemical manufacturing operations began in the 1800s and continued through the late 1960s. The buildings on the property were demolished in the late 1960s and 1970s and the property was generally vacant by about 1980. Beginning in the mid-1990s, the upland areas were used as a material storage and staging yard.

Historical manufacturing operations and processes resulted in the release of metals to the upland portion of the Disposal Site, evidenced by the presence of impacted subsurface soil (e.g., the CES-2 Area shown on **Figure 1-2**). Specific metals of concern are arsenic, lead and vanadium based on the following historical information:

- A material used to dry sulfur during sulfuric acid production reportedly contained arsenic,
- A "lead storage house" formerly occupied a portion of the Disposal Site, and
- Vanadium was widely used as a catalyst in the production of sulfuric acid beginning in the 1930s.

In addition, the production of sulfuric acid on the upland portion of the Disposal Site resulted in areas of low pH in groundwater (**Figure 1-2**). Remediation of the upland portion of the Disposal Site is currently being completed under a Release Abatement Measure (RAM).

Spillage during loading and unloading of raw materials on and near the water, principally along the northern and northeastern side of the embayment, likely contributed contaminants directly to sediment. As first noted by Tetra Tech Rizzo (2007) and subsequently confirmed by GZA (2015b), the highest concentrations of metals have generally been measured in the northern and northeastern parts of the embayment where materials were historically loaded and unloaded.

3.1.2 Non-Site Sources

A secondary area of high metals concentrations has been observed along a tidal channel in the flats on the south side of the embayment. This is likely associated with historical discharges from a drain pipe outlet located on Boston Water and Sewer Commission property to the south.

Phthalates (e.g., bis2-ethylhexyl)phthalate or BEHP) and polychlorinated biphenyls (PCBs) associated with the historical operations on the adjacent Monsanto West property have also been detected in sediments on the property. However, the spatial distribution of phthalates and PCBs

[3] Dredging and filling occurred over time and under a number of different licenses. As noted in the Combined 401 Water Quality Certification (MassDEP, 2016a), the last known dredging of the embayment occurred in 1943.

in sediments is different than that of the metals which are attributed to Disposal Site operations. The distribution of phthalates and PCBs is consistent with a different (non-Site) source of these chemicals.

The widespread presence of low levels of polycyclic aromatic hydrocarbons (PAHs) and petroleum hydrocarbons in sediments on the property can, at least partially, be attributed to other industrial and anthropogenic sources (e.g., stormwater runoff[4], industrial releases, and shipping-related impacts). The Mystic River is a very urbanized watershed and the river and adjacent land areas have a very long history of commercial and industrial uses.

3.2 Potential Migration Pathways

Contaminated soils from the upland portion of the Disposal Site likely eroded and migrated directly to the Mystic River via overland flow. This migration path is likely to be eliminated in the future due to ongoing remediation and redevelopment of the upland portion of the Disposal Site.

Low pH soil has caused metals (released from Disposal Site operations and naturally occurring) to leach from the subsurface fill into groundwater which discharges into the Mystic River. Under neutral pH conditions, the migration of metals in groundwater is limited by their low solubility and their tendency to adsorb to soil particles or precipitate out of groundwater. This migration path is likely to be limited in the future due to the recently completed in-situ treatment of soil and groundwater in the low pH area and excavation and off-site disposal of soil from the CES-2 area. Based on the results of surface water investigations performed by Menzie-Cura & Associates, Inc. ("MCA") and GZA prior to treatment, discharge of impacted groundwater is not significantly or negatively impacting surface water because of dilution.

The embayment has reportedly not been dredged since 1943 which predates the end of chemical manufacturing operations.[5] Sediments within the embayment do not appear to be transported out of the embayment by tidal currents. The low concentrations in sediment on the northern tidal flats (e.g. GZ-125, GZ-129, GZ-130, and GZ-131) compared to concentrations in the channel (e.g., GZ-112, GZ-115, and GZ-117) indicate little to no tidal transport in an upstream direction (towards the dam). The presence of higher concentrations at depth in the channel and close to the uplands indicates that the embayment is a depositional area (i.e., sediment from other areas is being deposited on top of the sediment impacted by historical releases related to the Site). This is supported by the relatively narrow range in concentrations observed along the channel bottom (e.g., GZ-117, GZ-119, GZ-121, GZ-123, GZ-128, GZ-134, and GZ-138). If the historic contamination was eroding and being transported into the Mystic River, the contaminant concentrations would increase towards the river (i.e., to the south) and impacted sediment would be expected to accumulated in the deeper hole at the edge of the property (i.e., where GZ-201 is located). However, the analytical data do not support this erosional scenario. Based on the evidence, migration of sediment out of the embayment via natural processes is not expected to have been a significant migration pathway in the past or be one in the future.

[4] For example, historical plans of the property indicate a drain pipe outlet located on the Boston Water and Sewer Commission property to the south and a 36-inch drain leading from the MBTA property to the north.
[5] MassDEP, 2016a; p. 2.

3.3 Potential Exposure Routes and Receptors

The primary potential human exposure pathway is dermal contact with sediment when wading in the nearshore. However, access to sediment is partially limited by a fence and bulkhead. Another potential exposure route for humans is the consumption of fish and shellfish which might have accumulated Site-related chemicals in their tissues. However, the Massachusetts Department of Public Health (DPH) has placed an advisory for certain marine species within Boston Harbor which includes the Mystic River.[6] Shellfish Growing Area Designations by the Massachusetts Department of Marine Fisheries (DMF), September 2009, indicate that all of the Mystic River and associated embayments and coves are currently classed as prohibited as a shellfish growing area, which means the area is closed to the harvesting of shellfish. Closure of these areas to shellfishing is enforced by Mass Environmental Police.

The Mystic River below the Amelia Earhart Dam serves as habitat for fish, shellfish, benthic invertebrates, waterfowl, and semi-aquatic mammals (GZA, 2015b). The primary exposure pathways for ecological receptors are direct contact with sediments, incidental sediment ingestion, and consumption of contaminated prey.

[6] MassDPH, 2016.

4.0 UPDATED METHOD 3 ECOLOGICAL RISK ASSESSMENT

The Ecological Risk Assessment for the sediment portion of the Site included in the Revised Phase II Report was presented as a Method 3 Stage I Ecological Screening (ES). The ES concluded that there were potentially significant exposure pathways with respect to the benthic community exposed to sediment. This conclusion was based on the results of a comparison of Disposal Site data to ecological benchmarks which is a component of a Stage II Ecological Risk Characterization (ERC). Following submittal of the Revised Phase II Report, MassDEP requested that the sediment Ecological Risk Assessment be revised to more explicitly follow a Stage II ERC approach.

4.1 Stage I Ecological Screening

This Method 3 Stage I ES, which identifies whether potentially significant exposures exist in the sediment within the Disposal Site boundary, was performed following:

- Regulations for a Method 3 Environmental Risk Characterization (310 CMR 40.0995) (MassDEP, 2014),
- Guidance for Disposal Site Risk Characterization (MassDEP, 1995; 1996),
- MassDEP Interim Technical Updates (MassDEP, 2006), and
- Other ecological risk assessment best management practices.

The objective of the Stage I ES is to identify and document conditions which do not warrant a Stage II ERC, either because of the absence of a potentially significant exposure pathway or because environmental harm is readily apparent and therefore additional assessment would be redundant.

Following a Stage I Environmental Screening, it may be concluded that:

1. A Stage II ERC is not required because there are no complete exposure pathways that could result in potentially significant exposures, and a condition of No Significant Risk of harm to Site biota and habitats clearly exists;
2. A Stage II ERC is not required because, for each contaminated medium, harm is readily apparent; therefore a condition of No Significant Risk of harm to the Site biota and habitats clearly does not exist, and a Stage II Environmental Risk Characterization would be redundant; or
3. A Stage II ERC is required because, for one or more contaminated media, there is not enough information to determine whether or not a condition of No Significant Risk of harm exists, and therefore those media are considered to present "potentially significant exposures."

MCA previously conducted a Stage I ES and a Stage II ERC (MCA, 2006) which demonstrated:

- A condition of No Significant Risk to surface water based on modeled groundwater discharge from Site uplands to the embayment.
- A condition of No Significant Risk to shorebirds and other wildlife populations exposed to sediment based food chain models.

Based on the findings of the previous risk assessments, the present Stage I ES only evaluates risk to benthic invertebrates exposed to Site sediment.

4.1.1 Environmental Setting and Complete Exposure Pathways

As previously noted, the property includes approximately 13 acres of sediment within the Lower Mystic River. As explained in Section 2.1, the Disposal Site boundary encompasses approximately 7.8 acres of sediment (**Figure 1-2**). Located downstream of the Amelia Earhart Dam, this portion of the Lower Mystic River has been classified by MassDEP and other state and federal agencies as a marine surface water body that serves as habitat for fish, shellfish, benthic invertebrates, waterfowl, and semi-aquatic mammals (GZA, 2015b). A detailed description of the ecological resources, and sediment and aquatic communities present at and around the Disposal Site was previously presented in Section 2.3 of the GZA Supplemental Phase II Report (GZA, 2015b).

There are no Areas of Critical Environmental Concern (ACECs) within 0.5 miles of the Disposal Site. No state-listed species are located within 0.5 miles of the Disposal Site. The US Fish and Wildlife Service (USFWS) online mapper does not identify any critical habitat for threatened and endangered species within the Lower Mystic River (USFWS, 2016).

Considering the presence of aquatic and benthic species observed during previous investigations, sediment exposure pathways are considered potentially complete.

4.1.2 Evaluation of Readily Apparent Harm

Disposal Site conditions do not satisfy any of the following three criteria listed in 310 CMR 40.0095(3)(b)(1) needed to meet Readily Apparent Harm:

- Visual evidence of stressed biota attributable to the Site, including fish kills or abiotic conditions have not been reported. While the embayment is currently a degraded habitat, surveys conducted by GZA identified limited populations of shellfish, snails, marine worms, and crabs (GZA, 2015b).
- Estimated (MCA, 2006) and measured (GZA, 2015b) surface water concentrations were below water quality benchmarks including USEPA Ambient Water Quality Criteria and Massachusetts Surface Water Standards, and a condition of No Significant Risk exists for surface water.
- Oil, tar, or other non-aqueous phase hazardous material have not been observed within one foot of the sediment surface. Note that while sediment discolored by the presence of pyrite ash has been observed in the intertidal, this does not constitute Readily Apparent Harm as defined by the MCP.

Therefore, Readily Apparent Harm does not exist at the Disposal Site.

4.1.3 Evaluation of Significant Exposure Pathways

In this section, each complete exposure pathway is evaluated to determine whether the exposures are significant. If significant exposures are determined to be unlikely for any pathway, that pathway can be eliminated from further consideration in the risk assessment. Screening criteria are used to rule out pathways, not individual chemicals. If a pathway is not ruled out, risks from all chemicals that result in exposure by that pathway should be further evaluated, even if some of the chemicals are present at levels below their screening criteria.

This exposure pathway evaluation was conducted by comparing the maximum detected bulk sediment concentrations to corresponding ecological screening benchmarks. Consistent with MassDEP guidance (MassDEP, 1996), only those compounds with concentrations that are not consistent with local conditions and compounds for which local conditions data are unavailable were compared to ecological sediment screening benchmarks.

Marine sediment benchmarks **(Table 4-1)** were preferentially selected from the following source:

- NOAA Effects Range - Medium (ER-M) (Long *et al.*, 1995)

ER-Ms have been previously used on this project (GZA, 2015b), and have been agreed to with MassDEP (MassDEP, 2016b).

Where a compound lacked an ER-M, sediment benchmarks were selected from among the following sources:

- Washington State Apparent Effects Thresholds (AETs) (Washington State, 2013)
- NOAA Screening Quick References Tables (Buchman, 2008)

The maximum detected concentrations in sediment within the Disposal Site boundary were compared to effects-based ecological screening benchmarks to determine whether current and potential future exposure could potentially be significant (**Table 4-1**). Note that when performing benchmark comparisons, concentrations were rounded to two digits in accordance with MassDEP's guidance on significant figures (MassDEP, 2009).

An analyte with a maximum detected concentration above its benchmark was identified as a potentially significant exposure.

- The maximum detected concentration of total PAHs, several individual PAHs, antimony, cadmium, and chromium were **below** conservative ecological screening benchmarks.
- The maximum detected concentration of PCBs, two phthalates, several individual PAHs, arsenic, lead, mercury, nickel, selenium, silver, vanadium, and zinc were **above** conservative ecological screening benchmarks.
- EPH fractions lacked screening benchmarks and thus could not be evaluated. Beryllium also lacked a screening benchmark but was consistent with local conditions.

Since concentrations in sediment exceed benchmarks, direct contact to sediment represents a significant exposure pathway.

4.1.4 Stage I ES Summary and Conclusions

The previous Stage I ES (MCA, 2006) demonstrated that a condition of No Significant Risk exists for surface water. The 2006 Stage II ERC (MCA, 2006) demonstrated that a condition of No Significant Risk exists for shorebirds and other shoreline wildlife.

The present Stage I ES concludes that there are potentially significant exposure pathways with respect to the benthic community exposed to sediment. Therefore, a Stage II ERC is required to determine whether a condition of No Significant Risk of harm exists.

4.2 Stage II Environmental Risk Characterization

The purpose of the Stage II ERC is to determine whether there is significant risk of environmental harm or evidence of environmental harm. The goal is to determine whether the release(s) of OHM from the Site have adversely impacted, or may adversely impact, the ecological function of environmental resource areas such as wetlands, aquatic and terrestrial habitat, fisheries or rare and endangered species.

4.2.1 Problem Formulation

The problem formulation phase is designed to establish the goals, scope and focus of the Stage II ERC. As previously noted, the 2006 Stage II ERC (MCA, 2006) demonstrated that a condition of No Significant Risk exists for shorebirds and other shoreline wildlife. Therefore, the focus of this Stage II ERC is benthic invertebrates exposed to contaminated sediment via direct uptake/dermal contact and dietary ingestion.

4.2.1.1 Environmental Setting

A baseline site survey of the ecological resources, and sediment and aquatic communities present at and around the Disposal Site was previously presented in Section 2.3 of the GZA Supplemental Phase II Report (GZA, 2015b) and is summarized above in Section 4.1.1.

4.2.1.2 Delineation of Nature & Extent

The nature and extent of contamination has been delineated as described in the Revised Phase II Report (AMEC, 2016b), including those attributable to non-Site sources (e.g., Monsanto West) and local conditions.

4.2.1.3 Complete Exposure Pathways

Considering the presence of a benthic community, a complete exposure pathway may therefore exist for sediment. Chemicals move from sediment into sediment porewater, and then into benthic receptors through several major biological exposure mechanisms:

- Uptake from interstitial water between sediment particles (porewater) into tissue
- Incidental ingestion of chemicals bound to sediment
- Dietary ingestion of chemicals in surface water
- Direct contact with chemicals in surface water
- Dietary ingestion of chemicals in contaminated biota

4.2.1.4 Ecological Conceptual Site Model

The ecological site conceptual model (**Figure 4-1**) illustrates initial estimates of contaminant fate and transport mechanisms, complete exposure pathways, and primary and secondary receptors. As noted previously, the 2006 Stage I ES demonstrated that a condition of No Significant Risk exists for surface water and the 2006 Stage II ERC (MCA, 2006) demonstrated that a condition of No Significant Risk exists for shorebirds and other shoreline wildlife, thus **Figure 4-1** illustrates only the sediment exposure pathways.

Specific assessment and measurement endpoints are not identified because generic endpoints were used, as discussed in Section 4.2.1.5. This model is based on the current understanding of Disposal Site conditions (see Section 3 of this report for the full CSM), serves as a framework for evaluating ecological exposure and risk, and shows:

- The source areas (i.e., historical release areas and potential non-Site related release areas);
- Transport mechanisms (processes that partition chemicals among various environmental media);
- Exposure media (those environmental media from which organisms may be exposed to chemicals); and
- Potential receptor organisms based on site ecological investigations.

As previously described, chemicals associated with operation on the Disposal Site, as well as non-Site sources (e.g., Monsanto West) were historically released to the land surface and infiltrated into the embayment. These products could potentially adversely affect aquatic organisms, such as plants, benthic organisms, and fish which inhabit this reach of the Lower Mystic River, as well as aquatic and semi-aquatic birds and mammals which could nest and forage there.

4.2.1.5 Assessment & Measurement Endpoints

Endpoints in the Stage I ERC define ecological attributes that are to be protected (assessment endpoints) and a measurable characteristic of those attributes (measurement endpoints) that can be used to gauge the degree of impact that has occurred or may occur. Assessment endpoints for the Stage II ERC are considered generic because they are based on the broad variety of organisms that inhabit sediment in the embayment and are therefore considered to be representative of entire communities.

The assessment and measurement endpoints are:

Assessment Endpoint	Measurement Endpoint
1. Sustainability (survival, growth, reproduction) of the benthic community exposed to sediment.	a. Comparison of bulk sediment concentration to ecological no-effects benchmarks.
	b. Comparison of bulk sediment concentrations to local conditions.

Site-specific toxicity testing, field surveys, or field experiments are not being used as measurement endpoints due to potential confounding effects from non-Site sources of contamination to sediment.

4.2.2 Measures of Exposure

Measures of exposure must consider the spatial and temporal distribution of OHM and represent the co-occurrence of contamination with the assessment endpoint organisms (i.e., the benthic community). For this Stage II ERC, the measure of exposure is concentration of OHM in the top six inches of sediment across the Site.

4.2.3 Analysis

To determine whether it is likely that there will be any adverse ecological effects on the benthic community, maximum sediment concentrations were compared to the higher of ecological benchmarks (**Table 4-1**) or local conditions (**Table 4-2**). By agreement with MassDEP specifically for this project, local conditions were established as the 75th percentile of the local conditions dataset from locations upstream in the Mystic River. As shown on **Table 4-2**, the 75th percentile local conditions value for barium, lead, mercury, vanadium, zinc, total PAHs, total PCBs, and BEHP are above published benchmarks, while the 75th percentile values for the remaining detected chemicals other than EPH fractions are below published benchmarks.

Table 4-3 compares the maximum concentration detected in sediment to the higher of the 75th percentile local conditions value and published benchmarks.

- The maximum detected concentration of total PAHs, antimony, cadmium, and chromium were **below** measurement endpoints.
- The maximum detected concentration of PCBs, BEHP, arsenic, barium, lead, mercury, nickel, selenium, silver, vanadium, and zinc were **above** measurement endpoints.
- EPH fractions lacked screening benchmarks and thus could not be evaluated. Beryllium also lacked a screening benchmark but was consistent with local conditions.

4.2.4 Uncertainty

The following represent potential uncertainties which could affect the outcome of the risk characterization:

- The use of maximum concentrations is a more conservative approach than using a measure of the central tendency of the data (i.e., mean of 95th percentile upper confidence limit of the mean or other estimate of the mean). Therefore, the risk assessment may be over-estimating the potential risk to benthic organisms.
- The use of screening benchmarks includes conservative assumptions, such as that 100 percent of a given contaminant is bioavailable. Use of conservative benchmarks results in an overestimation of risk.
- The lack of benchmarks for EPH fractions and beryllium may result in an underestimation of the total Disposal Site risk. However, the maximum concentrations of EPH is co-located with the Site-related chemicals of concern. Therefore, remedial actions taken to address the risk posed by arsenic, lead, mercury and vanadium will also address the risk posed by EPH fractions. Beryllium is generally present at concentrations below local conditions except one location which is co-located with Site constituents of concern. Therefore, beryllium does not represent a significant risk in and of itself.

4.2.5 Risk Characterization

This Stage II ERC considered all constituents present in the top six inches of sediment, including those attributable to non-Site sources (e.g., Monsanto West) and local conditions. Based on the comparison of maximum sediment concentrations to the measurement endpoints, and considering uncertainties, a condition of No Significant Risk does not exist for benthic organisms which are exposed to sediment.

4.3 Method 3 Ecological Risk Assessment Conclusions & Risk Management Recommendations

The 2006 Stage I ES (MCA, 2006) demonstrated that a condition of No Significant Risk exists for surface water. The 2006 Stage II ERC (MCA, 2006) demonstrated that a condition of No Significant Risk exists for shorebirds and other shoreline wildlife.

The present Stage I ES concludes that there are potentially significant exposure pathways with respect to the benthic community exposed to sediment. The present Stage II ERC concludes that a condition of No Significant Risk does not exist for benthic organisms exposed to sediment.

As discussed in the Revised Phase II Report (AMEC, 2016b), per agreement with MassDEP, the chemicals for which Wynn has liability are arsenic, lead, mercury, and vanadium. Therefore, the limits of risk for which Wynn is required to take remedial action are defined by the ER-M for arsenic and the local conditions values for lead, mercury, and vanadium (i.e., the higher of the effects benchmark or local conditions for each of these four metals).

A Downgradient Property Status (DPS) Submittal will be prepared for areas on the property outside the Remediation Area where non-Site contaminants (e.g., BEHP and PCBs) are present.

5.0 REMEDIAL ACTION OBJECTIVES (310 CMR 40.0851)

Remedial action objectives consist of specific goals for protecting health, safety, public welfare and the environment. These objectives will guide the development and evaluation of remedial action alternatives (RAAs) for the Site. The performance standards for a Phase III evaluation (310 CMR 40.0853) require that RAAs be identified and evaluated that are "reasonably likely to achieve a level of No Significant Risk", and that the recommended alternative be a Permanent Solution or a Temporary Solution. "No Significant Risk", as defined in the MCP (310 CMR 40.0006), is "a level of control of each identified substance of concern at a Site or in the surrounding environment such that no such substance of concern shall present a significant risk of harm to health, safety, public welfare or the environment during any foreseeable period of time."

A Permanent Solution is any measure or combination of measures which will, when implemented, ensure attainment of No Significant Risk. Permanent Solutions must also include measures that reduce, the levels of oil and hazardous materials in the environment to as close to background as feasible. A Temporary Solution is any measure, or combination of measures, which will, when implemented, eliminate any Substantial Hazard which is presented by a disposal site until a Permanent Solution is achieved. A Temporary Solution can be selected if a Permanent Solution is not currently feasible or response actions to achieve a Permanent Solution are feasible and shall be continued toward a Permanent Solution.

5.1 General Remedial Action Objectives

The general remedial objectives to be considered for the Phase III evaluation specified by the MCP are:

- Achieve a condition of No Significant Risk of harm to human health, safety, public welfare, and the environment, and reduce OHM to background conditions, if feasible;
- Eliminate or control continuing sources of OHM;
- Control plumes of dissolved OHM in groundwater and vapor phase OHM in the vadose zone;
- Eliminate Upper Concentration Limit (UCL) exceedances for OHM in soil and groundwater, if feasible; and
- Eliminate Substantial Hazards.

5.2 Site-Specific Remedial Action Objectives

Site-specific remedial action objectives have been determined based on the results of the previous Risk Characterizations conducted for the sediment portion of the Disposal Site.

The 2006 Stage I ES (MCA, 2006) demonstrated that a condition of No Significant Risk exists for surface water. The 2006 Stage II ERC (MCA, 2006) demonstrated that a condition of No Significant Risk exists for shorebirds and other shoreline wildlife. The present Stage I ES concludes that there are potentially significant exposure pathways with respect to the benthic community exposed to sediment. The present Stage II ERC concludes that a condition of No

Significant Risk does not exist for benthic organisms exposed to sediment. Therefore, remedial actions are necessary to address exposure to impacted sediments by benthic organisms in order to achieve a condition of No Significant Risk.

A Method 3 human health risk characterization concluded that a condition of No Significant Risk does exist for trespassers who might wade along the shoreline. A condition of No Significant Risk is also considered to exist for trespassers who might catch and consume fish and shellfish irregularly on the property. Therefore, no remedial actions are necessary to address potential risks to human health.

As discussed in Section 3.1, the primary sources of contamination to the sediment are historical manufacturing operations and processes on the upland portion of the property and the adjacent Monsanto West property. The upland portion of the property is being remediated through the RAM. The Monsanto West property was remediated during redevelopment of that area into the Gateway Center. Therefore, there are no potential uncontrolled sources for the Disposal Site.

There are no vapor phase OHM in the vadose zone which might migrate to sediment. Migration of metals in groundwater from the upland portion of the property to sediment is likely to be very limited in the future due to the recently completed in-situ treatment of soil and groundwater in the low pH area and excavation and off-site disposal of soil from the CES-2 area. Migration of sediment out of the embayment via natural processes is not expected to have been a significant migration pathway in the past or be one in the future. Therefore, no actions need to be taken to control migration of groundwater, vapor, or impacted sediment.

The achievement of a Temporary Solution requires elimination of any Substantial Hazards until a Permanent Solution is achieved. For the sediment portion of the Site there are no Substantial Hazards to either human or ecological receptors based on the 2016 Method 3 Risk Characterization. Therefore, no specific remedial actions need to be performed to address Substantial Hazards.

Based on the above discussion, the Site-specific remedial action objective for sediment is to eliminate significant risk to benthic organisms associated with exposure to sediment at concentrations which exceed benchmarks or local conditions.

6.0 IDENTIFICATION AND EVALUATION OF REMEDIAL ACTION ALTERNATIVES (310 CMR 40.0855)

This section presents the results of the identification and evaluation of remedial action alternatives that are potentially applicable to the Site. This evaluation consisted of two steps: (i) an initial screening of potential applicable remediation technologies, and (ii) the formulation and evaluation of comprehensive remedial action alternatives. The site-specific remedial objective for the Site (as discussed in Section 4.2) requires that the remedial action alternatives address potential exposure to sediment by benthic organisms which are currently present (or likely to be present in the future) at the Site.

6.1 Initial Technology Screening (310 CMR 40.0856)

The purpose of this step is to identify remedial action technologies for further evaluation, which are reasonably likely to be feasible, based on the OHM present, impacted media, and disposal site characteristics. For the purpose of this screening step, remedial action technologies are considered reasonably likely to be feasible if (310 CMR 40.0856):

- The technologies to be employed by the alternative are reasonably likely to achieve a Permanent or Temporary Solution; and
- Individuals with the expertise needed to effectively implement available solutions would be available, regardless of arrangements for securing their services.

The categories of remedial technologies/response actions that were evaluated include the following:

- Monitored Natural Recovery (MNR)
- In Situ Treatment (Amendment)
- Enhanced Sediment Deposition
- Mechanical Dredging
- Hydraulic Dredging
- Mechanical Capping

Each of these technologies is described in more detail below.

6.1.1 Monitored Natural Recovery (MNR)

MNR is one of the three main remedial alternatives for contaminated sediment recognized by US EPA (dredging and capping are the others). MNR uses ongoing, naturally occurring processes to contain, destroy, or reduce the bioavailability or toxicity of contaminants in sediment. These processes include that convert contaminants to less toxic forms (biodegradation), bind contaminants more tightly to sediment (sorption), or bury contaminated sediment beneath clean sediment (sedimentation). For this Site, natural sediment burial and contaminant attenuation are generally the processes which constitute MNR. Long-term monitoring with sediment sampling occurs at a set frequency (i.e., quarterly, semi-annual, and/or annual) to document reduction in sediment concentrations through deposition of incoming “cleaner” sediment, and/or dilution to reduce concentrations of impacted sediments.

6.1.2 In Situ Treatment (Amendment)

In situ treatment or amendment of the sediment, uses in situ sequestering or destruction of contaminants to reduce risks at a site. Materials with treatment capacity for sediment/porewater OHM by sorption (e.g., activated carbon, organoclays and apatite) or degradation are placed into or onto the sediment surface layer, into a sand cap, or within a geotextile mat. Direct amendment of surficial sediment with sorbents can reduce pollutant bioavailability to the food chain and flux of pollutants into the water column. Amendments can be spread on the surface of the contaminated sediment as a thin layer, intended to be mixed with the sediments through natural processes, or mixed into the surface using equipment similar to a rototiller. The intent in direct application is to change the native sediment geochemistry to reduce contaminant bioavailability without creating a new surface layer or cap. Amendments can also be introduced to a capping layer in a geotextile mat or added to capping materials before or during placement of caps. In situ treatment of sediment is a relatively new technology and there are uncertainties regarding treatment capacity, long-term permanence, and ability to retain contaminants over time. For this Site, migration of contamination from sediment/porewater into surface water and bioavailability are not the primary concerns.

6.1.3 Enhanced Sediment Deposition

Enhanced sediment deposition, sometimes referred to as enhanced MNR, uses structures (e.g., weirs, breakwaters, reefs, jetties) placed in the flow of the water body to slow the natural flow and allow sediment to deposit on the bottom. The intent is to disrupt the existing flow and sediment transport patterns and establish new equilibrium conditions where sediment deposition is enhanced in certain desired areas. However, enhancement of sediment deposition in one area may result in increased erosion in another area which may not be desirable. In addition, the structures must remain permanently in place or else natural equilibrium conditions will re-establish themselves. Selection, design, and installation of appropriate structures requires a thorough understanding of flow and sediment transport in the water body. For this Site, the tidal nature of the environment and the shifting flow directions at ebb and flood tide will make this challenging. The placement of structures within the embayment (and potentially the Mystic River) could also pose a challenge to navigation and the desired end uses of the area.

6.1.4 Mechanical Dredging

Mechanical dredging is a presumptive remedial technology for contaminated sediments. Mechanical dredging removes impacted sediments from the area of concern within a waterway by using direct mechanical force to dislodge and contain the material. Heavy equipment (various sizes of excavators and cranes) are mounted onto a barge and used to excavate the area of concern using precise global positioning system (GPS) guided equipment for horizontal and vertical accuracy. Removed sediments are placed on a materials barge where they are temporarily stockpiled to allow waters to drain out. Once the bulk of the water has drained back to the area within the environmental barriers, the sediments are transported to a land transfer facility. Sediments are then stabilized with a drying agent (i.e., portland cement) to remove additional waters and bring the moisture content of sediments to an allowable limit for off-site transportation and disposal. The sediments are then conveyed from the barge into trucks for off-site for disposal, or treated on-site.

Due to Site constraints an off-site shipping yard will need to be used for all waterway access, sediment processing, transportation and disposal. Tide information, bridge clearances, navigation channels and underwater utility locations are important considerations in mechanical dredging projects and must be identified and considered during the remedial design. Proximity to local shipping yards and coordination with harbor masters can also affect dredging costs.

6.1.5 Hydraulic Dredging

Hydraulic dredging uses a pump to create a vacuum at the dredge head to remove and transport sediment in a slurry form. The dredged material is usually pumped through a pipeline to a settling lagoon or tank (typically on land). Environmental dredging using hydraulic dredges typically produce slurries with less than 10% solids by weight. A “cutter head” hydraulic dredge is commonly used to apply mechanical force to dislodge the sediments for removal by the dredge pump. The slurry requires extensive dewatering prior to off-site reuse, recycling or disposal of the dredged materials. This is often accomplished through the use of settling tanks, mechanical filter presses, Geotubes and stabilization agents and may require multiple steps. Water generated during dredging and the dewatering of the slurry is typically treated and discharged back to the dredge area. As with mechanical dredging, Site constraints would require the initial processing of the slurry to occur on a barge which will affect productivity and dredging costs.

6.1.6 Mechanical Capping

Capping (isolation) is also considered a presumptive remedy for contaminated sediments. Mechanical capping uses one or more layers of imported clean material (i.e., sand, gravel, rock or synthetic material) as a barrier over contaminated sediments. The cap then creates a physical barrier which mitigates exposure to potential receptors. In a low energy system, a single isolation layer may be sufficient to be an effective cap. In higher energy environments, the cap may contain both an isolation layer and an erosion control layer. Clean fill is loaded onto a material barge at a landside transfer facility and transported to the site. Material can be placed by a mechanical excavator, broadcast spreader, conveyor belt or other suitable method.

6.1.7 Summary of Technology Screening

Table 6-1 summarizes the initial screening of technologies. Each technology is briefly described with advantages and disadvantages of each. Relative costs are identified along with whether the technology is compatible with Site characteristics. Technologies were screened based on their likely feasibility; ability to achieve a level of No Significant Risk; and their ability to achieve a Permanent Solution. Based on the initial screening outlined in **Table 6-1**, mechanical dredging, mechanical capping and MNR were retained for assembly into a range of alternatives. MNR alone may not achieve the remedial action objective in a reasonable timeframe, particularly in intertidal areas where erosion and sedimentation processes may be more dynamic. However, if natural recovery is further verified to be occurring, it can be used (primarily in subtidal environments) with other technologies to achieve an overall condition of No Significant Risk.

In situ treatment (amendment) was not retained as this technology is primarily intended to prevent migration of contaminants from sediment to surface water in the dissolved phase and this is not a concern at the Site. In addition, the amended cap material may not be a suitable habitat for benthic organisms. Enhanced sediment deposition was not retained as it would require the

installation of structures within the embayment and channel which could pose a hazard to navigation and limit future use of the area. In addition, the increased depositional rates might adversely affect benthic organisms.

6.2 Development of Alternatives

A combination of technologies can often be more efficient and cost-effective, rather than successive, Site-wide application of single technologies. The retained technologies described above have been assembled into a variety of remedial action alternatives that are reasonably likely to be feasible, achieve a level of No Significant Risk, and effectively achieve the established remedial action objective. The following are the remedial action alternatives for the Site, which will be retained for detailed evaluation:

- Alternative 1 - Full Dredge and Cap
- Alternative 2 - Partial Dredge and Cap
- Alternative 3 - Partial Dredge, Cap, and MNR
- Alternative 4 - Navigation Dredge, Cap, and MNR
- Alternative 5 - No Further Action (Navigation Dredge Only)

Alternatives 1-4 combine sediment removal with capping and/or MNR to mitigate the risk to benthic organisms due to exposure to contaminated sediment and to achieve a condition of No Significant Risk. These alternatives were developed primarily by varying the extent of dredging and/or capping. Alternative 5 provides a basis for comparison of the other "active" alternatives as it assumes no further remedial actions or monitoring measures would be conducted. Alternative 5 does assume that the previously permitted navigational dredging[7] and removal of five derelict barges is completed. The navigational dredging does not constitute a remedial action to address risk as it does not include capping of the deeper sediment which will be exposed upon completion of the navigational dredging.

Table 6-2 provides a conceptual design for each remedial action alternative including key elements of design and implementation, monitoring, and remediation waste. Conceptual layouts of each alternative are provided in **Figure 6-1** through **Figure 6-5**. A brief description of each alternative is presented below:

6.2.1 Alternative 1 – Full Dredge and Cap

Shallow sediments within the Disposal Site boundary pose a significant risk to benthic organisms. Based on previous studies of the benthic communities at the Site, USEPA's *Determination of the Biologically Relevant Sampling Depth for Terrestrial and Aquatic Ecological Risk Assessments* (USEPA, 2015) and other sources, the anticipated depth of bioturbation by organisms found (or likely to be found in the future) is 18 inches. Therefore, to achieve a condition of No Significant Risk, an 18-inch thick clean layer must be established. Implementation of Alternative 1 will remove impacted sediment to a depth of 18 inches across the area posing a Significant Risk.

[7] Dredging, structures and fill associated with navigation improvements and shoreline stabilization were previously approved by the U.S. Army Corps of Engineers (USACE), MassDEP, and Everett Conservation Commission.

Sediment removal will be performed using mechanical dredging. Following dredging, 18 inches of clean sand will be placed over the newly dredged surface.

Alternative 1 – Full Dredge and Cap includes the following primary components:

Debris and Barge Removal: Prior to the start of dredging, a debris survey will be performed and the debris will be removed to and placed on a barge for stockpiling prior to transport off-site for disposal at an approved facility. Buried debris encountered during the dredging works will be segregated and handled in a similar manner. One sunken barge and four additional barges located in the intertidal zone will be removed. None appear to be structurally stable such that they can be removed with salvage equipment and floated off intact. As a result, they must be dismantled in place to be removed. Removal will be conducted using barge mounted equipment and/or land-based equipment. The demolition materials will be loaded onto a combination of barges and/or trucks and disposed of in accordance with all applicable laws and regulations. The possible presence of asbestos, lead paint and other hazardous materials may require some special handling. Materials will be analysed to the extent possible prior to demolition to determine the appropriate procedures for disposal.

Dredging: A pre-dredge bathymetric survey will be performed to verify the existing contours immediately prior to the start of dredging. Sediment will be dredged using an excavator or crane equipped with an environmental clam shell bucket and then transferred to a hopper barge or scow. All work will be conducted within a turbidity curtain and turbidity monitoring will be conducted to assess the potential for ongoing impacts associated with sediment disturbance. Proposed dredging depths are anticipated to be approximately 18 inches below the existing mudline or the previously permitted elevation of -15 NAVD88 in the navigational dredge area. This will result in the removal of approximately 22,700 CY of sediment in addition to the previously approved 14,700 CY of navigational dredging (for a total of 37,400 CY of sediment) within an area of approximately 7.0 acres (306,000 SF). Note that the proposed area to be dredged is slightly smaller than the previously identified Remediation Area (7.4 acres) as some shoreline areas have already been addressed as part of the upland RAM. The total anticipated quantity of dredge includes an allowance of six inches (overdredge) to accommodate reasonable tolerances during dredge operations.

Dewatering, Stabilization and Offload: The dredged material will be transferred into a hopper barge or scow. Free water from the sediment in the scow will be decanted and discharged within the turbidity curtain at the dredging area. Scows typically have a sump pit in the corner to facilitate decanting/dewatering of sediment. Depending on the scow size and set-up, decant water will be pumped from the sump through a geotextile liner placed in the scow, or using a screened suction hose to minimize passing of solids**.** To facilitate dewatering, the scow may sit in the remediation area to allow the sediment to air-dry or Geotubes may be used to consolidate and dry the material.

Dewatered sediment will be transferred by barge to an off-site facility for further dewatering/stabilization (if necessary) and offloading. At the offloading facility it is anticipated that the sediment will be mixed with Portland cement (assumed 8 percent by weight) so that the material will have no free liquid (passing the Paint Filter Test, EPA 9095B) before it is sent to an off-site facility for reuse or disposal. The dredged material will be transported to a properly

licensed facility for reuse or disposal under a Bill-of-Lading or hazardous waste manifest (if required). Sediment may be pre-characterized at a frequency of one sample per 500 tons to identify reuse or disposal options prior to dredging. The total amount of sediment, including amendment, is estimated at 60,500 tons.

Capping: Dredged materials are to be replaced to restore existing elevations or approved navigational dredge elevations with an 18-inch thick layer of clean backfill (plus an anticipated 6-inch allowance to compensate for the over-dredge allowance). Fine to medium gravel will be used as the surface layer of the cap in the navigational dredge area in order to minimize propeller-induced erosion of the cap. Sand or silty sand will likely be used in the remaining subtidal areas and all intertidal areas in order to minimize potential erosion of the cap by wave actions and currents. The total volume of cap material to be placed in the dredged areas is approximately 25,000 CY. Once clean material has been placed following dredging, final elevations in the navigational dredge area will be -15 NAVD88 consistent with the permits issued for the navigational dredging. Elevations in intertidal areas as well as subtidal areas that are dredged will be consistent with existing elevations.

Monitoring and Maintenance: As previously noted, a pre-remediation debris survey and bathymetric survey will be conducted and the sediment may be pre-characterized. In addition, background turbidity readings will be collected from the Mystic River. If not pre-characterized, dredged sediments will be sampled in barges or in stockpiles to determine the appropriate facility for disposal. Barge demolition, dredging, and capping will be conducted within a turbidity curtain (or curtains) and turbidity monitoring will be conducted as determined by the Water Quality Certificate issued for the project. Confirmation sampling may be required by selected reuse or disposal facilities based on the amount and type of amendments used. Following construction, periodic bathymetric surveys of the cap area will be performed to monitor stability and effectiveness (initially at an annual frequency and then less frequently after a period of five years). Maintenance dredging will be conducted on a periodic basis to ensure that the channel depths required for navigation are maintained.

Regulatory Closure: An Activity and Use Limitation (AUL) will be filed to require continued maintenance and monitoring of the capped areas. A Permanent Solution with Conditions will be achieved in the Remediation Area upon completion of the dredging and capping and the filing of the AUL. A DPS submittal will be prepared to address contamination outside the Remediation Area for which Wynn is not responsible.

6.2.2 Alternative 2 – Partial Dredge and Cap

Implementation of Alternative 2 – Partial Dredge and Cap will remove impacted sediment to a depth of 18 inches from the intertidal and subtidal in the eastern portion of embayment (navigational dredge area and tidal flats) and an intertidal area to the northwest (green and tan areas on **Figure 6-2**). Sediment removal will be performed using mechanical dredging. Following dredging, 18 inches of clean backfill will be placed over the newly dredged surface as described in Alternative 1. The remaining subtidal areas within the Disposal Site boundary will be capped with 18 inches of clean sand.

The primary components of Alternative 2 are as follows:

Debris and Barge Removal: Debris and barge removal will be conducted as described in Alternative 1.

Dredging: Dredging will be conducted in the same fashion as Alternative 1. Alternative 2 will result in the removal of approximately 12,100 CY of sediment in addition to the previously approved 14,700 CY of navigational dredging (for a total of 26,800 CY of sediment) within an area of approximately 3.8 acres (165,000 SF).

Dewatering, Stabilization and Offload: Dewatering, stabilization and offload will be conducted as described in Alternative 1. Once amended, Alternative 2 is anticipated to generate 43,400 tons of sediment for off-site reuse or disposal.

Capping: Capping will be conducted in the same fashion and over the same area as Alternative 1. The total cap volume (25,000 CY) is the same as in Alternative 1.

Monitoring and Maintenance: Monitoring and maintenance requirements are the same as Alternative 1.

Regulatory Closure: Regulatory closure requirements are the same as Alternative 1. A Permanent Solution with Conditions will be achieved in the Remediation Area upon completion of the dredging and capping and the filing of the AUL. A DPS submittal will be prepared to address contamination outside the Remediation Area for which Wynn is not responsible.

6.2.3 Alternative 3 – Partial Dredge, Cap, and MNR

Implementation of Alternative 3 – Partial Dredge, Cap, and MNR includes the dredging and capping of the same intertidal and subtidal areas as Alternative 2 (green and orange areas on **Figure 6-3**). In this alternative, however, the remaining subtidal areas within the Disposal Site boundary (approximately 3.3 acres, tan area on **Figure 6-3**) will be addressed through MNR.

The primary components of Alternative 3 are as follows:

Debris and Barge Removal: Debris and barge removal will be conducted as previously described in Alternative 1.

Dredging: Dredging will be conducted using the same means and methods as Alternative 1. The area to be dredged and volume of sediment removal will be the same as Alternative 2 (26,800 CY of sediment removed from an area of approximately 3.8 acres).

Dewatering, Stabilization and Offload: Dewatering, stabilization and offload will be conducted as described in Alternative 1. The quantity of sediment for off-site reuse or disposal will be the same as Alternative 2 (43,400 tons).

Capping: Capping will be conducted in the same fashion as Alternative 1. The total cap volume is 13,300 CY based on an 18-inch thick layer of clean backfill (plus an anticipated 6-inch allowance to compensate for the over-dredge allowance) placed over an area of 3.8 acres.

Monitoring and Maintenance: In addition to the monitoring and maintenance requirements already described for Alternatives 1 and 2, Alternative 3 includes development of a detailed MNR work plan, a baseline assessment and periodic monitoring and reporting over a 30-year period. The detailed work plan will describe monitoring and sampling locations, methods and frequency as well as establish criteria to be used to evaluate the progress of MNR towards achieving a condition of No Significant Risk. The baseline assessment includes the collection of 20 sediment cores with 10 each from within the Disposal Site and at upgradient "local conditions" locations. Sediment cores will be used for the following purposes:

- High-resolution (up to 40 samples in the top four feet of sediment) analysis of metals, PAHs, phthalates, PCBs, total organic carbon, and grain size to establish baseline concentration profiles.
- Age dating via lead, cesium, and radium methods to quantitatively determine sedimentation rates.
- Sediment toxicity testing (28-day tests for survival, growth, and reproduction using the marine amphipod *Leptocheirus plumulosus*) consistent with previous site toxicity testing.
- Measurement and modelling of sediment erosion properties in the Site cores to determine site-specific sediment stability.

In addition, benthic community surveys will be conducted to document the abundance, diversity, and richness of benthic organisms within the Disposal Site and at the local conditions locations. A detailed report will be prepared to document the results of the baseline sediment characterization study.

MNR monitoring events will be conducted in years 3, 5, 10, 15, 20, 25, and 30 of the program. Events in years three and five allows for three events (including the baseline) to be evaluated during the first five-year Periodic Review. Each monitoring event will include re-sampling of the top six inches of sediment at each of the Site and local conditions locations for high-resolution (assumed 1 cm increment) analysis of metals, PAHs, phthalates, PCBs, total organic carbon, and grain size. The depth and increment of sampling will be determined by the actual sedimentation rates from the baseline monitoring events. In addition, benthic surveys will be conducted to document any changes in abundance, diversity and richness of species at the study locations.

Regulatory Closure: A Permanent Solution with Conditions will be achieved for the dredged and capped areas upon completion of the dredging and capping and the filing of the AUL. A DPS submittal will be prepared to address contamination outside the Remediation Area for which Wynn is not responsible. A ROS Submittal or Temporary Solution will be submitted for the areas where MNR is being employed. Status Reports will be submitted as required and a formal Periodic Review of the Temporary Solution (or ROS) will be performed every five years. If MNR is demonstrated to be effective, then a Permanent Solution will be achieved at some point in the future when exposure to sediments no longer poses a Significant Risk to benthic organisms. If MNR is demonstrated to be ineffective, then additional remedial actions will likely be performed in order to obtain a Permanent Solution.

6.2.4 Alternative 4 – Navigation Dredge, Cap, and MNR

Implementation of Alternative 4 – Navigation Dredge, Cap, and MNR includes the dredging and capping of the navigational dredge area only (orange area on **Figure 6-4**). The remaining intertidal and subtidal areas within the Disposal Site boundary (approximately 5.6 acres, tan area on **Figure 6-4**) will be addressed through MNR.

The primary components of Alternative 4 are as follows:

Debris and Barge Removal: Debris and barge removal will be conducted as previously described in Alternative 1.

Dredging: Dredging will be conducted in the same fashion as Alternative 1. The area to be dredged is approximately 1.4 acres and volume of sediment removal will be 4,500 CY of remedial dredging in addition to the approved 14,700 CY of navigational dredging (for a total of 19,200 CY of sediment).

Dewatering, Stabilization and Offload: Dewatering, stabilization and offload will be conducted as described in Alternative 1. The quantity of sediment for off-site reuse or disposal will be 31,000 tons.

Capping: Capping will be conducted in the same fashion as Alternative 1. The total cap volume is 5,000 CY based on an 18-inch thick layer of clean backfill (plus an anticipated 6-inch allowance to compensate for the over-dredge allowance) placed over an area of 1.4 acres.

Monitoring and Maintenance: Monitoring and maintenance requirements are the same as Alternative 3 except the number of monitoring locations within the Disposal Site will be increased to cover the larger MNR area.

Regulatory Closure: Regulatory closure requirements are the same as Alternative 3. A Permanent Solution with Conditions will be achieved for the dredged and capped areas. A DPS submittal will be prepared to address contamination outside the Remediation Area for which Wynn is not responsible. ROS or a Temporary Solution will apply for the MNR area until such time as it is demonstrated that MNR is (or is not) progressing towards a Permanent Solution. If MNR is determined to be ineffective, then additional remedial actions will likely be performed to achieve a Permanent Solution.

6.2.5 Alternative 5 – No Further Action (Navigation Dredge Only)

As previously stated, Alternative 5 – No Further Action provides a basis for comparison of the other “active” alternatives. This alternative assumes that only the previously permitted navigational dredging and removal of five derelict barges will be completed. No further remedial actions, including capping of exposed sediment or MNR monitoring, will be conducted.

The primary components of Alternative 5 are as follows:

Debris and Barge Removal: Debris and barge removal will be conducted as previously described in Alternative 1.

Dredging: Dredging will be conducted using the same means and methods as Alternative 1. Sediment will be dredged to achieve the previously permitted elevation of -15 NAVD88 in the navigational dredge area (**Figure 6-5**). This will result in the removal of approximately 14,700 CY of sediment within an area of approximately 1.4 acres.

Dewatering, Stabilization and Offload: Dewatering, stabilization and offload will be conducted as described in Alternative 1. The quantity of sediment for off-site reuse or disposal will be 23,800 tons.

Monitoring and Maintenance: Pre-dredging debris and bathymetric surveys, sediment pre-characterization, turbidity monitoring, and confirmation sampling will be conducted as described in Alternative 1. A post-dredging bathymetric survey will be performed to verify that the necessary channel depths have been achieved. Maintenance dredging will be conducted on a periodic basis to ensure that the channel depths required for navigation are maintained.

Regulatory Closure: Alternative 5 will not achieve a Permanent Solution. A Temporary Solution will be filed and Definitive and Enterprising Steps to achieve a Permanent Solution will be taken. Periodic Reviews of the Temporary Solution will be conducted every five years in order to determine if a feasible alternative for achieving a Permanent Solution exists. A DPS submittal will be prepared to address contamination outside the Navigational Dredge Area for which Wynn is not responsible.

6.3 Detailed Evaluation of Remedial Action Alternatives (310 CMR 40.0857)

The purpose of this section is to present the detailed comparative evaluation of the remedial action alternatives that were identified and developed in Section 5.2 against the criteria specified in 310 CMR 40.0858. Alternative 5 (No Further Action) will be retained for comparison purposes for the detailed evaluation although it is recognized that this alternative will not address the remedial action objective (as described in Section 4.2). The remaining four remedial action alternatives are reasonably likely to be feasible because: 1) the technologies to be employed by the alternatives are reasonably likely to achieve a Permanent or Temporary Solution, and 2) individuals with the expertise needed to effectively implement the alternatives will be available.

The Detailed Evaluation provides the basis for selection of a remedial action alternative. The MCP (310 CMR 40.0858) states that a remedial action alternative shall be selected based on the detailed evaluation criteria and should be a Permanent Solution unless its implementation is found to be less cost-effective and timely than a Temporary Solution. A Permanent Solution should, to the extent feasible, reduce the concentrations of OHM to levels that achieve or approach background.

Table 6-2 shows a summary of each alternative analyzed the eight detailed evaluation criteria specified in the MCP: effectiveness, reliability, implementability, cost, risk, benefit, timeliness, and non-pecuniary interests. The table also includes a qualitative ranking (low, moderate, high) of each alternative and a total “score” based on the sum of those rankings. The following discussion is a summary of the evaluation presented in **Table 6-2**. As such, the focus of this discussion is

key elements that cause the criteria to be ranked differently, as opposed to a detailed discussion of each criteria and alternative.

6.3.1 Effectiveness

The comparative effectiveness of the remedial action alternative is evaluated in terms of:

- Achieving a Permanent or Temporary Solution
- Reusing, recycling, destroying, detoxifying or treating OHM; and
- Achieving or approaching background concentrations.

Alternative 1 has a high effectiveness rating as a Permanent Solution will be achieved across the area posing a Significant Risk by physically removing contaminated sediment from the Site. This will also achieve background concentrations in the dredged and capped areas. Alternatives 2, 3, and 4 have progressively lower ratings for effectiveness primarily due to the lower amounts of OHM being removed from the Site. Alternative 2 is rated as high to moderate as both the dredged/capped area and the capped area will achieve background concentrations. Alternatives 3 and 4 are rated as moderate and moderate to low (respectively) as background concentrations may be approached over time in the MNR areas. Alternative 5 (No Further Action) has a low effectiveness rating as it will not achieve a Permanent Solution and has the lowest removal of OHM. As with Alternatives 3 and 4, “local conditions” rather than background will likely be approached or achieved over an extended period of time.

6.3.2 Reliability

The comparative short and long term reliability of the alternatives is evaluated in terms of:

- The degree of certainty that the alternative will be successful; and
- The effectiveness of any measures required to manage residues or remaining wastes or control emissions or discharges to the environment.

Alternatives 1 and 2 have high reliability rating as dredging and capping are both presumptive remedies for contaminated sediments and have a high certainty of success. Residual contaminated sediment in the embayment will be isolated beneath a clean cap which has a high degree of reliability. The use an environmental bucket, turbidity curtains, and good work practices will control inadvertent discharges to the environment during dredging, capping, and off-site processing of sediment. Alternative 3 has a moderate reliability rating primarily due to 1) the uncertainty associated with the use of MNR to achieve a Permanent Solution and 2) the potential for impacted sediment in the MNR areas to be mobilized. Similarly, Alternative 4 is rated as moderate to low due to the larger MNR footprint and correspondingly lower degree of certainty and increased potential for issues arising from residual sediment. Alternative 5 has the lowest rating as navigational dredging alone will not achieve a Permanent Solution and will expose more contaminated sediment which could then become mobile.

6.3.3 Implementability

The comparative difficulty in implementation of the alternatives in terms of:

- Technical complexity;

- Integration and disruption of facility operations and other current or potential remedial actions;
- Monitoring, operations and maintenance requirements or Disposal Site access requirements or limitations;
- Availability of necessary services, materials, equipment or specialists;
- Availability, capacity and location of necessary off-site treatment, storage and disposal facilities; and
- Whether the alternative meets regulatory requirements for any likely approvals, permits, or licenses.

The degree of technical complexity for the proposed alternatives is primarily related to the extent of the area to be dredged and/or capped. The larger the dredging footprint the more difficult managing materials, equipment, tidal fluctuations and existing bathymetry will be. Extensive planning and preparation will be necessary for successful dredging (particularly in the intertidal), dewatering, transporting and offloading dredged material, and placing the cap.

Integration or disruption of facility operations is not a factor for any of the alternatives as no landside access or staging will be allowed. All materials and equipment will be brought into the work area by barge from off-site docking and transfer facilities.

Operation, maintenance and monitoring (OMM) requirements to ensure the stability of the cap in Alternatives 1 and 2 are moderate and the same for each alternative as the extent of the cap is the same. Alternative 3 has comparable amount of OMM as there are some trade-offs between a smaller cap area and a more complex monitoring plan for MNR. Alternative 4 has higher OMM requirements than Alternatives 1 through 4 due to the large MNR area.

The availability of services, materials, equipment, specialists and off-site facilities is generally good and does not vary much by alternative. However, the quantity of dredging and capping may affect the overall availability and capacity of these items. Therefore, Alternative 5, which has the lowest dredge quantity, is the least likely to be constrained by limitations on services, materials, equipment, specialists and off-site facilities.

Multiple permits from the US Army Corps of Engineers (USACE), multiple MassDEP branches, and the Boston and Everett Conservation Commissions will be required to implement Alternatives 1 through 4. Each of the alternatives is expected to meet the requirements established by each of those agencies for dredging and capping. MNR will face scrutiny from MassDEP Bureau of Waste Site Cleanup and may not meet with full approval even with a robust monitoring plan. The navigational dredging necessary for Alternative 5 has already been permitted and no additional approvals are required.

Based on the combination of factors discussed above, Alternative 1 has the lowest implementability rating (most difficult to implement) while Alternative 5 has the highest rating (easiest to implement).

6.3.4 Costs

The comparative costs of the alternatives are evaluated in terms of:

- Implementing the alternative, including without limitation: design, construction, equipment, Disposal Site preparation, labor, permits, disposal, operation, maintenance and monitoring costs
- Costs of environmental restoration, potential damages to natural resources, including consideration of impacts to surface waters, wetlands, wildlife, fish and shellfish habitat; and
- Relative consumption of energy resources in the operation of the alternatives and externalities associated with the use of those resources.

Conceptual-level cost estimates developed for each of the remedial action alternatives are included in **Appendix A**. The estimates include capital costs related to materials, labor, laboratory analysis, oversight, and reporting, as appropriate. The cost estimates have been developed at a +50/-30 percent level of accuracy, consistent with USEPA guidance for conceptual design/feasibility study level cost estimates (USEPA, 2000). Estimated construction, cap OMM[8] and MNR costs (rounded to the nearest $10,000) for each of the remedial alternatives are summarized in **Table 6-4** below.

Table 6-4: Estimated Construction, OMM, and MNR Cost

Remedial Alternative	Estimated Construction Cost	Estimated Cap OMM Cost	Estimated MNR Cost	Estimated Total Cost
Alternative 1 Full Dredge and Cap	$19,110,000	$1,120,000	$0	$20,230,000
Alternative 2 Partial Dredge and Cap	$14,670,000	$1,120,000	$0	$15,790,000
Alternative 3 Partial Dredge, Cap, and MNR	$13,560,000	$600,000	$2,250,000	$16,410,000
Alternative 4 Navigation Dredge, Cap, and MNR	$9,540,000	$220,000	$3,880,000	$13,640,000
Alternative 5 No Further Action	$7,260,000	$0	$0	$7,260,000

Note: Estimated costs include 20% contingency for construction, cap OMM, and MNR.

Alternative 1 has the highest cost rating (lowest score) due to its high total cost and consumption of energy during dredging, capping, processing and transporting of sediment. Alternatives 2 and 3 have both been given moderate cost ratings. Alternative 2 has a lower total cost and energy consumption than Alternative 1 due to the reduced dredging footprint. Both Alternatives 1 and 2 result in the same immediate net restoration of natural resources. Alternative 3 has a higher total

[8] Costs for maintenance dredging are not included as those are operational costs which are not anticipated to vary based on the alternative selected.

cost than Alternative 2; however, the inclusion of MNR significantly reduces the overall energy consumption of this alternative. MNR also delays the restoration of natural resource areas relative to dredging and capping. The larger MNR area (and reduced dredging and capping) results in lower total cost and lower energy consumption. Alternative 5 has the lowest total cost and lowest energy consumption; however, it will not restore natural resources.

6.3.5 Risks

The risks of the alternatives are evaluated in terms of:

- The short and long term risks to health, safety, public welfare, and the environment associated with the implementation and OMM of the alternative; and
- Potential risks to health, safety, public welfare and the environment associated with the residual remaining on the Site after the alternative is implemented.

The implementation of Alternatives 1, 2, and 3 would pose moderate short-term risks to construction workers associated with the use of heavy equipment during dredging and capping. Alternatives 4 and 5 pose lower risks during implementation due to the significantly smaller quantities of dredging. Each of the alternatives pose a moderate risk to the public welfare and environment during dredging, transport, and reuse or disposal of the dredged sediments.

Alternatives 1 and 2 are similar in that they both rely on immediate physical removal (dredging) and isolation (capping) to reduce sediment concentrations to below risk limits. As a result, there is no risk associated with the residuals left on the Site after the alternatives are implemented. Alternatives 3 and 4 have low to moderate risks to environmental receptors during the time required to achieve the remedial objective via MNR. Alternative 5 poses a high risk to the environment as the navigational dredging will expose more heavily contaminated sediment which is currently out of the zone where benthic organisms might be present.

Based on the combination of factors outlined above, Alternatives 1 and 2 represent low to moderate risks, Alternative 3 poses a moderate risk, and Alternative 4 is a moderate to high risk, and Alternative 5 is a high risk.

6.3.6 Benefits

The benefits of the remedial action alternatives are evaluated in terms of:

- Restoring natural resources;
- Providing for the productive reuse of the Disposal Site;
- Avoiding costs of relocating people, businesses, or providing alternative water supplies; and
- Avoiding lost value of the Disposal Site.

Alternatives 1 and 2 provide the highest benefits with regards to mass removal, achievement of the remedial objective, restoration of natural resources and allowing for re-use of property in timely manner. Dredging and capping will remove (or isolate) significant volumes of contaminated sediment and immediately provide improved habitat for benthic organisms. Quick achievement of a Permanent Solution through dredging and capping will minimize any potential loss in value. Alternatives and 4 have slightly lower ratings as MNR will require more time (potentially 30 years)

to restore natural resources and achieve a Permanent Solution. There may also be a potential loss in value during the extended period of time required to achieve a Permanent Solution. Alternative 5 has the lowest rating as it will not directly restore natural resources (natural sedimentation will still occur over time) and the lack of a Permanent Solution will cause a loss in value in the event Wynn seeks to sell the property.

6.3.7 Timeliness

The comparative timeliness of the alternatives are evaluated in terms of eliminating any uncontrolled sources of oil and/or hazardous material and achieving of a level of No Significant Risk. There are no uncontrolled sources ate the Site; therefore, this evaluation focuses on achievement of a condition of No Significant Risk.

Alternatives 1 and 2 will both achieve a condition of No Significant Risk upon completion of the dredging and capping which is anticipated to be completed in only a matter of months. Therefore, this alternatives have been rated high for timeliness. Alternatives 3 and 4 will require an extended period of time (potentially up to 30 years) to achieve a condition of No Significant Risk for the entire area posing a risk. This long time-frame is due to the time required for additional sediment to accumulate and bury the contaminated sediment in the MNR areas. Therefore, this alternatives have been rated as moderate. Alternative 5 will not achieve a condition of No Significant Risk and so has been rated low.

6.3.8 Non-Pecuniary Interests

The alternatives are evaluated in terms of relative effects upon non-pecuniary interests, such as aesthetic values, nuisance odors and disruption to public access.

Alternative 1 will have moderate effects on non-pecuniary interests. Aesthetic values will immediately be improved following dredging and capping. However, there may be some nuisance odors during dredging and access to the embayment will be limited during remediation. Alternative 2 is rated slightly higher (moderate to high) due to the decreased likelihood of nuisance odors (less dredged material) and shorter duration of access limitations. Alternatives 3 and 4 are also rated as moderate as the positive effects from less dredging compared to Alternative 1 are offset by decreased (or at least delayed) aesthetic improvements in the MNR areas. Alternative 5 has the lowest rating with respect to non-pecuniary interests as the lack of aesthetic improvements outweigh the positive effects of minimal dredging and access limitations.

6.4 Selection of the Remedial Action Alternative (310 CMR 40.08590

The last line of **Table 6-3** shows a total ranking for each alternative based on the sum of the individual rankings for each of the eight criteria. Of the standard criteria for remedial option screening, the three primary drivers for this Site are effectiveness, cost, and timeliness.

Alternative 1 (Full Dredge and Cap) ranks highest for effectiveness, reliability, benefits, and timeliness. However, it also ranks lowest for cost and implementability and for those reasons it has not been selected. Alternative 2 (Partial Dredge and Cap) ranks just as highly as Alternative 1 on reliability, benefits and timeliness and better than Alternative 1 for cost and implementability

giving it the highest total ranking. Concerns about the acceptance of MNR as an approach and the extended time period likely needed to achieve a Permanent Solution resulted in Alternatives 3 and 4 not being selected.

Therefore, Alternative 2 has been selected as the proposed remedial action alternative for the sediment portion of the Former Everett Staging Yard Disposal Site. The Partial Dredge and Cap alternative consists of the demolition of the barges, navigational dredging, remedial dredging of the navigational dredge area and intertidal areas, capping the dredged areas, and capping the subtidal portions of the channel. This remedial alternative represents the best combination of time to achieve a Permanent Solution, certainty of success (i.e. achieving a Permanent Solution), reliability, and capital cost.

7.0 FEASIBILITY EVALUATIONS (310 CMR 40.0860)

Under certain conditions, the MCP (310 CMR 40.0860) requires an evaluation of the feasibility of:

- Implementing a Permanent Solution;
- Reducing the concentrations of oil and hazardous material in the environment to levels that achieve or approach background;
- Reducing the concentrations of oil and hazardous material in soil at a disposal site to levels at or below applicable soil Upper Concentrations Limits; and
- Eliminating, preventing or mitigating Critical Exposure Pathway(s).

Because the selected remedial action alternative, Partial Dredge and Cap (Alternative 2) is expected to result in a Permanent Solution, soil is not a media of concern for this portion of the Site, and there are no Critical Exposure Pathways, only the feasibility of reducing concentrations of OHM in the environment to levels that achieve or approach background is required.

The MCP at 310 CMR 40.0006 defines background concentrations as "levels of oil and hazardous material that would exist in the absence of the disposal site of concern, including both Natural Background and Anthropogenic Background." Natural Background reflects concentrations "that would exist in the absence of the disposal site of concern, are ubiquitous and consistently present in the environment at and in the vicinity of the disposal site of concern, and are attributable to geologic or ecological conditions." Anthropogenic Background includes atmospheric deposition of industrial process or vehicle emissions, Historic Fill, and petroleum residues incidental to the normal operation of motor vehicles.

MassDEP has not published background concentrations for sediment which can be used for direct comparison. However, they have established naturally occurring levels of metals and PAHs in soil, and background concentrations of metals and PAHs in sediment would not be expected to be any lower than background concentrations in natural soil.

The selected alternative, Partial Dredge and Cap, will reduce the concentrations of OHM in sediment to background in the areas that are dredged and capped as the clean backfill material used in the cap is presumed to be equivalent to background. Concentrations in the small area of sediment outside the Remediation Area but within the Disposal Site boundary will exceed background. A condition of No Significant Risk with respect to Disposal Site contaminants exists in this area as concentrations are below ecological benchmarks. Therefore, no remedial actions are required to achieve No Significant Risk for Disposal Site contaminants. Remedial actions to achieve or approach background are therefore infeasible as the cost of any such actions (dredging and/or capping) are more than 20 percent of the cost of achieving a condition of No Significant Risk (Section 9.3.3.4 of MassDEP Policy #04-160). Therefore, the cost far outweighs the incremental benefit in risk reduction. In addition, remedial actions to achieve or approach background would disturb approximately 20,000 SF of intertidal habitat which exceeds the 5,000 SF threshold in Section 3.0 of MassDEP Policy #04-160.

It is important to note that the local conditions concept for sediments is not the same as the MCP definition of background. Local conditions acknowledges that sediments in certain water bodies, particularly those located in industrial urban areas, contain constituents from sources such as other disposal sites, permitted discharges, and non-point sources. In the case of the Mystic River

and this Site, the established local conditions concentrations chemicals are significantly elevated, which means that sediments entering the Site from the surrounding area will likely exceed background.

8.0 ENGINEERING DESIGN (310 CMR 40.0874(3)(b))

This section documents the engineering concepts and design criteria used for the design of the final Comprehensive Remedial Action. The remedy described in this section is based on, but is not identical to, Alternative 2 – Partial Dredge and Cap described in Section 6 of this report. The final remedy described in this section reflects the ongoing construction at the property, the results of additional information collected following completion of the feasibility study and other refinements to increase constructability, reduce cost, and ensure the long-term stability of the proposed cap. Therefore, the areas and quantities referenced within this section are slightly different than those presented for conceptual remedy in Section 6.

The relevant items listed under 310 CMR 40.0874(3)(b) are addressed in this section, including:

- goals of the remedial action;
- any significant changes in or new information that affects the design;
- any significant changes in design or new information;
- Site maps showing existing features and proposed locations of activities;
- characteristics, quantity and location of environmental media or materials to be treated or otherwise managed;
- conceptual plan of the activities, treatment units, facilities and processes to be used;
- relevant design and operating parameters;
- design features for control of spills and accidental discharge or system malfunction;
- methods for management or disposal of any treatment residual, contaminated soils, and other waste materials;
- Site-specific characteristics, which may be affected by the remedial action;
- measures to avoid any deleterious impact on environmental receptors and natural resource areas; and
- Inspections and monitoring, which will be performed to ensure adequate construction and performance.

Performance standards are based on applicable requirements contained in the MCP, related guidance and policy issued by the MassDEP, and other relevant regulations, guidance and policy referenced in the MCP. The overriding objective of the performance standards is conformance with the Response Action Performance Standard (RAPS, 310 CMR 40.0191) in the MCP.

Design standards are based on applicable standards of engineering design generally accepted by the profession, materials and product standards and minimum design standards in related regulations, policy and guidance.

8.1 Site-Specific Remedial Action Goals

The overall goal of the selected remedial action alternative is to achieve a Permanent Solution for the sediment portion of the Site. This will be accomplished by eliminating significant risk to benthic

organisms associated with exposure to contaminated sediment at concentrations which exceed benchmarks or local conditions.

Sediment remediation will be accomplished through the dredging and capping or capping of contaminated sediments. Dredged materials will be transported off-site for reuse or disposal. These remedial actions will address sediment contamination associated with Site-related metal contamination (arsenic, lead, mercury and vanadium) as well as non-Site contamination (other metals, petroleum hydrocarbons, PAHs, and PCBs).

Successful implementation and completion of the remedial action will be achieved when a clean surficial sediment layer (within the top 18 inches) is present across the area which poses a significant risk. Post-remediation monitoring (primarily topographic and bathymetric surveys) will be used to assess the stability of the cap following completion of cap placement. A Permanent Solution with Conditions will be achieved following the implementation of an AUL to memorialize the limits of the capped area and post-construction operation, maintenance and monitoring requirements.

8.2 Significant Changes or New Information Related to Disposal Site Conditions

A geotechnical investigation and evaluation was required for final design of the sediment remediation to confirm the applicability of the capping system, the structural integrity of the deeper sediments, and structural stability of the bulkhead during and after dredging and cap installation. In order to evaluate the strength of the sediments, a total of 14 sediment cores were collected for geotechnical testing (field and lab).

The following core depths were collected:

- 3 cores to 3 feet below the sediment surface (GZ-114, GZ-119, and GZ-134)
- 5 cores to 20 feet below the sediment surface (GZ-2, GZ-6, GZ-12, GZ-17, and GZ-108)
- 6 cores to 5 feet below the sediment surface (GZ-122, GZ-129, GZ-205, GZ-211, GZ-215 and GZ-226)

These locations are shown in the geotechnical design memo included in **Appendix B**.

Sediment cores were collected by TG&B Marine Services, Inc. (TG&B) of Bourne, MA. Sediment samples were collected using a vibracore sampler mounted on a boat outfitted with a GPS unit. The boat navigated to the predetermined locations shown in Figure 2 for sample collection. A three-inch outer diameter steel sampler was loaded with a dedicated hard plastic or polycarbonate liner and fitted with a driving shoe. The sampler was then advanced from the sediment surface to the desired depth using either the weight of the corer or the vibration from the vibracore head causing the sediment sample to fill the liner. Undisturbed sample cores were delivered to AMEC for visual characterization and sample collection. Samples were characterized using the Modified Burmeister Classification System with Unified Soil Classification System (USCS) codes assigned to each distinct stratigraphic unit. Field shear strength testing by ASTM D4648 using a calibrated mini-vane device was then performed on undisturbed cores.

Select portions of four of the cores were sent for laboratory testing including index testing and consolidation:

- Incremental Consolidation (method B) – ASTM D2435

- Density (Unit Weight) – ASTM D2937
- Moisture Content – ASTM D2216
- Specific Gravity – ASTM D854
- Atterberg Limits – ASTM D4318
- Grain Size Analysis with Hydrometer – ASTM D422

Geotechnical analyses described in **Appendix B** include bearing capacity, consolidation and sediment cap mixing. Based on these analyses and the design cap materials, the bearing capacity and anticipated settlement from consolidation of the soft cap subgrade sediments should not damage the cap or cause significant sloughing during construction or after the cap has been constructed. Based on the sediment-cap mixing calculations, it is estimated that approximately 2 inches of material (or more) may mix into the soft sediments in the main channel, 4 to 6 inches in the Navigational Dredge Area and minimal (<1 inch) mixing will occur in the tidal flats.

The design incorporates limitations on the thickness of cap layers which can be placed at any one time to reduce mixing. Placing large quantities of material at one time will not be allowed. The performance objective for the capping is the achievement of an 18-inch thick clean zone, excluding any mixing which may occur. As described in more detail in subsequent sections and the specifications, cap thickness will be determined by pre- and post-capping surveys with verification by cores, pans, or other methods if necessary.

8.3 Site Maps Showing Existing Features and Proposed Locations of Activities

Existing Site features including the limit of work, demolition, dredge/cap and cap areas, and previously completed shoreline features are shown on the Construction Drawings included in **Appendix C**. Existing site features are shown on Drawing C-101. The demolition work is shown on Drawing C-102. The location of the proposed remedial action including dredging and capping and environmental controls are shown on Drawings C-103 and C-104. Cross sections showing the proposed depths of dredging and final surface elevations are shown on Drawings C-105 and C-106. Construction related details are included on Drawings C-501 and C-502.

8.4 Environmental Media to be Treated/Managed

Environmental media to be treated and/or managed as part of the remedy include contaminated sediment within the intertidal and subtidal portions of an embayment of the Mystic River and water which drains from the sediment following dredging (effluent).

The dredged sediment will be transferred into a hopper barge or scow. The rubber seals and overlapping sides of the environmental dredge bucket will minimize the quantity of sediment that will flow into the water column when the dredged sediment is conveyed into the accompanying collection barge or scow. Once the material is loaded into the receiving vessel, the contractor will have the option to decant water at the Site or to decant the effluent once the material has reached the contractor's offloading facility.

It is anticipated that the contractor will decant the free water from the sediment in the scow within a turbidity curtain within the limit of work. Scows typically have a sump pit in the corner to facilitate

decanting/dewatering of sediment. Depending on the scow size and set-up, decant water will be pumped from the sump through a geotextile liner placed in the scow, or using a screened suction hose to minimize passing of solids.

Effluent will be tested for turbidity using a portable multiparameter water quality meter (such as an YSI 6920). Should turbidity field results exceed the background (upstream) sample by a predetermined action level, then the effluent decanted into the settling tank/holding barge will be subjected to longer settling times or run through a filter fabric screen into a secondary settling tank as needed, and tested again, prior to discharge.

8.5 Conceptual Plan of Activities, Treatment Units, Facilities, and Processes

The conceptual plan for the selected remedial action alternative, Alternative 2 - Partial Dredge and Cap, includes:

- Barge demolition and debris removal,
- Dredging,
- Dewatering, stabilization and off-load of dredged material,
- Capping,
- Monitoring and maintenance, and
- Regulatory closure.

The following sections describe the refined design of Alternative 2 as outlined in Section 5.2.2 as selected to address the areas, media, and constituents of concern identified in Section 3.

8.6 Relevant Design and Operating Parameters

The MCP requires that the following information be included in the RIP:

- Design criteria, assumptions and calculations;
- Expected treatment, destruction, immobilization or containment efficiencies and documentation of how that degree of effectiveness was determined; and
- Demonstration that the selected remedial action alternative will achieve the identified remedial goals.

The following sections discuss the relevant design and operating parameters for the major components of the proposed remedy.

8.6.1 Barge Demolition and Debris Management

Barge demolition and debris removal are required for construction but are not in and of themselves remedial actions.

Debris from the barge demolition is likely to include asphalt, brick, and concrete (ABC), granite blocks, sheet metal and wood. Barge demolition may also include asbestos containing material (ACM). All demolition debris will be segregated and directly loaded into barges or trucks and transported to an off-site facility for proper recycling or disposal.

Any solid material identified within the dredge area that does not pass through a grid opening of 24 inches by 24 inches square will also be considered debris. Anticipated debris encountered during dredging may include, but not be limited to: timber piles, granite blocks, concrete, brick, plastics, tires, wire/cable/chain, sheet metal, anchors, wood debris, and other miscellaneous materials.

Debris that is removed from the dredge area will be decontaminated on a barge located within the limits of work and will then be transported to an off-Site location for off-loading and transportation to a disposal facility. Decontamination water will be collected and treated as described in Section 7.6.3.

Debris from the barge demolition and encountered during dredging will be segregated into categories such as non-impacted ABC; non-hazardous waste landfill material (e.g., impacted ABC, impacted PPE, used adsorptive pads, booms, and other containment materials and equipment, used polyethylene sheeting, and spent particulate media filters); solid waste landfill material (e.g., general refuse, trash, unstained/untreated wood waste); metals; treated wood waste; and ACM. The anticipated quantities of debris to be removed from the Site have not been calculated as the barges are unsafe for inspection. Prior to mobilization for demolition, the contractor shall perform a pre-demolition survey of the barges as well as conduct a debris survey of the dredge area to quantify the potential amount of debris to be removed from the Site.

8.6.2 Sediment Dredging

Mechanical dredging is proposed for the portion of the Remediation Area to be dredged. Proposed dredge depths are anticipated to be approximately 18 inches below the existing mudline or the previously permitted navigation dredge elevation of -15 NAVD88 with an anticipated overdredge allowance of up to six inches.

Sediment will be dredged using an excavator or crane equipped with an environmental clam shell bucket. The bucket will be lowered through the water column to the bottom. The bucket will close around the bottom sediment and the operator will be notified by a signal that the bucket is sealed. If the bucket does not seal, then the operator will investigate for obstructions and take appropriate action to allow the bucket to seal before raising it through the water column. This type of operation will result in a reduction in the amount of turbidity during construction as compared to a standard bucket. The dredged material will be transferred into a hopper barge or scow.

The area proposed for dredging is separated into two distinct dredge areas:

- Dredge (elevation based) – proposed dredge to elevation -16.5 NAVD88
- Dredge (depth based) – proposed dredge to 1.5 feet below existing mudline

These two dredge areas equal approximately 4.3 acres (2.2 acres in the main part of the embayment and 2.1 acres in the intertidal area). Note that the total area to be dredged has differs from that in Alternative 2 – Partial Dredge and Cap (described in Section 6 of this report) by 1) squaring off the dredging area to be more constructable and 2) excluding additional portions of the Remediation Area which are being addressed from land.

In the elevation based dredge area, sediment will be removed to elevation -16.5 NAVD88 to allow for sufficient depth for navigational purposes after capping (approximately 16,530 CY). This

includes targeted dredging of up to 12 inches in certain areas of the deeper channel to achieve a final capped elevation of -15 NAVD88. In the depth based dredge area, remedial dredging will generally be performed to a depth of 18 inches below existing mudline (approximately 7,580 CY). Including a six-inch overdredge allowance the total estimated dredge volume to be removed is 27,540 CY. Material quantities for the total projected dredge volume are summarized in **Table 8-1**.

Table 8-1: Estimated Sediment Dredging Volume

Dredge Area	Neatline Dredge (CY)	6-Inch Overdredge (CY)
Elevation Based Dredge (Elevation -16.5 NAV88)	16,530	1,335
Depth Based Dredge (1.5 feet below mudline)	7,580	2,090
Total Dredge	24,110	3,425
Total with Overdredge		27,540

The dredging rate has been estimated at 300 CY/day using a 2 CY environmental bucket. Removal of 27,540 CY at 300 CY/day assuming a 12 hour shift will require approximately 92 working days for sediment removal. Additional project time will be required for mobilization, demolition, capping and demobilization.

8.6.3 Sediment Dewatering, Stabilization and Offload

As described above, the dredged sediment will be transferred into a hopper barge or scow. Once the material is loaded into the receiving vessel, the contractor will have the option to decant water within the limit of work or to decant the effluent once the material has reached the contractor's offloading facility. It is anticipated that the contractor will decant the free water from the sediment in the scow within a turbidity curtain within the limit of work. Depending on the scow size and set-up, decant water will be pumped from the internal scow sump through a geotextile liner placed in the scow, or using a screened suction hose to minimize passing of solids.

It is anticipated that the dewatered sediment will be transported to a local processing and receiving facility. An 8% Portland cement addition is proposed for additional dewatering at the processing facility to allow the sediment to meet the processing facilities requirements to be off-loaded and acceptable for transportation and disposal.

The amended sediment will be off-loaded from the scow at a rate sufficient to maintain the production requirements and the approved project schedule. A drip apron will be utilized during the off-loading process to prevent sediment from entering the surrounding water. The Contractor will manage construction water from the dredged material dewatering process; runoff collected from the drip apron and sediment transport scows; and water from other water-generating activities conducted. This water will be collected, treated, and discharged in accordance with all permits and specifications.

8.6.4 Capping

Once dredging has been completed, clean cap materials will be placed to restore the dredged areas to pre-construction elevations or the previously permitted elevation -15 NAVD88. In the portion to be capped only, 18 inches of clean cap material will be placed directly on the underlying sediment. The primary function of the cap material is to provide a clean substrate suitable as habitat for benthic organisms.

Sand is anticipated to be the primary component of the cap throughout. However, the specific nature of the material to be placed is influenced by the physical location of the cap and regulatory requirements covering those areas. The Remediation Area has been broken into three distinct capping areas/types:

- Navigation Subtidal Cap – a 2-layer cap composed of a layer of coarse sand capped with a medium gravel material to resist propeller induced erosion (see propeller wash technical memo in **Appendix B**).
- Subtidal Cap – capped with a coarse sand material for stability and to resist propeller induced erosion in the channel.
- Intertidal Cap – capped with a silty sand to match existing material.

The total capping area is approximately 7.26 acres (5.17 acres in the main part of the embayment and 2.09 acres in the intertidal area). As with the dredging area, the total capping area differs from that that in Alternative 2 – Partial Dredge and Cap (described in Section 6 of this report) by 1) squaring off the area to be more constructable and 2) excluding a portion of the Remediation Area which is being addressed from land. The cap in the Navigation Dredge Area will be composed of medium gravel and sand (approximately 2,770 CY total). In the other subtidal areas, the cap material will be coarse sand (approximately 9,665 CY). For cap placement within the intertidal areas, 1.5 feet of silty sand material (6,735 CY) will be placed to restore the existing tidal mud flats to original condition. The cap quantities above do not include an overplacement allowance of two inches. Including the overplacement allowance, the total cap volume is approximately 21,120 CY. The quantities for the total projected cap volume are summarized in **Table 8-2**.

Table 8-2: Estimated Sediment Capping Volume

Cap Areas	1.5 Foot Cap (CY)	-+2-Inch Overplacement (CY)
Navigation Subtidal Cap	2,770	310
Subtidal Cap	9,665	1,080
Intertidal Cap	6,735	560
Total	19,170	1,950
Total with Over-placement		21,120

Adjacent to the existing BWSC outfall in the southern corner of the tidal flats, a stone outlet protection structure will be installed to protect the installed cap from erosion. Based on the

dimension of the pipe, assumed slope, and calculated discharge velocity, the stone outlet protection is proposed to be 34 feet long and 15 feet wide at its widest point. A geotextile filter fabric will be placed in this portion of the dredge area to prevent migration of the fine soil particles through voids in the armor stone and distribute the weight of the stone to prevent settlement of the stone into the underlying sediments. The median stone size will be 8-inch diameter (50% of the stone will be greater than 8-inches) to be placed at an average thickness of two feet. The total volume of stone is estimated to be approximately 20 CY.

There are several viable methods for placing the cap in the subtidal and intertidal areas. The means and methods to be used will be identified by the contractor once the job is bid and contracted. However, potential methods for placement of the cap are discussed below.

One method for placing the cap in the subtidal areas consists of essentially reversing the dredge operation, using the same equipment as was used during the dredging operations. The equipment would be decontaminated after the completion of dredging operations. The silty sand, coarse sand, gravel, or other material would be imported, likely on a material barge from the transfer facility. The material barge would then be maneuvered to the capping location. When the material barge is tied off to the work barge, the excavator or crane would lower the environmental bucket to the required depth and slowly spreads the sand over the previously dredged area. Use of tremie pipe to direct material from a floating barge through the water column or thin-layer placement through the water column (by way of measured placement at the water surface which is allowed to settle through the water column) may also be employed.

In the intertidal, the cap material will be slowly placed into the surveyed excavation in lifts and graded to the design thickness. In the event that backfilling activities cannot be completed during one low tide period, the leading dredge face (excavation face) may be covered with a temporary plastic membrane and secured with sandbags/backfill material until the next tidal cycle that permits work to resume.

8.6.5 Demonstration of Achievement of Remedial Goals

The initial limits of proposed sediment dredging and capping are defined within the Revised Phase II Report (AMEC 2014b). The limits of dredging and capping as defined in this Phase III RAP/Phase IV RIP follow those initial limits of impacts and have been redefined for constructability purposes.

As previously noted, the performance objective for is the achievement of an 18-inch thick clean zone, excluding any mixing which may occur. Bathymetric surveys and sediment coring will be used to verify the in-place cap thickness to determine the final vertical elevation of capping material placed. The horizontal and vertical limits will be surveyed by the Contractor prior to the start of work for comparison and demonstration that the remedial goals are achieved. Monitoring of the stability of the cap is discussed in detail in the OMM Plan in **Appendix E**.

8.7 Design Features for Control of Spills/Discharges

Monitoring will be conducted throughout the work to document compliance with criteria established by the bid specifications, including acceptable VOC and dust levels described in Specification Section 01 35 43 – Environmental Procedures. In addition, in-water turbidity monitoring will be conducted for compliance with the requirements of the Water Quality Certificate

and Specification Section 01 57 30 – Marine Resuspension Control. A Waste Management Plan (WMP), and Environmental Control Plan (ECP) will be prepared by the contractor prior to construction and will be implemented during remediation activities.

Actions to control, minimize, and/or eliminate the risk of an accidental spill or discharge of oil, hazardous or sediment materials have been incorporated into the Specifications, and include the following:

- The stand-alone permeable turbidity curtain with flotation collar or equivalent with reefing lines and billow controls as shown on the 60% Issued for Permitting package of Drawings (Drawings) in **Appendix C** and described in the 60% Issued for Permitting package of the Specifications (Specifications) in **Appendix D**.
- A secondary oil containment boom as described in the Specifications.
- Sorbent booms and pads as described in the Specifications.

8.8 Management/Disposal of Treatment Residuals, Contaminated Soils and Other Waste Materials

A pre-characterization sampling program may be implemented by Wynn or the selected contractor within the proposed dredge areas to characterize and profile the dredged material prior to processing, transportation and off-site recycling or disposal. If not pre-characterized, dredged and dewatered/stabilized sediments will be sampled in barges or in stockpiles to determine the appropriate facility for disposal. Waste characterization samples will be collected in-situ based on the total volume of impacted sediments and requirements established by the waste disposal facilities. The following parameters will be tested for at an anticipated frequency of one sample per 500 tons of sediment:

- MCP 14 metals by USEPA Method 6020A/7471B
- Total VOCs by USEPA Method 8260C;
- Total SVOCs (including pyridine) by USEPA Method 8270;
- Total PCBs by USEPA Method 8082A;
- Total pesticides/herbicides (including toxaphene) by USEPA Methods 8081A/8151A;
- Total Petroleum Hydrocarbons by USEPA Method 815C;
- Toxicity Characteristic Leaching Procedure (TCLP) for metals, VOCs, SVOCs and pesticides/herbicides;
- Specific Conductance by USEPA Method 9050;
- Reactive Cyanide/Sulfide by USEPA Method 7.3;
- Corrosivity (pH) by USEPA Method 9045; and
- Ignitability by USEPA Method 1030.

The characterization waste results will be reported in ether a Phase IV Status Report or the Phase IV Final Inspection Report, along with the total volume of sediment transported for off-site recycling and disposal.

Sediment that meets criteria defining a listed hazardous waste or is a characteristic hazardous waste will be transported off-site for disposal using a Uniform Hazardous Waste Manifest. Sediment that is not classified as a hazardous or characteristic waste will be managed using the MassDEP Bill of Lading (BOL) process for contaminated media. The BOL includes the Licensed Site Professional (LSP) Opinion rendered in accordance with 310 CMR 40.0030.

The contractor will also be required to manage construction water from the dredged material dewatering process; runoff collected from the drip apron and sediment transport scows; and water from other water-generating activities conducted. This water will be collected, treated, and discharged in accordance with all permits and specifications and as discussed in Section 7.6.3 above.

8.9 Disposal Site Characteristics Affected by the Proposed Construction

8.9.1 Existing Site Activities or Operations

Currently there are no active operations in the sediment remediation area of the waterway. The upland portions of the Site are very active, however access is restricted for this sediment remediation work and shall not interfere.

8.9.2 Natural Resource Areas, Local Planning and Development Issues

The remediation efforts will result in removal of impacted sediment from the proposed dredge areas and replacement with a clean cap material within both the dredging and capping portions of the Site. The capping material will generally create a restored habitat for benthic organisms.

8.9.2.1 Short Term Impacts to Local Infrastructure

The primary short-term impact to local infrastructure is associated with the transport of equipment and materials to and from the Site. As described earlier, the upland portions of the Site are generally not accessible for the remediation. Therefore the shipment of the majority of equipment and waste via barge instead of by land will greatly reduce anticipated impacts to local roadways during the project. There may be some limited impacts during the barge removals which may be conducted from land. With the majority of the construction access by water, the project will have short-term impacts on waterways associated with dredging and capping activities and the concurrent barge or scow transportation of dredged sediments and cap materials.

8.9.2.2 Long Term Impacts to Local Infrastructure

The long-term impacts to natural resource areas and local infrastructure are anticipated to be positive. Currently, the Site has five abandoned barges and impacts to the sediment restricting benthic habitat. Following remediation, the area will be restored to provide waterfront views and for visitors. The project is also being coordinated with efforts to install a new floating dock system to provide upgraded landing facilities. Within the embayment, commercial and private boaters will benefit from increased water depth within the navigation channel following the completion of the project. Natural resource areas will be restored with material that will provide significantly improved habitat for benthic organisms.

8.10 Measures to Protect Environmental Receptors and Natural Resource Areas

The environmental controls proposed for the Site to protect the environmental receptors and natural resources areas are those already described in Section 7 above and also in the Specifications included in **Appendix D**.

9.0 CONSTRUCTION PLANS AND TECHNICAL SPECIFICATIONS (310 CMR 40.0874(3)(c))

9.1 Plans, Specifications, and Procedures

Appendix C provides the 60% Issued for Permitting package of Drawings that were generated to support this combined Phase III RAP/Phase IV RIP. Similarly, **Appendix D** provides the 60% Issued for Permitting package of the Specifications that were developed. The Specifications selected for inclusion in this Phase III RAP/Phase IV RIP are those that most directly pertain to the implementation of the remedy, including the performance of key tasks such as demolition, dredging and backfill, and management and disposal of dredged materials; related inspections and monitoring requirements; and essential procedures including health and safety protocols, environmental protocols, security procedures, and installation and maintenance of erosion and sedimentation controls and marine resuspension controls.

Revisions to the Drawings and Specifications may be implemented during the final design process and/or proposed by the selected contractor during procurement. If these design or implementation changes are deemed appropriate by the project engineers, these modifications will be documented in the Phase IV Final Inspection Report. If significant modifications are necessary, then an As-Built Construction Report will be submitted to MassDEP documenting those changes.

9.2 Construction Schedule

The current design and procurement schedule is as follows:

- 90% Design and Issue for Bid – June 6, 2017
- Contractor Bids due – June 30, 2017
- Contractor Award and Notice to Proceed – July 28, 2017
- Contractor Mobilization / Begin In-Water Work – September 30, 2017

Construction is planned to occur over one construction season starting in September 2017. The following restrictions are anticipated to apply to this project schedule:

- Silt-producing in-water work will be subject to time of year (TOY) restrictions established by DMF, which restricts activities between February 15 and June 30 to avoid effects on winter flounder (*Pseudopleuronectus americanus*) spawning activities.
- Silt-producing in-water work will be subject to TOY restrictions established by USACE, which restricts activities between February 15 and September 30 to avoid effects on shellfish and diadromous fish spawning activities.

The primary silt-producing activities during this project will include the barge demolition and debris removal, dredging of sediments, and cap installation. To comply with TOY restrictions, the project schedule calls for the project to begin on September 30, 2017 and be substantially completed by February 15, 2018. Every effort will be made to coordinate and expedite activities such that in-water work is completed prior to February 15; however, a variance from TOY restrictions may be requested to allow for the completion of remaining work in some localized sections of the work.

BMPs and environmental controls will be used throughout the remediation work to limit adverse impacts to environmental receptors.

10.0 OPERATION, MAINTENANCE, AND MONITORING (310 CMR 40.0874(3)(d))

The MCP requires that an OMM Plan be developed and included in the RIP when such activities are required to ensure the effective performance and integrity of the remedial action and/or the achievement of remedial goals.

A draft OMM Plan has been developed to address the inspection, maintenance and monitoring of the capping system installed as part of the remedial action implementation. The draft OMM Plan is included in **Appendix E** and includes routine OMM activities such as visual inspections, bathymetric and topographic surveys.

The primary objective of the OMM Plan is to assess the integrity of the cap after installation. The Specifications provide details on materials to be used, testing required to verify proper materials are used, tolerances for placement, and methods to be used to verify proper material thicknesses and characteristics are actually placed. After installation, the OMM Plan will:

- Verify the presence and physical integrity of the cap material.
- Provide for repairs and maintenance to the cap(s) if monitoring efforts indicate that such activities are necessary.

Physical monitoring of the cap will be performed to verify the presence and stability of the cap material. Bathymetric and topographic surveys will be conducted upon the completion of the remediation to establish "as-built" conditions, as required by the Specifications. The results of this survey will establish baseline post-construction conditions for comparison to information collected during long-term monitoring of the OMM Plan.

Bathymetric and topographic surveys will be performed periodically to monitor the elevation of the sediment cap surface within the remediation area. A summary of the proposed monitoring program frequency is provided in **Table 10-1** below.

Table 10-1: Proposed Monitoring Program Frequency

Data Collection Program	Schedule (Years 1-5)	Schedule (Years 6-11)	Schedule (Years 12+)
Bathymetric and Topographic Survey	Annual (5 surveys)	Biennial (3 surveys)	Every 5 Years

Surveys will be conducted in a manner that will provide resolution and accuracy consistent with the procedures followed to perform the "as-built" survey. Specifications for topographic and bathymetric surveying, including the development of a Survey Work Plan (to be prepared by the remediation contractor and submitted for approval), are presented in the Specifications and Contract Drawings. The methodology specified in the Survey Work Plan to perform the as-built survey (or equivalent) will be used to perform the OMM surveys.

Sediment cores will be collected in place of bathymetric and topographic surveys if future in-water use at the Site interferes with the ability to obtain bathymetric and topographic surveys. Sediment cores may also be collected to assess whether changes in cap elevation are due to erosion, subsidence, or compaction. Cores will be progressed via push or vibratory methods to a depth

sufficient to obtain both cap material and native sediment based on final as-built cap thickness or the most recent survey data, as applicable. A minimum of 80% recovery is required to consider the core acceptable for comparison. The core will be split and layers measured to verify cap thickness.

In the event that the bathymetric or topographic surveys identify areas where the sediment elevation is significantly different from the post-construction elevation (or the most recent survey), then additional data will be collected (e.g., re-survey, sediment cores, underwater video surveying, or diver survey) and response actions will be taken, as appropriate, to repair or enhance the cap.

If the periodic surveys indicate the cap thickness criteria are not met, but inspection results indicate that substrate settlement has occurred rather than loss of cap thickness, such settlement would not trigger maintenance activities. The settled surface elevations would serve as the new baseline for future monitoring comparisons. If results indicate loss of cap thickness, one of the following response actions would be conducted:

- Repair the area where unacceptable loss of material was observed through addition of material to the cap area.
- Increase armoring in the area where unacceptable loss was observed with larger material type or a thicker layer of material, and consider similar changes in areas that may be susceptible to similar damage in the future.

11.0 HEALTH AND SAFETY PLAN (310 CMR 40.0874(3)(e))

The Health and Safety Plan (HASP) for the remediation program is provided in **Appendix F**. The HASP addresses activities that AMEC personnel may conduct during the implementation and construction of the selected remedial alternative as described in this Phase III RAP/Phase IV RIP. Compliance with the HASP is required of all personnel involved with this remediation program. However, the HASP is not intended to and may not address the activity-specific health and safety needs or requirements of any contractors and their employees and therefore cannot be used as the sole HASP document by contractors or their personnel. As required by the Occupational Safety and Health Administration (OSHA), contractors must provide applicable job hazard analyses for each task/activity they will perform during remediation.

The remediation HASP may be revised to incorporate additional or updated information made available to health, safety, and environmental (HSE) personnel. This information may include monitoring results, changes in remediation activities or equipment, etc. Any changes proposed must be reviewed by HSE staff and are subject to approval by the HSE Manager and the Project Manager. Approved HASP changes will be communicated to all affected on-site personnel.

12.0 PERMITS, LICENSES, AND/OR APPROVALS (310 CMR 40.0874(3)(f))

Construction and implementation of the selected Remedial Action Alternative primarily consists of demolition, dredging and capping. These activities require federal, state, and local permits and/or approvals as outlined below. Inspection, sampling and analysis requirements for permits are included in the actual permits.

Permits that have already been obtained by Wynn include:

- Massachusetts Environmental Protection Act (MEPA) – Notice of Project Change (Remediation)
- MEPA – Multiple Filings (Resort and Navigational Dredging, including removal of sunken barge)
- Massachusetts Wetlands Protection Act (WPA) Notice of Intent (NOIs) for resort project (Everett) – Order of Conditions (Navigational Dredging, including sunken barge removal)
- Massachusetts Department of Environmental Protection (MassDEP) Combined 401 Water Quality Certification (Navigational Dredging, including sunken barge removal)
- MassDEP Waterways – Chapter 91 License (Resort and Navigational Dredging, including sunken barge removal)
- USACE Clean Water Act (CWA) Section 404 Individual Permit (Resort and Navigational Dredging, including sunken barge removal)

Permit applications that are in process or have been submitted by Wynn include:

- Massachusetts WPA Notices of Intent (NOIs) for remediation (Boston and Everett) (Remediation)
- MassDEP Combined 401 Water Quality Certification (Remediation)
- MassDEP Waterways – Chapter 91 License (Remediation)
- USACE CWA Section 404 Individual Permit Modification (Remediation)

13.0 PROPERTY ACCESS ISSUES (310 CMR 40.0874(3)(g))

The property is currently an active construction site for the Wynn Boston Harbor project. A small portion of the eastern upland area adjacent to the abandoned barges may be available for use during the demolition portion of the work. It is not anticipated that there will be landside access at the Disposal Site during sediment dredging and capping. Therefore, all work performed during the remediation will be completed by using water access.

The current upland construction project requires all workers to attend a safety training course for access to the construction site. If upland access is allowed for the barge demolition, this training will be required for workers who may perform work from the uplands.

14.0 REFERENCES

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MassDEP, 2016e. Email communication from John Fitzgerald (MassDEP) to Matthew Grove (AMEC) dated November 18, 2016. “Subject: Wynn sediment meeting – key points”.

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TABLES

Table 4-1
Stage I Ecological Screening - Benchmark Comparison
Sediments Adjacent to the Former Everett Staging Yard
RTN 3-13341

Parameter (mg/kg) [a]	Maximum Detected Concentration [b]	Ecological Sediment Screening Benchmark	Source [c]	Is Max > Benchmark? [d]
PCBs				
Total PCBs	3.4	0.18	ER-M	Yes
SVOCs				
Bis(2-ethylhexyl)phthalate	131	3.1	WA AET	Yes
Di-n-octylphthalate	7.9	6.2	WA AET	Yes
Hexachlorobutadiene	0.28	0.12	WA AET	Yes
PAHs				
2-Methylnaphthalene	0.17	0.67	ER-M	No
Acenaphthene	0.24	0.5	ER-M	No
Acenaphthylene	0.65	0.64	ER-M	Yes
Anthracene	0.97	1.1	ER-M	No
Benzo(a)anthracene	1.9	1.6	ER-M	Yes
Benzo(a)pyrene	2.0	1.6	ER-M	Yes
Benzo(b)fluoranthene	3.2	1.8	WA AET	Yes
Benzo(k)fluoranthene	1.2	1.8	WA AET	No
Benzo(g,h,i)perylene	1.7	0.67	WA AET	Yes
Chrysene	2.1	2.8	ER-M	No
Dibenzo(a,h)anthracene	0.46	0.26	ER-M	Yes
Fluoranthene	3.6	5.1	ER-M	No
Fluorene	0.32	0.54	ER-M	No
Indeno(1,2,3-cd)pyrene	1.9	0.69	WA AET	Yes
Naphthalene	0.83	2.1	ER-M	No
Phenanthrene	2.1	1.5	ER-M	Yes
Pyrene	3.3	2.6	ER-M	Yes
Total PAHs	22	45	ER-M	No
EPH				
C11-C12 Aromatics	472	--	--	--
C9-C18 Aliphatics	114	--	--	--
C19-C36 Aliphatics	783	--	--	--
Total EPH	1274	--	--	--
Metals				
Antimony	2.5	9.3	NOAA Squirt	No
Arsenic	182	70	ER-M	Yes
Barium	190	48	NOAA Squirt	Yes
Beryllium	1.5	--	--	--
Cadmium	9.0	9.6	ER-M	No
Chromium	169	370	ER-M	No
Lead	1070	218	ER-M	Yes
Mercury	2.5	0.71	ER-M	Yes
Nickel	84	51.6	ER-M	Yes
Selenium	53	1	NOAA Squirt	Yes
Silver	5.1	3.7	ER-M	Yes
Vanadium	354	57	NOAA Squirt	Yes
Zinc	1230	410	ER-M	Yes

Created by: AMR 12/4/2016
Checked by: SM 12/52016

Table 4-1
Stage I Ecological Screening - Benchmark Comparison
Sediments Adjacent to the Former Everett Staging Yard
RTN 3-13341

Notes:
[a] Only detected parameters are shown.
[b] 0-6 inch sediment interval
[c] Sources:
ER-M: NOAA Effects Range - Median concentrations (Long *et al.*, 1995)
WA AET - Washington State marine sediment apparent effects thresholds (AETs) (WAC 173-204, 2013)
NOAA Squirt - NOAA Screening Quick References Tables (Buchman, 2008)
[d] A maximum (max) detected concentration that is higher than the screening benchmark indicates a potentially significant expsoure

-- Benchmark not available
EPH - Extractable petroleum hydrocarbons
PAHs - Polycyclic aromatic hydrocarbons
PCBs - Polychlorinated biphenyls
NOAA - National Oceanographic & Atmospheric Administration
mg/kg - milligrams per kilogram

Table 4-2
Comparison of Local Conditions Values to Ecological Benchmarks
Sediments Adjacent to the Former Everett Staging Yard
RTN 3-13341

Parameter	75th Percentile [a]	ER-M [b]
Antimony	<5	9.3
Arsenic	19	70
Barium	140	48
Beryllium	0.9	--
Cadmium	4	9.6
Chromium	96	370
Lead	430	218
Mercury	0.979	0.71
Nickel	37.5	51.6
Selenium	<6.29	1
Silver	2.1	3.7
Vanadium	65	57
Zinc	827	410
Total PAHs	224	45
Total PCBs	0.87	0.18
Bis(2-Ethylhexyl)phthalate	32.6	3.1
C11-C22	478	--
C19-C36	1000	--
C9-C18	<157	--

[a] For parameters with small data sets (Bis(2-Ethylhexyl)phthalate, C11-C22, C19-C36, and C-9-C18), the maximum value is presented.

If ER-M is not avaialble, equivalent value is shown (see Table 4-1 for source).

-- ER-M or other benchmark not available

< - Parameter indicated was not detected at the concentration shown.

Table 4-3
Stage II ERC Analysis
Sediments Adjacent to the Former Everett Staging Yard
RTN 3-13341

Parameter (mg/kg) [a]	Maximum Detected Concentration [b]	Measurement Endpoint Value	Source [c]	Is Max > Measurement Endpoint? [d]
Metals				
Antimony	2.5	9.3	NOAA Squirt	No
Arsenic	182	70	ER-M	Yes
Barium	190	140	LC	Yes
Beryllium	1.5	--	--	--
Cadmium	9.0	9.6	ER-M	No
Chromium	169	370	ER-M	No
Lead	1070	430	LC	Yes
Mercury	2.5	0.979	LC	Yes
Nickel	84	51.6	ER-M	Yes
Selenium	53	1	NOAA Squirt	Yes
Silver	5.1	3.7	ER-M	Yes
Vanadium	354	65	LC	Yes
Zinc	1230	827	LC	Yes
PAHs				
Total PAHs	22	224	LC	No
SVOCs				
Bis(2-ethylhexyl)phthalate	131	32.6	LC	Yes
PCBs				
Total PCBs	3.4	0.87	LC	Yes
EPH				
C11-C12 Aromatics	472	--	--	--
C9-C18 Aliphatics	114	--	--	--
C19-C36 Aliphatics	783	--	--	--

Notes:
[a] Only detected parameters are shown.
[b] 0-6 inch sediment interval
[c] Sources:
ER-M: NOAA Effects Range - Median concentrations (Long *et al.*, 1995)
WA AET - Washington State marine sediment apparent effects thresholds (AETs) (WAC 173-204, 2013)
NOAA Squirt - NOAA Screening Quick References Tables (Buchman, 2008)
LC = 75th percentile value from local conditions dataset
[d] A maximum (max) detected concentration that is higher than the screening benchmark indicates a potentially significant expsoure

-- Benchmark not available
EPH - Extractable petroleum hydrocarbons
PAHs - Polycyclic aromatic hydrocarbons
PCBs - Polychlorinated biphenyls
NOAA - National Oceanographic & Atmospheric Administration
mg/kg - milligrams per kilogram

Table 6-1
Initial Technology Screening
Sediment Portion of Former Everett Staging Yard Disposal Site
RTN 3-13341

Technology	Description	Advantages	Disadvantages	Relative Cost	Can Achieve a Condition of No Significant Risk for Sediments?	Retained for Further Evaluation?	Rationale
Monitored Natural Recovery (MNR)	Monitoring of natural recovery processes which will bury contaminated sediment beneath clean sediment (sedimentation).	• Not a disruptive process (no in water construction or landside processing). • Can naturally reduce current risks. • No disposal or waste stream. • Low capital cost.	• Slow process. • Sedimentation rates may not be even across all areas. • Less predictable sedimentation processes in dynamic environments (tidal). • Long-term sampling and monitoring required to demonstrate effectiveness. • Contaminants remain in place. • Risk of re-exposure.	Low	Yes	Yes for a portion of the Site	• Minimal disruption to embayment and benthic community. • Could achieve Permanent Solution in areas where active sedimentation occurs.
In Situ Treatment (Amendment)	Placement of a substrate, such as activated carbon, to treat dissolved phase constituents that migrate from the sediment to surface water.	• Treats dissolved phase constituents.	• Flux of dissolved phase constituents to the embayment is not a concern at this Site. • Does not address risk to benthic organisms from direct contact with contaminated sediments. • Amended sediment may not be good substrate for benthic organisms.	Moderate	No	No	• Flux of dissolved phase constituents to the embayment is not a concern at this Site. • Does not address risk to benthic organisms.
Enhanced Sediment Deposition	Installation of structure(s) to alter flow dynamics and increase deposition of sediment on the bottom.	• Deposited sediment would cover subtidal areas to mitigate and eventually eliminate risk to benthic organisms.	• Would require placement of structures in embayment and possibly in channel which could pose a risk to navigation. • May not be approved by Army Corps of Engineers • Increasing sedimentation limits depth of embayment for navigation. • Could adversely affect benthic community. • Unlikely to be effective in intertidal areas.	Moderate	Yes	No	• Adversely affects uses of the embayment, and potentially the river, for navigation. • Could adversely affect benthic community.
Mechanical Dredging	Physical removal of contaminated sediment through the use of an excavator and bucket mounted on a barge.	• Navigational dredging already permitted through mechanical dredging. • Eliminates Significant Risk in dredged areas. • Quickly meets requirements for a Permanent Solution. • Less dewatering required than hydraulic dredging.	• Significant disruption to embayment and benthic community during dredging. • Could expose more contaminated sediments present at depth. • No access from upland areas due to resort construction. • Turbidity controls required during implementation.	High	Yes	Yes	• Navigational dredging already approved. • Effective presumptive remedy for sediments. • Quickly meets requirements for Permanent Solution in dredged areas.
Hydraulic Dredging	Physical removal of contaminated sediment through loosening the sediment with a cutter head and then sucking the sediment into a holding tank.	• Eliminates Significant Risk in dredged areas. • Quickly meets requirements for a Permanent Solution.	• Significant disruption to embayment and benthic community during dredging. • Could expose more contaminated sediments present at depth. • No access from upland areas due to resort construction. • Significant quantity of water to be treated/managed. • Turbidity controls required during implementation.	High	Yes	No	• No landside access available for sediment processing and dewatering (holding tanks, piping, processing, etc.)

Table 6-1
Initial Technology Screening
Sediment Portion of Former Everett Staging Yard Disposal Site
RTN 3-13341

Technology	Description	Advantages	Disadvantages	Relative Cost	Can Achieve a Condition of No Significant Risk for Sediments?	Retained for Further Evaluation?	Rationale
Mechanical Capping	Placement of clean cover material (sand, gravel, rip rap, synthetic) over contaminated sediment.	• Eliminates Significant Risk in capped areas. • Quickly meets requirements for a Permanent Solution.	• Leaves sediment posing a risk in place which could become exposed. • Significant disruption to embayment and benthic community during capping. • No access from upland areas due to resort construction. • Turbidity controls required during implementation. • Monitoring of cap to ensure stability will likely be required.	Moderate	Yes	Yes	• Effective presumptive remedy for sediments. • Quickly meets requirements for Permanent Solution in capped areas.

Table 6-2
Description of Remedial Action Alternatives
Sediment Portion of Former Everett Staging Yard Disposal Site
RTN 3-13341

	Alternative 1	Design and Implementation	Monitoring	Remediation Waste
Remedial Action Alternative 1 – Figure 6-1	Full Dredge and Cap (Navigation Dredge, Full Remedial Dredge, and Cap)	• Install environmental controls. • Demolish five existing barges and remove miscellaneous debris. • Removal of sediments via mechanical dredging system. • Dewatering on hopper barge within turbidity barriers. • Sediment processing at facility off-site (8% amendment rate). • Off-site transportation and disposal of dredged sediments. • Off-site facility loading for imported fill. • Mechanical placement of cap material via hopper barge and broadcast spreader equipment. <u>Navigational Dredging</u> • Approximately 1.39 acre area with removal of material to elevation -15 feet (14,700 CY). <u>Remedial Dredging</u> • Approximately 7.03 acre area with removal of 18-inches of material (plus a 6-inch overdredge) (22,700 CY). Area overlaps Navigational Dredging area. <u>Post Dredge Cap Installation</u> • Approximately 7.03 acre cap with 18-inches of material (plus 6-inches to account for the overdredge) (25,000 CY includes 10% material bulking).	<u>Pre-Construction</u> • Collect background turbidity readings from the Mystic River. • Conduct pre-demolition survey of barges and existing debris for removal prior to dredging. • Conduct pre-construction survey of proposed dredge area using bathymetric and topographic survey methods. • Collect pre-characterization samples to identify waste disposal options. Alternatively, sediment can be characterized in barges or stockpiles following dredging. <u>Construction</u> • Conduct environmental sampling and monitoring as determined by permit conditions. • Confirmation sampling as required by selected disposal facility if amendment is needed for moisture content control. <u>Post Remediation</u> • Perform periodic bathymetric and topographic survey of cap area to monitor stability and effectiveness (annual initially and then decreasing frequency). • Perform periodic maintenance dredging to maintain navigational channel. • Perform periodic cap maintenance as required to maintain cap thickness.	• Dredged sediments will be removed from the Site and transported to an off-site sediment processing and transfer facility. • Sediments will be reused or disposed of at a licensed off-site facility. • Sediments could be amended with a stabilization agent to reduce moisture content prior to off-site reuse or disposal. • Miscellaneous municipal solid waste, and spent sedimentation controls. <u>Approximate Sediment Weight Anticipated:</u> • 60,500 tons impacted sediment (includes 8% amendment bulking rate).
	Alternative 2	**Design and Implementation**	**Monitoring**	**Remediation Waste**
Remedial Action Alternative 2 – Figure 6-2	Partial Dredge and Cap (Navigation Dredge, Limited Remedial Dredge, and Cap)	• Install environmental controls. • Demolish five existing barges and remove miscellaneous debris. • Removal of sediments via mechanical dredging system. • Dewatering on hopper barge within turbidity barriers. • Sediment processing at facility off-site (8% amendment rate). • Off-site transportation and disposal of dredged sediments. • Off-site facility loading for imported fill. • Mechanical placement of cap material via hopper barge and broadcast spreader equipment. <u>Navigational Dredging</u> • Approximately 1.39 acre area with removal of material to elevation -15 feet (14,700 CY). <u>Remedial Dredging</u> • Approximately 3.76 acre area with removal of 18-inches of material (plus a 6-inch overdredge) (12,100 CY). Area overlaps Navigational Dredging area.	<u>Pre-Construction</u> • Collect background turbidity readings from the Mystic River. • Conduct pre-demolition survey of barges and existing debris for removal prior to dredging. • Conduct pre-construction survey of proposed dredge area using bathymetric and topographic survey methods. • Collect pre-characterization samples to identify waste disposal options. Alternatively, sediment can be characterized in barges or stockpiles following dredging. <u>Construction</u> • Conduct environmental sampling and monitoring as determined by permit conditions. • Confirmation sampling as required by selected disposal facility if amendment is needed for moisture content control. <u>Post Remediation</u> • Perform periodic bathymetric and topographic survey of cap area to monitor stability and effectiveness (annual initially and then decreasing frequency). • Perform periodic maintenance dredging to maintain navigational channel. • Perform periodic cap maintenance as required to maintain cap thickness.	• Dredged sediments will be removed from the Site and transported to an off-site sediment processing and transfer facility. • Sediments will be reused or disposed of at a licensed off-site facility. • Sediments could be amended with a stabilization agent to reduce moisture content prior to off-site reuse or disposal. • Miscellaneous municipal solid waste, and spent sedimentation controls. <u>Approximate Sediment Weight Anticipated:</u> • 43,400 tons impacted sediment (includes 8% amendment bulking rate).

Table 6-2
Description of Remedial Action Alternatives
Sediment Portion of Former Everett Staging Yard Disposal Site
RTN 3-13341

		Post Dredge Cap Installation • Approximately 7.03 acre cap with 18-inches of material (plus 6-inches to account for the overdredge) (25,000 CY includes 10% material bulking).		
	Alternative 3	**Design and Implementation**	**Monitoring**	**Remediation Waste**
Remedial Action Alternative 3 – Figure 6-3	Partial Dredge, Cap and MNR (Navigation Dredge, Limited Remedial Dredge and Cap, MNR)	• Install environmental controls. • Demolish five existing barges and remove miscellaneous debris. • Removal of sediments via mechanical dredging system. • Dewatering on hopper barge within turbidity barriers. • Sediment processing at facility off-site (8% amendment rate). • Off-site transportation and disposal of dredged sediments. • Off-site facility loading for imported fill. • Mechanical placement of cap material via hopper barge and broadcast spreader equipment. Navigational Dredging • Approximately 1.39 acre area with removal of material to elevation -15 feet (14,700 CY). Remedial Dredging • Approximately 3.76 acre area with removal of 18-inches of material (plus a 6-inch overdredge) (12,100 CY). Area overlaps Navigational Dredging area. Post Dredge Cap Installation • Approximately 3.76 acre cap with 18-inches of material (plus 6-inches to account for the overdredge) (13,300 CY includes 10% material bulking).	Pre-Construction • Collect background turbidity readings from the Mystic River. • Conduct pre-demolition survey of barges and existing debris for removal prior to dredging. • Conduct pre-construction survey of proposed dredge area using bathymetric and topographic survey methods. • Collect pre-characterization samples to identify waste disposal options. Alternatively, sediment can be characterized in barges or stockpiles following dredging. • Baseline assessment of sediment concentrations, sedimentation rates, sediment stability, and benthic community. Construction • Conduct environmental sampling and monitoring as determined by permit conditions. • Confirmation sampling as required by selected disposal facility if amendment is needed for moisture content control. Post Remediation • Perform periodic bathymetric and topographic survey of cap area to monitor stability and effectiveness (annual initially and then decreasing frequency). • Conduct periodic sampling of sediment to evaluate MNR effectiveness. • Perform periodic maintenance dredging to maintain navigational channel. • Perform periodic cap maintenance as required to maintain cap thickness.	• Dredged sediments will be removed from the Site and transported to an off-site sediment processing and transfer facility • Sediments will be reused or disposed of at a licensed off-site facility. • Sediments could be amended with a stabilization agent to reduce moisture content prior to off-site reuse or disposal. • Miscellaneous municipal solid waste, and spent sedimentation controls Approximate Sediment Weight Anticipated: • 43,400 tons impacted soil (includes 8% amendment bulking rate)
	Alternative 4	**Design and Implementation**	**Monitoring**	**Remediation Waste**
Remedial Action Alternative 4 – Figure 6-4	Navigation Dredge, Cap and MNR (Navigation Dredge with Cap and MNR)	• Install environmental controls. • Demolish five existing barges and remove miscellaneous debris. • Removal of sediments via mechanical dredging system. • Dewatering on hopper barge within turbidity barriers. • Sediment processing at facility off-site (8% amendment rate). • Off-site transportation and disposal of dredged sediments. • Off-site facility loading for imported fill. • Mechanical placement of cap material via hopper barge and broadcast spreader equipment. Navigational Dredging • Approximately 1.39 acre area with removal of material to elevation -15 feet (14,700 CY).	Pre-Construction • Collect background turbidity readings from the Mystic River. • Conduct pre-demolition survey of barges and existing debris for removal prior to dredging. • Conduct pre-construction survey of proposed dredge area using bathymetric and topographic survey methods. • Collect pre-characterization samples to identify waste disposal options. Alternatively, sediment can be characterized in barges or stockpiles following dredging. Construction • Conduct environmental sampling and monitoring as determined by permit conditions. • Confirmation sampling as required by selected disposal facility if amendment is	• Dredged sediments will be removed from the Site and transported to an off-site sediment processing and transfer facility • Sediments will be reused or disposed of at a licensed off-site facility. • Sediments could be amended with a stabilization agent to reduce moisture content prior to off-site reuse or disposal. • Miscellaneous municipal solid waste, and spent sedimentation controls. Approximate Sediment Weight: • 31,000 tons impacted sediment (includes 8% amendment bulking rate)

Table 6-2
Description of Remedial Action Alternatives
Sediment Portion of Former Everett Staging Yard Disposal Site
RTN 3-13341

		Remedial Dredging • Approximately 1.39 acre area with removal of 18-inches of material (plus a 6-inch overdredge) (4,500 CY). Area is the Navigational Dredging area. Post Dredge Cap Installation • Approximately 1.39 acre cap with 18-inches of material (plus 6-inches to account for the overdredge) (5,000 CY includes 10% material bulking).	needed for moisture content control. Post Remediation • Baseline assessment of sediment concentrations, sedimentation rates, sediment stability, and benthic community in MNR area. • Perform periodic bathymetric and topographic survey of cap area to monitor stability and effectiveness (annual initially and then decreasing frequency). • Conduct periodic sampling of sediment to evaluate MNR effectiveness. • Perform periodic maintenance dredging to maintain navigational channel. • Perform periodic cap maintenance as required to maintain cap thickness.	
	Alternative 5	**Design and Implementation**	**Monitoring**	**Remediation Waste**
Remedial Action Alternative 5 – Figure 6-5	No Further Action (Navigation Dredge only)	• Install environmental controls. • Demolish five existing barges and remove miscellaneous debris. • Removal of sediments via mechanical dredging system. • Dewatering on hopper barge within turbidity barriers. • Sediment processing facility off-site (8% amendment rate). • Off-site transportation and disposal of removed sediments. Navigational Dredging • Approximately 1.39 acre area with removal of material to elevation -15 feet (14,700 CY).	Pre-Construction • Collect background turbidity readings from the Mystic River. • Conduct pre-demolition survey of barges and existing debris for removal prior to dredging. • Conduct pre-construction survey of proposed dredge area using bathymetric and topographic survey methods. • Collect pre-characterization samples to identify waste disposal options. Alternatively, sediment can be characterized in barges or stockpiles following dredging. Construction • Conduct environmental sampling and monitoring as determined by permit conditions. • Confirmation sampling as required by selected disposal facility if amendment is needed for moisture content control. Post Remediation • Conduct post dredging bathymetric and topographic survey to confirm necessary channel depths have been achieved. • Perform periodic maintenance dredging to maintain navigable channel.	• Dredged sediments will be removed from the Site and transported to an off-site sediment processing and transfer facility • Sediments will be reused or disposed of at a licensed off-site facility. • Sediments could be amended with a stabilization agent to reduce moisture content prior to off-site reuse or disposal. • Miscellaneous municipal solid waste, and spent sedimentation controls. Approximate Sediment Weight Anticipated: • 23,800 tons impacted sediment (includes 8% amendment bulking rate)

Notes:
Quantities are engineer's estimates and are anticipated to be within minus 30% and plus 50% of actual quantities.

CY – cubic yard
ft- feet
MNR – Monitored Natural Recovery

Table 6-3
Detailed Evaluation of Remedial Action Alternatives
Sediment Portion of the Former Everett Staging Yard Disposal Site
RTN 3-13341

Criteria	**Alternative 1** **Full Dredge and Cap** Navigation Dredge, Full Remedial Dredge, and Cap (Figure 6-1)	**Alternative 2** **Partial Dredge and Cap** Navigation Dredge, Limited Remedial Dredge, and Cap (Figure 6-2)	**Alternative 3** **Partial Dredge, Cap, and MNR** Navigation Dredge, Limited Remedial Dredge and Cap, and MNR (Figure 6-3)	**Alternative 4** **Navigation Dredge, Cap, and MNR** Navigation Dredge with Cap and MNR (Figure 6-4)	**Alternative 5** **No Further Action** Navigation Dredge Only (Figure 7-5)
Effectiveness	High (3) • Will achieve a Permanent Solution with impacts removed by dredging and isolated by capping • Impacted sediment which poses a risk to be reused or disposed of off-site • Background concentrations will be achieved in areas that are dredged and capped	High to Moderate (2.5) • Will achieve a Permanent Solution with impacts removed by dredging and isolated by capping • Significant quantity of impacted sediment which poses a risk to be reused or disposed of off-site • Background concentrations will be achieved in areas that are dredged and capped or just capped	Moderate (2) • Will achieve a Permanent Solution with impacts removed by in dredged and capped areas • May achieve Permanent Solution with time in MNR area • Significant quantity of impacted sediment which poses a risk to be reused or disposed of off-site • Background concentrations will be achieved in areas that are dredged and capped or just capped • Background conditions may be approached in MNR area over time	Moderate to Low (1.5) • Will achieve a Permanent Solution with impacts removed by in dredged and capped areas • May achieve Permanent Solution with time in MNR area • Lower quantity of impacted sediment which poses a risk to be reused or disposed of off-site • Background concentrations will be achieved in areas that are dredged and capped or just capped • Background conditions may be approached in MNR area over time	Low (1) • Will not achieve a Permanent Solution in Navigation Dredge Area as dredging alone will expose more contaminated sediment • Will achieve a Temporary Solution • Limited quantity of impacted sediment which poses a risk to be reused or disposed of off-site • Background concentrations may be approached over time
Reliability	High (3) • High certainty of success for potential to achieve a Permanent Solution with impacts removed by dredging and isolated by capping • High reliability of measures to manage residues or control discharges from site with turbidity controls and off-site sediment processing and disposal	High (3) • High certainty of success for potential to achieve a Permanent Solution with impacts removed by dredging and isolated by capping • High reliability of measures to manage residues or control discharges from site with turbidity controls and off-site sediment processing and disposal	Moderate (2) • High certainty of success for potential to achieve a Permanent Solution in dredged and capped areas • Moderate to low certainty of success to achieve a Permanent Solution in MNR areas • High reliability of measures to manage residues or control discharges from site with turbidity controls and off-site sediment processing and disposal • Moderate reliability of MNR to manage residual impacted sediment	Moderate to Low (1.5) • High certainty of success for potential to achieve a Permanent Solution in limited dredged and capped areas • Moderate to low certainty of success to achieve a Permanent Solution in MNR areas • High reliability of measures to manage residues or control discharges from site with turbidity controls and off-site sediment processing and disposal • Moderate reliability of MNR to manage residual impacted sediment	Low (1) • Low certainty of success for potential to achieve a Permanent Solution with navigational dredging only • High reliability of measures to manage residues or control discharges from site with turbidity controls and off-site sediment processing and disposal • Low reliability of measures to manage residual impacted sediment
Implementability	Low to Moderate (1.5) • High technical complexity due to large footprint for sediment dredging and capping, tide fluctuations, and existing bathymetry • Limited to no integration with or disruption to facility operations as no landside access will be allowed • Moderate operation, maintenance, and monitoring (OM&M) to ensure stability of cap • Moderate availability of necessary services, materials, equipment and specialists locally • Moderate availability of off-site processing, treatment and disposal facilities	Moderate (2) • Moderate technical complexity due to smaller footprint for sediment dredging • Limited to no integration with or disruption to facility operations as no landside access will be allowed • Moderate OM&M to ensure stability of cap • Moderate availability of necessary services, materials, equipment and specialists locally • Moderate to high availability of off-site processing, treatment and disposal facilities due to smaller quantities of dredge material • Will meet requirements of multiple permits needed for implementation	Moderate (2) • Moderate technical complexity due to smaller footprint for sediment dredging • Limited to no integration with or disruption to facility operations as no landside access will be allowed • Moderate OM&M to ensure stability of cap and effectiveness of MNR • Moderate availability of necessary services, materials, equipment and specialists locally • Moderate to high availability of off-site processing, treatment and disposal facilities due to smaller quantities of dredge material • Will meet requirements of multiple permits needed for implementation	Moderate to High (2.5) • Moderate to low technical complexity due to smaller footprint for sediment dredging • Limited to no integration with or disruption to facility operations as no landside access will be allowed • Moderate to high OM&M to ensure stability of cap and effectiveness of MNR • Moderate availability of necessary services, materials, equipment and specialists locally • High availability of off-site processing, treatment and disposal facilities due to smaller quantities of dredge material • Will meet requirements of multiple permits needed for implementation • MNR may not meet with full approval by MassDEP	High (3) • Low technical complexity due to smaller footprint for sediment dredging • Limited to no integration with or disruption to facility operations as no landside access will be allowed • Low OM&M to ensure navigable channel maintained • Moderate to high availability of necessary services, materials, equipment and specialists locally (less specialized equipment) • High availability of off-site processing, treatment and disposal facilities due to smaller quantities of dredge material • Navigational dredging already permitted

Table 6-3
Detailed Evaluation of Remedial Action Alternatives
Sediment Portion of the Former Everett Staging Yard Disposal Site
RTN 3-13341

Criteria	**Alternative 1** **Full Dredge and Cap** Navigation Dredge, Full Remedial Dredge, and Cap (Figure 6-1)	**Alternative 2** **Partial Dredge and Cap** Navigation Dredge, Limited Remedial Dredge, and Cap (Figure 6-2)	**Alternative 3** **Partial Dredge, Cap, and MNR** Navigation Dredge, Limited Remedial Dredge and Cap, and MNR (Figure 6-3)	**Alternative 4** **Navigation Dredge, Cap, and MNR** Navigation Dredge with Cap and MNR (Figure 6-4)	**Alternative 5** **No Further Action** Navigation Dredge Only (Figure 7-5)
	• Will meet requirements of multiple permits needed for implementation		• MNR may not meet with full approval by MassDEP		
Costs[1, 3]	High (1) • $19.1M for barge removal, sediment dredging, and capping • $1.1M for long term O&MM of cap • Restores natural resources in dredged and capped areas • High relative consumption of energy during dredging and capping	Moderate (2) • $14.7M for barge removal, sediment dredging, and capping • $1.1M for long term O&MM of cap • Restores natural resources in dredged and capped areas • High relative consumption of energy during dredging and capping	Moderate (2) • $13.6M for barge removal, sediment dredging, and capping • $1.8M for MNR baseline and monitoring • $0.6M for long term O&MM of cap • Lower immediate restoration of natural resources • Lower relative consumption of energy due to reduced dredging and capping	Moderate to Low (2.5) • $9.5M for barge removal, sediment dredging, and capping • $3.2M for MNR baseline and monitoring • $0.2M for long term O&MM of cap • Lower immediate restoration of natural resources • Lower relative consumption of energy due to reduced dredging and capping	Low (3) • $7.3M for barge removal and navigational dredging • Does not restore natural resource areas • Lowest relative consumption of energy due to limited dredging and no capping
Risks[3]	Low to Moderate (2.5) • Moderate short-term risk to construction workers during implementation associated with use of heavy equipment and dredging of impacted sediment • Moderate short-term risk to public/environment during dredging, transport and reuse or disposal • Minimal risk during short time required to achieve remedial objective • Minimal risk to health, safety, public welfare or the environment following completion of remedial action	Low to Moderate (2.5) • Moderate short-term risk to construction workers during implementation associated with use of heavy equipment and dredging of impacted sediment • Moderate short-term risk to public/environment during dredging, transport and reuse or disposal • Minimal risk during short time required to achieve remedial objective • Minimal risk to health, safety, public welfare or the environment following completion of remedial action	Moderate (2) • Moderate short-term risk to construction workers during implementation associated with use of heavy equipment and dredging of impacted sediment • Moderate short-term risk to public/environment during dredging, transport and reuse or disposal • Low risk to health, safety, public welfare or the environment following completion of dredging and capping • Low to moderate risk during time required to achieve remedial objective via MNR	Moderate to High (1.5) • Low to moderate short-term risk to construction workers during implementation associated with use of heavy equipment and dredging of impacted sediment • Moderate short-term risk to public/environment during dredging, transport and reuse or disposal • Low to moderate risk to health, safety, public welfare or the environment following completion of dredging and capping • Moderate risk during time required to achieve remedial objective via MNR	High (1) • Low to moderate short-term risk to construction workers associated with use of heavy equipment and dredging of impacted sediment • Moderate short-term risk to public/environment during dredging, transport and disposal • High risk to environment due to exposed, more contaminated sediments
Benefits	High (3) • Highly likely to remove mass, achieve remedial objectives, restore natural resources and allow for re-use of property in timely manner	High (3) • Highly likely to remove mass, achieve remedial objectives, restore natural resources and allow for re-use of property in timely manner	Moderate (2) • Moderate likelihood to remove mass, achieve remedial objectives, restore natural resources and allow for re-use of property in timely manner	Moderate to Low (1.5) • Moderate to low likelihood to remove mass, achieve remedial objectives, restore natural resources and allow for re-use of property in timely manner	Low (1) • Will remove limited mass in navigation dredge area only. • Unlikely to achieve remedial objectives and restore natural resources • Will allow for re-use of property in timely manner
Timeliness	Moderate (2) • 5 months to achieve level of No Significant Risk in dredged and capped areas	High (3) • 3.5 months to achieve level of No Significant Risk in dredged and capped areas	Moderate (2) • 3 months to achieve level of No Significant Risk in dredged and capped areas	Moderate to Low (1.5) • 2 months to achieve level of No Significant Risk in dredged and capped areas	Low (1) • Will not achieve level of No Significant Risk

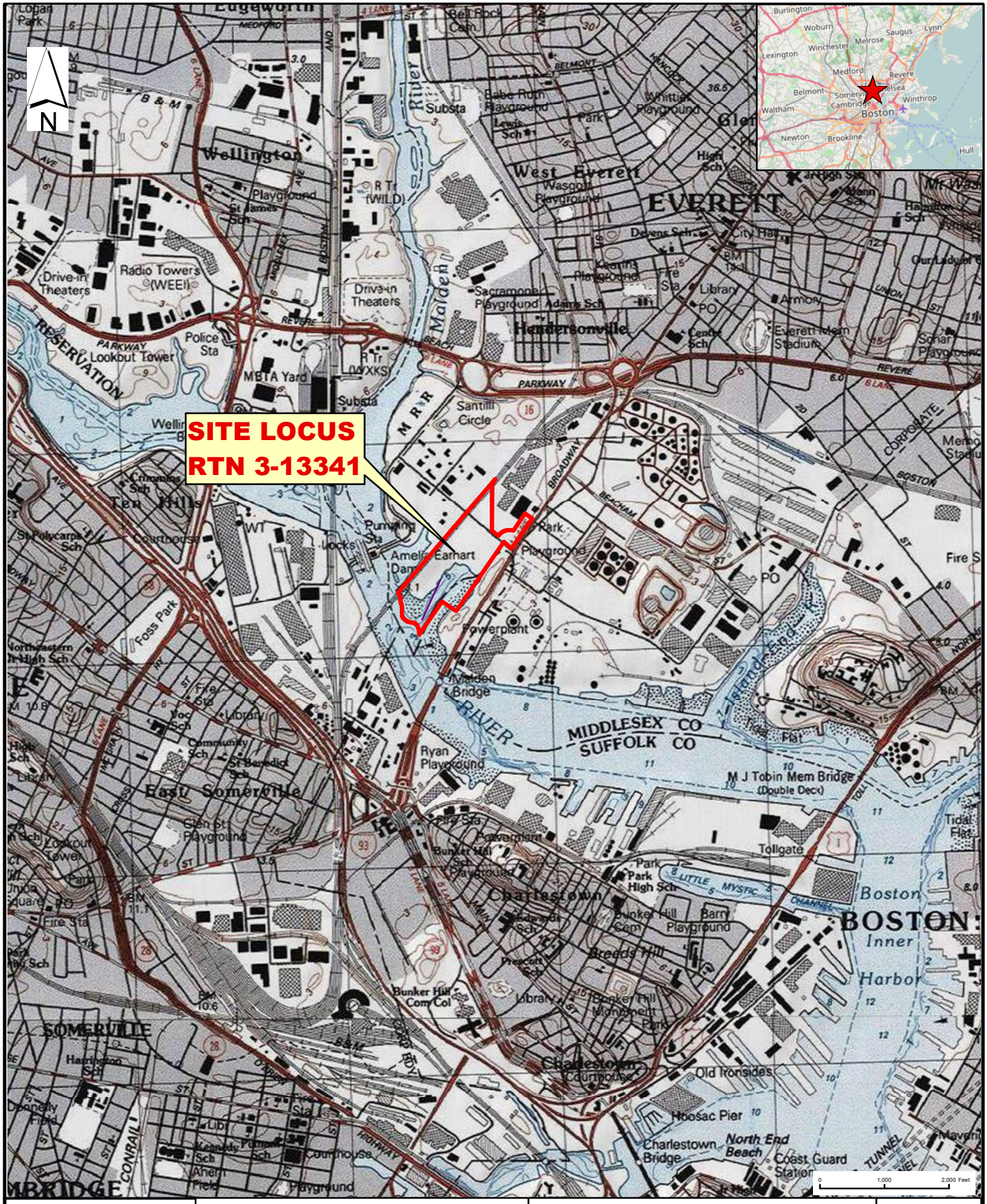
Table 6-3
Detailed Evaluation of Remedial Action Alternatives
Sediment Portion of the Former Everett Staging Yard Disposal Site
RTN 3-13341

Criteria	**Alternative 1** **Full Dredge and Cap** Navigation Dredge, Full Remedial Dredge, and Cap (Figure 6-1)	**Alternative 2** **Partial Dredge and Cap** Navigation Dredge, Limited Remedial Dredge, and Cap (Figure 6-2)	**Alternative 3** **Partial Dredge, Cap, and MNR** Navigation Dredge, Limited Remedial Dredge and Cap, and MNR (Figure 6-3)	**Alternative 4** **Navigation Dredge, Cap, and MNR** Navigation Dredge with Cap and MNR (Figure 6-4)	**Alternative 5** **No Further Action** Navigation Dredge Only (Figure 7-5)
			• Potentially extended period of time (years to decades) to achieve level of No Significant Risk in MNR area	• Potentially extended period of time (years to decades) to achieve level of No Significant Risk in large MNR area	
Non-pecuniary interests[3]	Moderate (2) • Dredging and capping will immediately improve aesthetics of site • Some nuisance odors may occur during dredging • Access to embayment limited for during of dredging and capping	Moderate (2) • Dredging and capping will immediately improve aesthetics of site • Limited nuisance odors may occur during limited dredging period • Access to embayment limited for shorter duration of dredging and capping	Moderate (2) • Dredging and capping will immediately improve aesthetics of limited area of site • Limited nuisance odors may occur during limited dredging period • Access to embayment limited for shorter duration of dredging and capping	Moderate (2) • Dredging and capping will immediately improve aesthetics of limited area of site • Limited nuisance odors may occur during limited dredging period • Access to embayment limited for shorter duration of dredging and capping	Moderate to High (2.5) • Navigation dredging will provide limited aesthetic improvement compared to other alternatives • Low likelihood of nuisance odors • Very short duration of limited access
Total Ranking[2]	18	20	16	15	13.5

Notes:
[1] Costs are engineer's estimates and are anticipated to be within minus 30% and plus 50% of actual quantities consistent with USEPA feasibility study guidance.
[2] Ranking evaluations based on High (3), Moderate (2) and Low (1).
[3] Ranking for Cost, Risk and Non-pecuniary interests are reversed to reflect accurate ranking (i.e., high cost was given a low ranking).

MassDEP – Massachusetts Department of Environmental Protection
MNR – Monitored Natural Recovery
O&MM – Operation and Maintenance

FIGURES



amec foster wheeler

SITE:
Former Everett Staging Yard
1 Horizon Way, Everett, MA
RTN 3-13341

Approximate Parcel Boundary

TITLE:
Site Location Map

SCALE:	DATE:	PROJECT:
1 inch = 2,000 feet	12/23/2016	3651160042.003

DRAWN BY: M. Martin **CHECKED BY:** C. Platt

LOCATION: P:\Comm-Ind\Projects\Clients T to Z\Wynn\3651160042\GIS

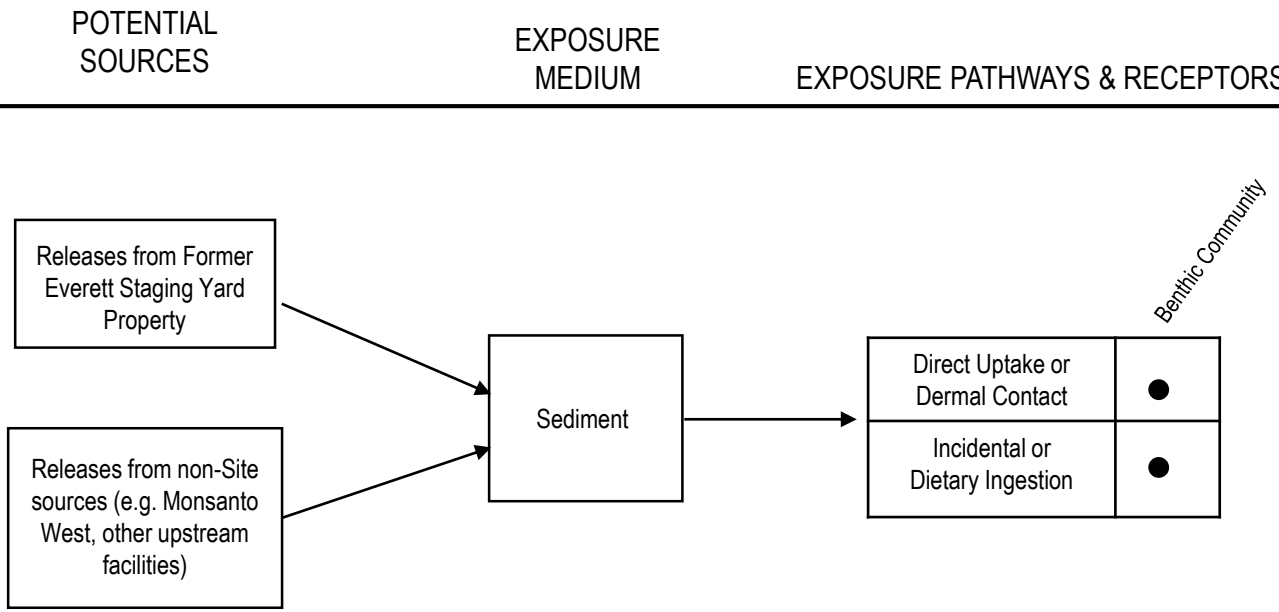
1-1

Figure 4-1. Ecological Conceptual Site Model

Sediments Adjacent to Former Everett Staging Yard

1 Horizon Way, Everett, Massachusetts

RTN 3-13341



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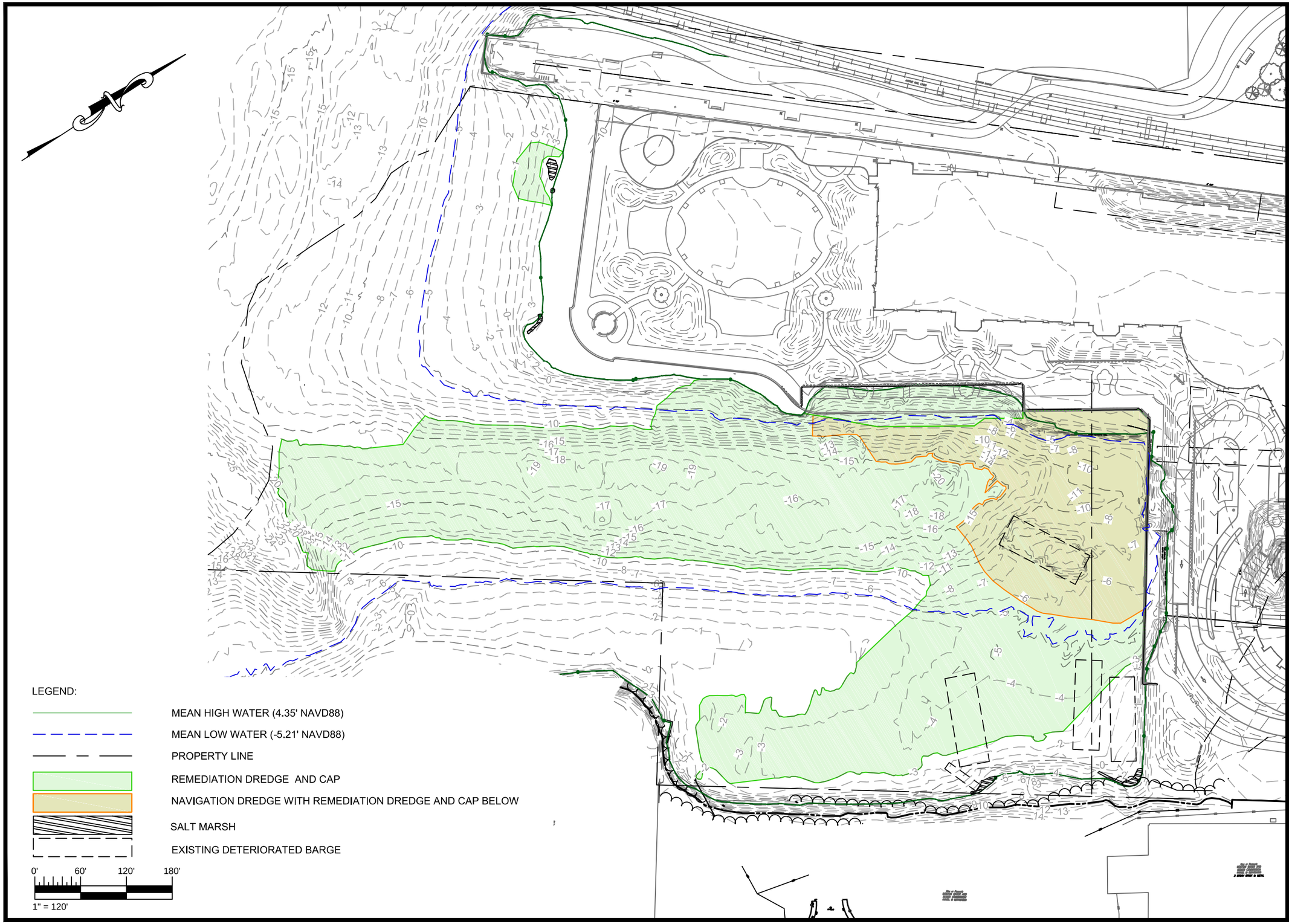

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CLIENT:

Wynn BOSTON HARBOR

PROJECT:

FORMER EVERETT
STAGING YARD
1 HORIZON WAY
EVERETT, MA
RTN 3-13341

REV	DATE	DESCRIPTION

ISSUE / REVISION:

DESIGNED BY: MRF	DRAWN BY: MRF
CHECKED BY: DAA	DATE: FEBRUARY 2017
SCALE: AS SHOWN	ISSUE / REVISION: 0

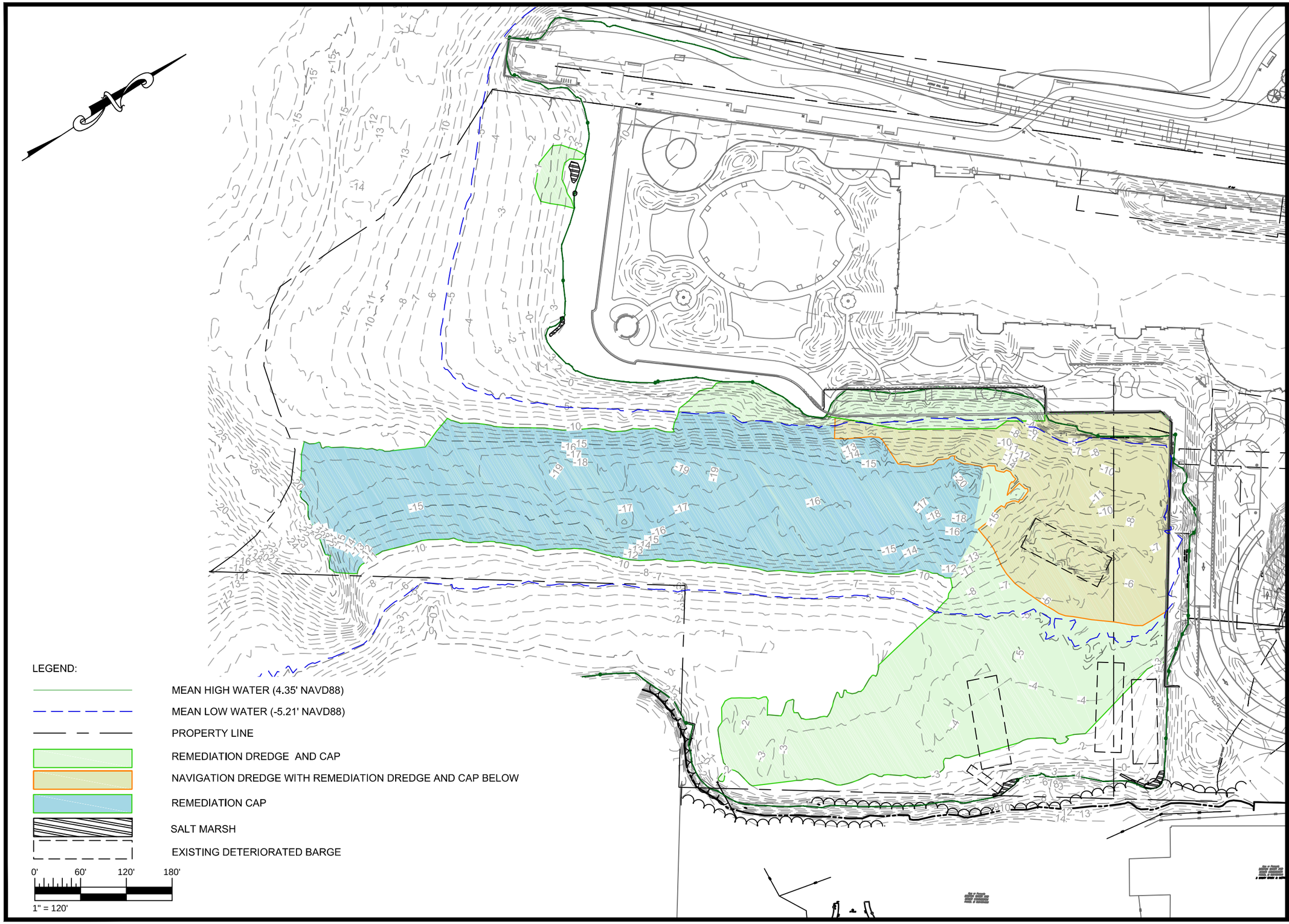
PROJECT NUMBER:
3651160042

TITLE:

REMEDIAL
ALTERNATIVE 1
FULL DREDGE AND
CAP

FIGURE NUMBER:

6-1



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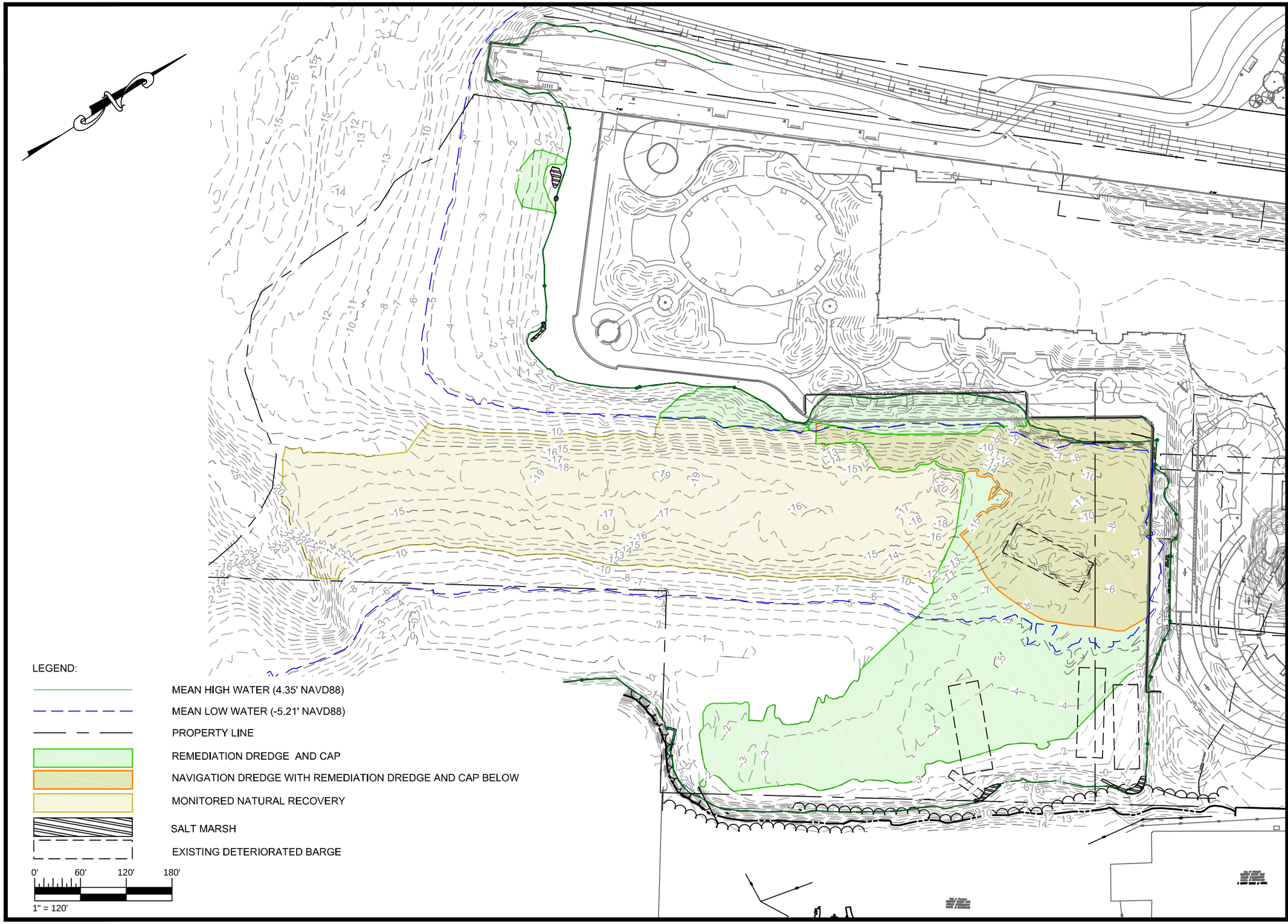
SCALE: AS SHOWN	ISSUE / REVISION: 0
PROJECT NUMBER: 3651160042	

TITLE:

REMEDIAL ALTERNATIVE 2 PARTIAL DREDGE AND CAP

FIGURE NUMBER:

6-2



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ISSUE / REVISION:

DESIGNED BY: MRF	DRAWN BY: MRF
CHECKED BY: DAA	DATE: FEBRUARY 2017
SCALE: AS SHOWN	ISSUE / REVISION: 0

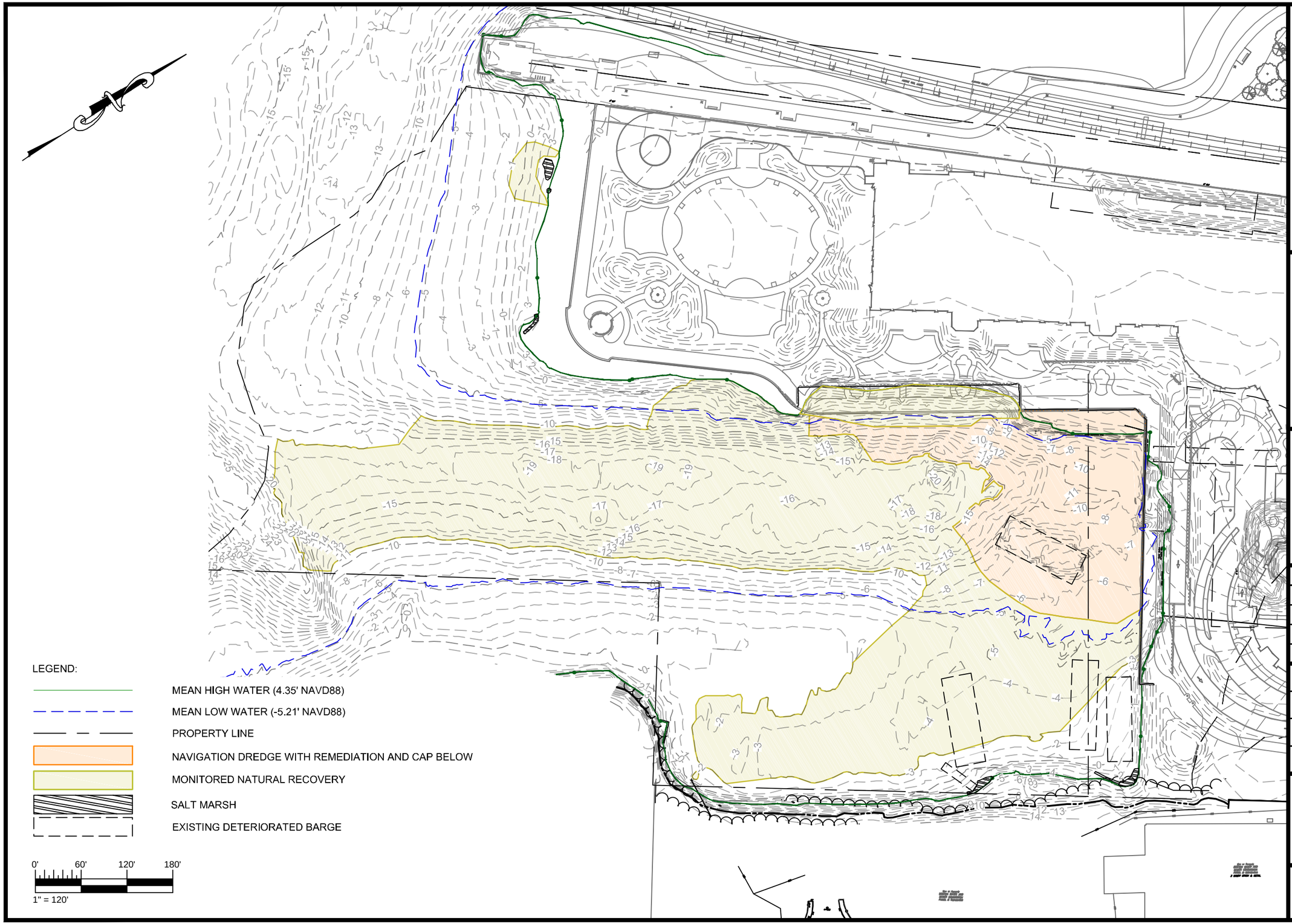
PROJECT NUMBER: 3651160042

TITLE:

REMEDIAL
ALTERNATIVE 3
PARTIAL DREDGE, CAP
AND MNR

FIGURE NUMBER:

6-3



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REV	DATE	DESCRIPTION

ISSUE / REVISION:

DESIGNED BY: MRF	DRAWN BY: MRF
CHECKED BY: DAA	DATE: FEBRUARY 2017
SCALE: AS SHOWN	ISSUE / REVISION: 0
PROJECT NUMBER: 3651160042	

TITLE:

REMEDIAL ALTERNATIVE 4 NAVIGATION DREDGE, CAP AND MNR

FIGURE NUMBER:

6-4

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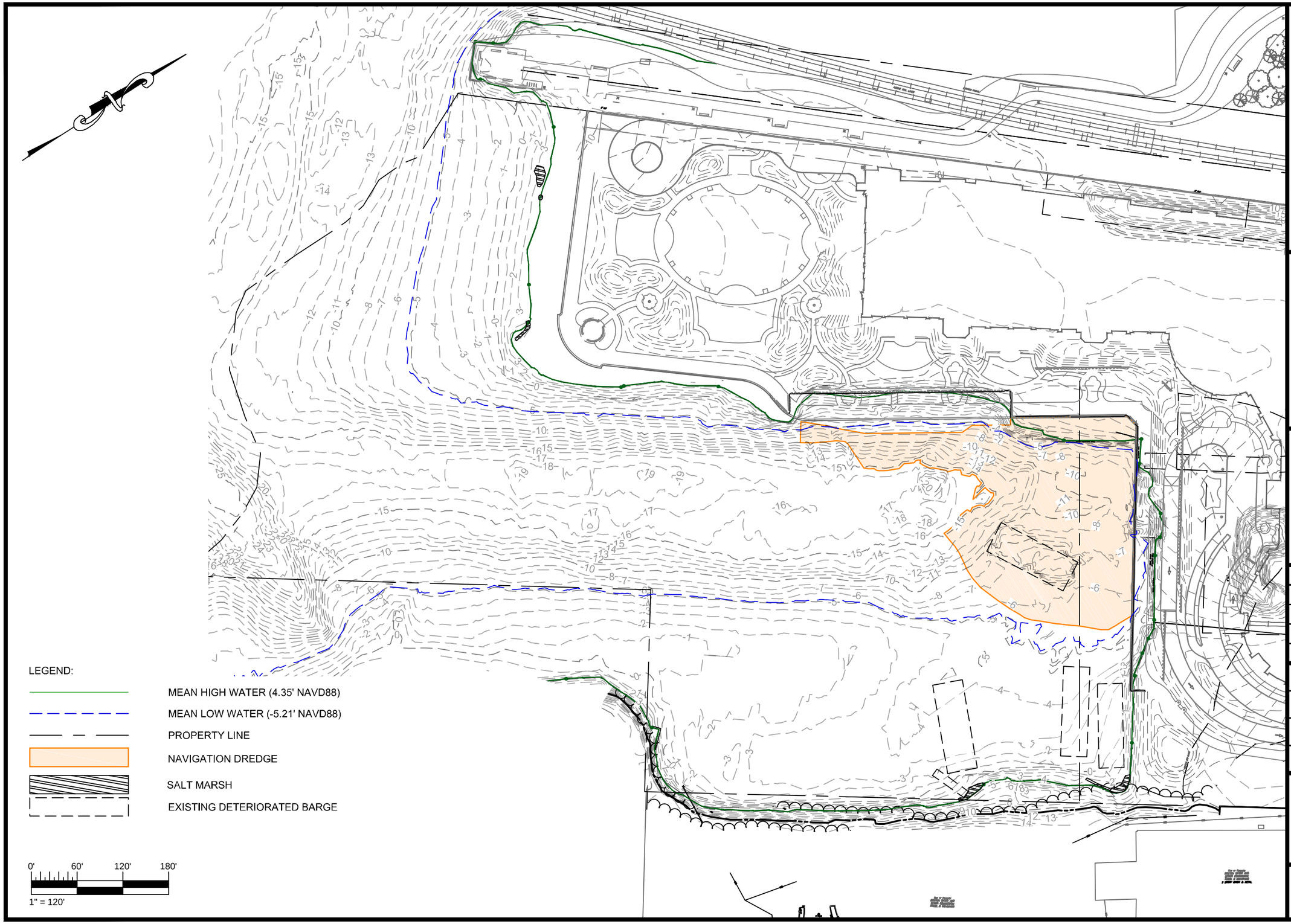

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PROJECT:

FORMER EVERETT
STAGING YARD
1 HORIZON WAY
EVERETT, MA
RTN 3-13341

REV	DATE	DESCRIPTION

ISSUE / REVISION:

DESIGNED BY: MRF	DRAWN BY: MRF
CHECKED BY: DAA	DATE: FEBRUARY 2017
SCALE: AS SHOWN	ISSUE / REVISION: 0

PROJECT NUMBER: 3651160042

TITLE:

REMEDIAL ALTERNATIVE 5 NO FURTHER ACTION

FIGURE NUMBER:

6-5

FILE: \\WFD-FS1\Projects\old_WFD-FS3_Data\Departments\~ CAD Projects\Wynn Everett Sediments ~ 3651160042\7.0 CAD\7.1 Design ~ Permitting\Sheets\Feasibility Study Alternatives1 (2).dwg BY: dana.dempsey DATE: 20 Jun 2017 - 2:04pm

APPENDIX A

Detailed Cost Estimate

Appendix A
Detailed Cost Estiamtes for Remedial Action Alternatives
Sediment Portion of the Former Everett Staging Yard Disposal Site
RTN 3-13341

	Cost/ Unit	Unit	Alternative 1 Full Dredge and Cap (7.03 acre dredge to 1.5ft below existing surface with 7.03 acre, 1.5ft thick cap restoration)	Alternative 2 Partial Dredge and Cap (Including Sideslopes) (3.76 acre dredge to 1.5ft below existing surface with 7.03 acre, 1.5ft thick cap restoration)	Alternative 3 Partial Dredge, Cap and MNR (3.76 acre dredge to 1.5ft below existing surface with 3.76 acre 1.5ft thick cap restoration and 3.27 acre MNR)	Alternative 4 Navigation Dredge, Cap and MNR (1.39 acre dredge to 1.5ft below navigational dredge with 1.39 acre, 1.5ft thick cap restoration and 5.64 acre MNR)	Alternative 5 No Further Action (Navigation Dredge) (1.39 acre navigational dredge)
Barge Removal and Disposal[1]							
Contractor Overhead & Profit (O&P)	25%	%	$ 148,175	$ 148,175	$ 148,175	$ 148,175	$ 148,175
Barge Removal Mobilization	$ 200,000	LS	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000
Crane	$ 37,500	LS	$ 37,500	$ 37,500	$ 37,500	$ 37,500	$ 37,500
Divers	$ 84,000	LS	$ 84,000	$ 84,000	$ 84,000	$ 84,000	$ 84,000
Cut & Shear	$ 31,200	LS	$ 31,200	$ 31,200	$ 31,200	$ 31,200	$ 31,200
Transport	$ 110,000	LS	$ 110,000	$ 110,000	$ 110,000	$ 110,000	$ 110,000
Scrap and Disposal[2]	$ 130,000	LS	$ 130,000	$ 130,000	$ 130,000	$ 130,000	$ 130,000
Barge Removal Subtotal			***$ 741,000***	***$ 741,000***	***$ 741,000***	***$ 741,000***	***$ 741,000***
Dredging and Capping[3,11]							
Contractor O&P	25%	%	$ 1,947,500	$ 1,503,000	$ 1,343,250	$ 905,500	$ 649,000
Pre-characterization Sampling		LS	$ 225,000	$ 189,000	$ 163,000	$ 113,000	$ 113,000
Dredging Mobilization[4]	10%	%	$ 536,900	$ 427,500	$ 363,600	$ 238,100	$ 164,500
Dredge & Barge to Transfer Facility[5]	$ 30.00	CY	$ 1,121,000	$ 804,000	$ 804,000	$ 575,000	$ 440,000
Process & Offload Dredged Material at Transfer Facility[6]	$ 25.00	CY	$ 934,000	$ 670,000	$ 670,000	$ 479,000	$ 367,000
Dewater/Amend (8%)	$ 30.00	TON	$ 1,816,000	$ 1,303,000	$ 1,303,000	$ 931,000	$ 713,000
Load and Transport to Waste Management Turnkey Landfill[7]	$ 40.00	TON	$ 2,421,000	$ 1,737,000	$ 1,737,000	$ 1,241,000	$ 951,000
Disposal at WM Turnkey[7]	$ 70.00	TON	$ 4,236,000	$ 3,040,000	$ 3,040,000	$ 2,172,000	$ 1,664,000
Cover Material[8]	$ 25.00	CY	$ 624,000	$ 624,000	$ 334,000	$ 123,000	$ -
Mechanical Placement of Fill	$ 30.00	CY	$ 749,000	$ 749,000	$ 400,000	$ 148,000	$ -
Survey and Control[9]	$ 125,000	LS	$ 125,000	$ 125,000	$ 125,000	$ 125,000	$ 125,000
Demobilize[2]	5%	LS	$ 268,000	$ 214,000	$ 182,000	$ 119,000	$ 82,000
Dredging and Capping Subtotal			***$ 15,003,000***	***$ 11,386,000***	***$ 10,465,000***	***$ 7,170,000***	***$ 5,269,000***
Construction Management[12]	$ 30,000	MO	$ 180,000	$ 96,000	$ 96,000	$ 36,000	$ 36,000
Captial Cost Subtotal			$ 15,924,000	$ 12,223,000	$ 11,302,000	$ 7,947,000	$ 6,046,000
Construction Contingency	20%		$ 3,184,800	$ 2,444,600	$ 2,260,400	$ 1,589,400	$ 1,209,200
Total Construction Cost			**$ 19,108,800**	**$ 14,667,600**	**$ 13,562,400**	**$ 9,536,400**	**$ 7,255,200**
Monitored Natural Recovery[10]							
Detailed Workplan		LS	$ -	$ -	$ 43,000	$ 75,000	$ -
Baseline Sampling Event		LS	$ -	$ -	$ 417,000	$ 720,000	$ -
Periodic Monitoring (7 events)		LS			$ 1,241,000	$ 2,140,000	
5-Year Reviews (6 reports)		LS	$ -	$ -	$ 174,000	$ 300,000	$ -
MNR Subtotal			***$ -***	***$ -***	***$ 1,875,000***	***$ 3,235,000***	***$ -***
30-Year Long Term Monitoring							
Bathymetric Survey [13]	$ 15,000	LS	$ 180,000	$ 180,000	$ 97,000	$ 36,000	$ -
10-Year Cap Repair Work	$ 250,000	/10YR	$ 750,000	$ 750,000	$ 403,000	$ 148,000	$ -
Long Term Monitoring Subtotal			***$ 930,000***	***$ 930,000***	***$ 500,000***	***$ 184,000***	***$ -***
Monitoring Subtotal			***$ 930,000***	***$ 930,000***	***$ 2,375,000***	***$ 3,419,000***	***$ -***
MNR and Monitoring Contingency	***20%***		***$ 186,000***	***$ 186,000***	***$ 475,000***	***$ 683,800***	***$ -***
Total MNR and Monitoring Cost			**$ 1,116,000**	**$ 1,116,000**	**$ 2,850,000**	**$ 4,102,800**	**$ -**
TOTAL PROJECT COST OPINION			**$ 20,224,800**	**$ 15,783,600**	**$ 16,412,400**	**$ 13,639,200**	**$ 7,255,200**

Appendix A
Detailed Cost Estiamtes for Remedial Action Alternatives
Sediment Portion of the Former Everett Staging Yard Disposal Site
RTN 3-13341

1. Barge Removal assumes demolition and removal of one submerged barge, three large grounded barges and one small grounded barge.
2. Scrapping and disposal fee assumes all metal will be scrapped at local metal shop.
3. Remediation dredge area includes area below navigation dredge area, volumes are additive as navigation dredge is above elevation of remediation dredge
4. Mobilization and demobilization costs do not include pre-characterization sampling, transportation and disposal line items. Items included are site setup, equipment mobilization and contractor submittals.
5. Dredge cost include excavation and transport to local transfer facility Massachusetts. Assumes material bulking factor of 20%.
6. Assumes material will be stockpiled at transfer facility prior to disposal and barges will be kept in rotation to and from project site for additional loadout of material.
7. Assumes transportation and disposal of non-hazardous material to Waste Management Turnkey Landfill in NH. Does not include mooring fee at transfer facility.
8. Cap placement volume includes 10% material bulking.
9. Survey and Control includes diver assisted control point pre-excavation and hydrographic survey confirmation post fill activities.
10. MNR costs based on sampling and analysis and 30 year monitoring program outlined in detailed scope of work for Alternative 3. Other MNR costs scaled based on relative area to be monitored.
11. Dredge depth includes 6-inch overdredge.
12. Construction Management includes full-time oversight by engineer, travel and project management support. Assume 6 month construction timeframe for Alternative 1 and prorated based on percent area for remaining alternatives.
13. Bathymetric surveys to be conducted on an annual basis for 5 years, then biennial until year 11, then every 5 years thereafter (12 events) with comparison to previous survey results and recommendation for maintenance on the cap.

APPENDIX B

Design Calculations and Assumptions

Geotechnical Evaluation
Propeller Induced Erosion Evaluation
Coastal Engineering Evaluation

June 16, 2017

Ms. Danielle Ahern, PE
Amec Foster Wheeler E&I, Inc.
271 Mill Road
Chelmsford, Massachusetts 01824

Subject: **Subaqueous Cap Geotechnical Analysis and Recommendations**
Wynn Boston Harbor Development
Everett, Massachusetts
Amec Foster Wheeler Project No. 3651-16-0042

Dear Ms. Ahern:

Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) is pleased to submit this report of our geotechnical analysis and recommendations for the above referenced project. This report includes the results of our geotechnical analysis and recommendations for the above reference project. Included in the report are a review of the information provided to us, a discussion of the site, geotechnical analyses performed and our recommendations for the design and construction of the subaqueous cap. The Attachments contain calculation packages and project data to support the recommendations within the report.

Geotechnical analyses include bearing capacity, consolidation and sediment-cap mixing. Based on these analyses and the design cap materials, the bearing capacity and anticipated settlement from consolidation of the soft cap subgrade sediments should not damage the cap or cause significant sloughing during construction or after the cap has been constructed. Based on the sediment-cap mixing calculations, it is estimated that approximately 2 inches of material (or more) may mix into the soft sediments in the Main Channel, 4 to 6 inches in the Navigational Dredge Area (NDA) and minimal (<1 inch) in the tidal flats.

Basis of Recommendations and Exclusions

The recommendations provided herein are based on the subsurface conditions and on project information provided to us; they apply only to the specific project and site discussed in this report. If the project information section in this report contains incorrect information or if additional information becomes available, you should convey the corrected or additional information to us and retain us to review our recommendations. We will then modify them if the new information has rendered them inappropriate for the proposed project.

Regardless of the thoroughness of a field exploration, there is always a possibility that conditions between sampling locations will differ from those at specific sampling locations, and that conditions will not be as anticipated by the designers or contractors. In addition, the construction process may itself alter site conditions.

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www.amecfw.com

This report and recommendations have been provided based upon the field testing data obtained during the exploration and provided project information. These analyses and recommendations do not include evaluation of the following:

- Evaluation of cap material gradations. Cap material information was provided by others.
- Erosion and stability of cap materials that experience external forces from tidal fluctuations, stormwater inflow from the multiple discharge points located within the embayment or vessel propeller wash.
- Slope stability analysis of the proposed side slopes of the embayment post construction of the cap.
- Consolidation characteristics of materials outside of the NDA. At the time of investigation the NDA was the critical area for exploration purposes and based on subsurface conditions from the exploration and others, this area was deemed the worst case in designing the cap for the 3 subject areas.

Project Information

Wynn MA, LLC ("Wynn") is the developer of the Wynn Boston Harbor casino and resort project (the "Project") located at 1 Horizon Way in Everett, Massachusetts. The project site is located in an embayment of the Mystic River, located south of the Amelia Earhart dam. The embayment is approximately 350 to 500 feet wide, measured from the Wynn development to the property located to the east, which is operated by the Massachusetts Water Resources Authority ("MWRA") and Boston Water and Sewer Commission ("BWSC"). The embayment contains a former channel which was reportedly constructed in the mid-1800s. Records indicate the channel was about 1,000 feet long with a width of 100 feet, and an original draft of 18 to 25 feet below mean low water. The channel flared out at the mouth of the embayment to about 250 feet wide. The channel has since shoaled, and the present depth does not exceed 13 feet below mean low water.

Proposed remedial actions at the project site include sediment remediation. The remediation will take place for the most part on a portion of a parcel in Everett, Massachusetts and on a portion of a parcel in Boston, Massachusetts. These parcels include sediment below Mean High Water ("MHW") in the Mystic River and comprise the Everett Staging Yard property, which was the site of a former Monsanto chemical manufacturing facility. The Remediation Area includes two subdivided areas within the embayment including the NDA and tidal flats.

The proposed Remediation Area is approximately 7.2 ± acres of tidal and subtidal waters within the embayment. The plan includes dredging shallow sediments that will be transported off-site, and capping with a subaqueous cap of clean backfill material. Up to 28,000 cubic yards of material is currently proposed to be dredged from the Remediation Area to a target depth of up to 18 inches below existing grades or the previously approved Navigational Dredge elevation of -15 feet North American Vertical Datum of 1988 (NAVD88) or 10 feet below mean low water. The total anticipated quantity of dredge includes an allowance of up to six inches (overdredge) to accommodate reasonable tolerances during dredge operations.

In order to provide ample water depth for waterside amenities and sufficient draft for vessels, dredging within the NDA was approved as part of the Project development. The navigational

dredge will involve the removal of approximately 17,335 cubic yards of sediment over approximately 68,140 square feet to provide an adequate water depth of 10 feet below mean low water (or elevation -15 NAVD88) for vessels. The quantity of dredge for the NDA is included in the overall project quantity of 28,000 cubic yards.

Once dredging has been completed, clean backfill material will be placed in the Remediation Area to provide a clean substrate suitable as a habitat for benthic organisms. Tabulated below are the proposed dredge and cap thicknesses for the three areas of the embayment. The specific type of the material to be placed will also be influenced by the physical location of the cap and regulatory requirements covering those areas.

Area	Dredge Thickness (inches)	Cap Thickness (inches)
Main Channel	0	18
Navigational Dredge	varies*	18
Tidal Flats	18	18

*Area will be dredged to elevation -15 ft NAVD88.

Field Exploration and Testing

Sediment core samples for the geotechnical evaluation were obtained at 15 locations by TG&B Marine of Bourne, Massachusetts in March and April of 2017. Locations are presented on Figure 1. Relatively undisturbed samples were acquired in plastic tube liners advanced within a vibracore. Table 1 presents the depths and descriptions of the sediment cores recovered. Sample depths were selected to represent the sediments that will remain beneath the future dredge line. Three main areas of the embayment were sampled including the NDA, main channel and tidal flats.

The recovered sediment cores were segmented into 6 inch sections to allow for laboratory testing to be performed at select intervals. The segmented samples were tested in the field using a Laboratory Miniature Vane Shear (mini-vane) testing apparatus manufactured by Wykeham Farrance. A total of 132 tests were performed to evaluate the undrained shear strength within the 3 subject areas of the embayment.

The mini-vane testing apparatus is used to obtain estimates of the undrained shear strength of fine grained soils. The test is performed by inserting a four-bladed vane into an undisturbed or remolded soil sample and rotating the vane at a constant rate to determine the torque required to shear a cylindrical area of the soil sample. The torque is measured by a calibrated spring. The torque obtained from testing is converted to an undrained shear strength of the soil. Results of the mini-vane testing are presented in Appendix A.

Four representative samples collected in the NDA were sent to GeoTesting Express of Acton, MA to obtain index and consolidation characteristics of the cap subgrade sediments. Laboratory testing included the following tests:

- Grain Size Distribution with Hydrometer Analysis (ASTM D422)
- Atterberg Limits (ASTM D4318)
- Moisture Content (ASTM D2216)

- Specific Gravity (ASTM D854)
- Density (ASTM D7263)
- Incremental 1-D Consolidation (ASTM D2435)

Results of laboratory testing are presented in Appendix B.

Table 1: Geotechnical Sediment Core Sampling Information

Embayment Area Sampled	Location ID	Approximate Mud Line Elevation (NAVD 88)	Water Depth (ft)	Geotechnical Sample Depth Interval (ft)	Approximate Geotech Sample Elevation (NAVD 88)	Sampler Penetration (ft)	Sample Recovery (ft)
Navigational Dredge Area	GZ-2*	-10	5	0-20	-10 to -30	20	18.4
	GZ-6*	-10	3.6	0-20	-10 to -30	20	18.2
	GZ-12*	-8	5.8	0-20	-8 to -28	20	17.5
	GZ-17*	-6	4	0-20	-6 to -26	20	14.9
	GZ-108	-15	10.3	0-20	-15 to -35	20	19.5
Main Channel Area	GZ-114	-15	12.8	0-3	-15 to -18	3.8	3
	GZ-119	-18	14.2	0-3	-18 to -21	3.5	3.5
	GZ-122	-1	5.2	0-5	-1 to -6	5	4.1
	GZ-129	-5	8.9	0-5	-5 to -10	5	4.3
	GZ-134	-17	12.3	0-3	-17 to -20	3.2	3.2
Tidal Flats Area	GZ-110	-3	5.5	0-5	-3 to -8	5	4.1
	GZ-205	-11	16.8	0-5	-11 to -16	5.8	5.8
	GZ-211	-3	6.6	0-5	-3 to -8	5.2	4.4
	GZ-215	-2	5.7	0-5	-2 to -7	5	4.4
	GZ-226	-4	8	0-5	-4 to -9	5	3.9

* Indicates sample location at which laboratory sample was obtained

Geotechnical Analysis

The soil properties used in the geotechnical analyses were selected from field and laboratory testing performed on select samples collected by Amec Foster Wheeler as detailed in the above Field Exploration and Testing section. Cap material properties were based on information provided by other members of the Amec Foster Wheeler design team.

Geotechnical analyses include bearing capacity, consolidation and sediment-cap mixing. Based on these analyses and the design cap materials, the bearing capacity and anticipated settlement from consolidation of the soft cap subgrade sediments should not damage the cap or cause significant sloughing during construction or after the cap has been constructed. Based on the sediment-cap mixing calculations, it is estimated that approximately 2 inches of material (or more) may mix into the soft sediments in the Main Channel, 4 to 6 inches in the NDA and minimal (<1 inch) in the tidal flats.

Bearing Capacity

Bearing capacity was evaluated for the three subject areas of the embayment, to verify that the proposed sand cap could be supported by the soft subgrade sediments. Results are detailed in calculation package G-001 "Bearing Capacity of Soft Sediments" in Appendix C. Local bearing failure was evaluated using shear strength criteria that was estimated from the field and lab data, which represents likely conditions to be encountered during construction of the cap. A second method, detailed by Palermo et al. (1998) was also used in which only the cohesive strength of the subgrade materials was considered. The resulting bearing capacity factors of safety for the evaluated areas are presented in Table 2.

Table 2: Bearing Capacity Factors of Safety

	Factor of Safety	
Area	Local Bearing Capacity (short term)	Cohesion Only Bearing Capacity
Main Channel	2.1	2.9
Tidal Flat	6.8	8.6
Navigational Dredge Area	0.8	1.1

A factor of safety less than 1 was calculated using the local bearing capacity failure method in the NDA. Although the factor of safety is less than one, the calculation assumes the load is applied all at one time. If the cap is placed, as recommended, in 6 inch lifts, the potential for a bearing capacity failure will be reduced.

Consolidation

An evaluation of soft sediment consolidation beneath the weight of the proposed cap were also performed. Results are detailed in calculation package G-002 "Consolidation of Soft Sediments" in Appendix C. Consolidation of the subgrade could lead to settlement; if localized variation in the subgrade were to cause differential settlement over relatively short distances, it is possible that the cap could be breached, whereas a soil cap has no tensile strength. Widespread, consistent settlement would lower the finished surface but is not expected to compromise the cap.

The laboratory data indicate two consolidation characteristics for each tested soil, recompression and primary consolidation, which is dependent on the magnitude of vertical pressure the soils have experienced in the past. In the Main Channel, the sediments are "normally consolidated" and have likely not experienced vertical pressure equal to that imposed by the future cap. That is, the vertical stresses associated with the cap will exceed the former stress, and the soil will undergo consolidation (volume change) along the "virgin compression curve" observed in the lab data. This is where the most settlement can be expected.

Within the NDA, soils below the future dredge line have been subjected to past vertical stress of several feet of sediments that, upon removal and replacement with the cap, will be less than or just slightly higher than the previous stress. These sediments may expand slightly due to the stress reduction and undergo "recompression" upon reloading. Consolidation is not expected as

long as the stresses imposed by the future cap (weight of the cap materials) will be approximately the same as those imposed by stresses from the in-situ material (the material being dredged). Similarly, within the Tidal Flats, the stress imposed by placement of the cap materials will be approximately the same as the stresses imposed by the in-situ material that will be removed by dredging. Here the consolidation settlement is expected to be negligible.

Based on these analyses, consolidation settlement and/or recompression settlements in the NDA should be minimal, i.e., less than 1.0 inch. In most cases, the load of material being removed during the dredging process is greater than the load of the applied cap. It is not anticipated that the cap will experience damage from settlement of the subgrade sediments.

Based on calculations using the primary consolidation, it is estimated that consolidation settlements in the Main Channel area may range in magnitude from 11 to 13 inches. Settlement calculated using data from GZ-17 showed roughly 5.5 inches of settlement. This value is suspected to be an outlier and may not be representative. The estimated settlements may occur over a period of 0.5 to 2.5 years.

It is important to note that the samples used in the consolidation analysis of the Main Channel area were samples obtained and tested from the NDA. Based on minivane testing data, the material in the Main Channel has an average undrained shear strength of roughly 2 times that of the NDA. Therefore, the actual settlement in the Main Channel may be less than predicted.

Although the calculated values are relatively high (greater than 6 inches), it is not anticipated that the cap performance will be impacted by settlements of these magnitudes. Due to the cap being a “flexible” layer of sand applied across the entire bottom of the embayment, any differential settlement between locations should not affect the cap performance as the sand will move with and conform to the underlying sediment. The cap thickness will remain consistent even though the surface may develop small undulations due to the settlement. It is not expected that large differential settlements will occur in short distances. The settlements that do occur are not expected to compromise the sand cap to the point at which there may be a break in the cap where contaminated sediment may re-suspend or come in contact with water. The cap thickness should be verified on a regular basis to verify that the clean cap thickness is maintained at 18 inches. If it is found that the cap is no longer 18 inches thick, additional material should be imported to bring the cap thickness back to the anticipated design thickness.

Sediment-Cap Mixing

Mixing of dissimilar soils placed in contact where fluid pressures are involved is inevitable. The amount of mixing is dependent on grain size difference, e.g., placing coarse gravel or cobbles above a soft clay will result in significant mixing. This is due in part to the velocity at which the new material makes impact with the surface of the existing, as well as the relative strength of the lower soils. Much has been written about prior subaqueous cap construction projects over the past 40 years, from which empirical data for mixing depths can be derived. The data suggests that placing a filter material that bridges the gradation gap between the fine subgrade and the coarser capping material will reduce the amount of cap material “lost” due to mixing.

It is anticipated that sediment-cap mixing will occur during construction. Based on review of other projects and existing data, it is anticipated that mixing of sediment and cap materials may occur on the magnitude of 2 inches (or more) in the Main Channel area, 4 to 6 inches in the NDA (assuming an appropriate gradation of sand is used in the lowest 6 inches) and less than 1 inch in the tidal flats (assuming replacement with like materials).

Filter gradation calculations performed in accordance with published methodologies used by the US Army Corps of Engineers and recommended by the US Environmental Protection Agency, presented in Appendix C as G-003 "Sediment-Cap Mixing," indicate that the Coase Sand proposed for cap construction within the Main Channel will be suitable for a filter beneath the Medium Gravel slated for use in the NDA. The Medium Gravel gradation falls outside the ideal filter criteria shown in the calculation package. Hence if Medium Gravel were placed in the NDA without a filter layer of Coarse Sand, or other finer material, the mixing zone would be deeper, perhaps as much as 12 inches or more. All soil gradations for this project are subject to verification once the borrow source(s) have been identified.

Subaqueous Cap Design Recommendations

Below are our recommendations and considerations for the design and construction of the proposed subaqueous cap:

- Based on our evaluations, a geotextile reinforcement (discussed earlier with the design team) will not be required.

- Given the soft nature of the subgrade sediments, it is anticipated that consolidation settlement will occur in the Main Channel area. Calculations estimate the settlement may range in magnitude from 11 to 13 inches and occur over a period of 0.5 to 2.5 years. The gradation and stiffness of the subgrade sediments appear to be consistent within the investigated areas. Thus, differential settlement is not expected to be a detrimental factor.

- Pore pressures in the subgrade sediment will increase as cap material is placed. Excess pore pressure, resulting from placing the cap material too quickly, reduces the shear strength of the material and could lead to bearing capacity failure. It is recommended that the cap materials be placed in thin lifts (~6 inches) in order to allow the pore pressures to dissipate between lifts. Placing material in thin lifts and in a dispersive manner will lower the potential for a bearing failure during construction.

- It is anticipated that sediment-cap mixing will occur during construction. Based on review of other projects and existing data, it is anticipated that mixing of sediment and cap materials may occur on the magnitude of 2 inches (or more) in the Main Channel area, 4 to 6 inches in the NDA (assuming an appropriate gradation of sand is used in the lowest 6 inches) and less than 1 inch in the tidal flats (assuming replacement with like materials).

- A dispersive placement method is recommended, rather than placing large quantities of material at one time, to reduce mixing. The performance objective is to obtain an 18-inch thick clean zone excluding any mixing zone. Depending on contractor methods, this may require placement of additional material in the main channel or NDA. No additional material

is expected to be required in the tidal flat area. Cap thicknesses will be determined by pre- and post-capping surveys with verification by cores, pans or other methods if necessary.

- Based on sediment-cap mixing calculations, it is recommended that a 6 inch layer of coarse sand be placed beneath the proposed medium gravel cap material in the NDA. The purpose of the layer is to provide a filter between the medium gravel and the contaminated settlement to reduce clean cap materials from mixing into the sediment.

- It is recommended that a post construction inspection and maintenance program be developed to monitor in-situ cap conditions after placement. The maintenance program should be developed to maintain cap thickness over the entire area to ensure capped sediments do not become exposed and re-suspended.

Closing

We appreciate the opportunity of providing our services to you during the exploration and design phases of this project and look forward to assisting you further during the design and construction phases as well. If you have any questions concerning this report or any of our testing, inspection design or consulting services please do not hesitate to contact us.

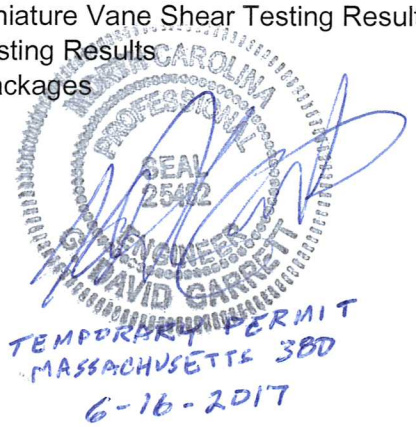
Respectfully submitted,

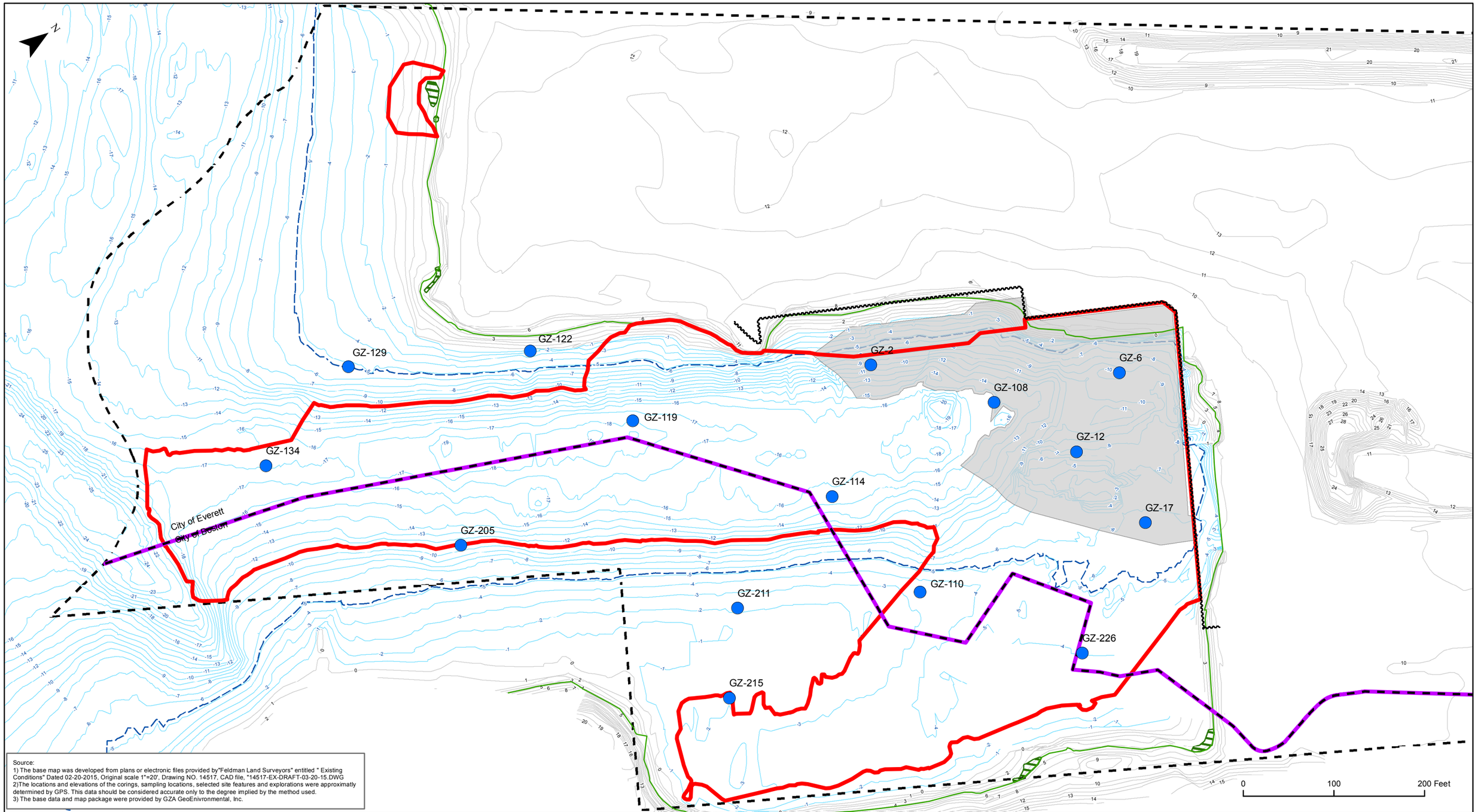
Amec Foster Wheeler Environment & Infrastructure, Inc.

Brian Weyer
Geotechnical Professional

G. David Garrett, P.E.
Senior Geotechnical Engineer

Appendix A – Laboratory Miniature Vane Shear Testing Results
Appendix B – Laboratory Testing Results
Appendix C – Calculation Packages





Source:
1) The base map was developed from plans or electronic files provided by"Feldman Land Surveyors" entitled " Existing Conditions" Dated 02-20-2015, Original scale 1"=20', Drawing NO. 14517, CAD file, "14517-EX-DRAFT-03-20-15.DWG
2)The locations and elevations of the corings, sampling locations, selected site features and explorations were approximatly determined by GPS. This data should be considered accurate only to the degree implied by the method used.
3) The base data and map package were provided by GZA GeoEnvironmental, Inc.

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- Sediment Remediation Boundary
- Bulkhead
- Approximate Parcel Boundary
- Previously Permitted Navigational Dredge Area
- Salt Marsh
- City Boundary
- Mean High Water
- Bathymetric Contour (<0) NAVD88
- Topographic Contour (>0) NAVD88
- Mean Low Water
- Geotechnical Sediment Core Location

Geotechnical Sediment Core Location Plan
Wynn Boston Harbor Development
1 Horizon Way, Everett, MA

Drawn By: J. Hightower	Checked By: B. Weyer
PROJECT NO: 3651160042	Date : 5/16/2017

FIGURE NO: **1**

Document Path: P:\Comm-Ind\Projects\Clients T to Z\Wynn\3651160042_Peer Review\GIS Files from Boston Server 3-15-2017\7.3 GIS\Figure_2_proposed_sediment_locations.mxd

APPENDIX A

Laboratory Miniature Vane Shear Test Data

MINI-VANE DATA SHEET

Project Name: Wynn Everett
Project Number:3651160042.013
Technicians: B. Weyer & S. Mizusawa
Date: April 4 - 6, 2017

						PEAK STRENGTH				RESIDUAL STRENGTH			
LINER	ELEVATION		SPRING #	VANE	SPRING CONSTANT	START DEG	END DEG	TOTAL DEG	PEAK SHEAR STRENGTH (ksf)	START DEG	END DEG	TOTAL DEG	RESIDUAL SHEAR STRENGTH (ksf)
	Top	Bottom											
134	-17.0	-17.5	933-1	1/2 x 1	0.0025567	76	103	27	0.07	76	-	-	-
134	-17.0	-17.5	933-1	1 x 1	0.0005593	39	162	123	0.07	39	68	29	0.0162197
134	-17.5	-18.0	933-1	1 x 1	0.0005593	40	126	86	0.05	40	49	9	0.0050337
134	-17.5	-18.0	933-1	1 x 1	0.0005593	40	116	76	0.04	40	59	19	0.0106267
134	-18.0	-18.5	933-1	1 x 1	0.0005593	39	162	123	0.07	39	46	7	0.0039151
134	-18.0	-18.5	933-1	1 x 1	0.0005593	40	175	135	0.08	40	55	15	0.0083895
134	-18.5	-19.0	933-1	1 x 1	0.0005593	41	212	171	0.10	41	57	16	0.0089488
134	-18.5	-19.0	933-1	1 x 1	0.0005593	39	70	31	0.02	39	43	4	0.0022372
134	-19.0	-19.5	933-1	1/2 x 1	0.0025567	41	70	29	0.07	41	45	4	0.0102268
134	-19.0	-19.5	933-1	1 x 1	0.0005593	40	247	207	0.12	40	62	22	0.0123046
134	-19.5	-20.0	933-1	1/2 x 1	0.0025567	25	66	41	0.10	25	38	13	0.0332371
134	-19.5	-20.0	933-1	1/2 x 1	0.0025567	24	56	32	0.08	24	29	5	0.0127835
119	-18.0	-18.5	933-1	1 x 1	0.0005593	24	70	46	0.03	24	34	10	0.005593
119	-18.5	-19.0	933-1	1 x 1	0.0005593	24	128	104	0.06	24	44	20	0.011186
119	-19.0	-19.5	933-1	1 x 1	0.0005593	24	110	86	0.05	24	47	23	0.0128639
119	-19.5	-20.0	933-1	1 x 1	0.0005593	24	130	106	0.06	24	44	20	0.011186
119	-20.0	-20.5	933-1	1 x 1	0.0005593	25	194	169	0.09	25	54	29	0.0162197
119	-20.5	-21.0	933-1	1 x 1	0.0005593	25	81	56	0.03	25	-	-	-
114	-15.0	-15.5	933-1	1 x 1	0.0005593	355	53	58	0.03	355	9	14	0.0078302
114	-15.5	-16.0	933-1	1 x 1	0.0005593	25	90	65	0.04	25	32	7	0.0039151
114	-16.0	-16.5	933-1	1 x 1	0.0005593	25	70	45	0.03	25	30	5	0.0027965
114	-16.5	-17.0	933-1	1 x 1	0.0005593	25	74	49	0.03	25	27	2	0.0011186
114	-17.0	-17.5	933-1	1 x 1	0.0005593	26	79	53	0.03	26	28	2	0.0011186
114	-17.5	-18.0	933-1	1 x 1	0.0005593	0	61	61	0.03	0	4	4	0.0022372
114	-18.0	-18.5	933-1	1 x 1	0.0005593	87	-	-	-	87	-	-	-
122	-1.0	-1.5	933-1	1 x 1	0.0005593	-	-	-	-	-	-	-	-
122	-1.5	-2.0	933-1	1 x 1	0.0005593	7	180+	-	-	7	-	-	-
122	-1.5	-2.0	933-1	1/2 x 1	0.0005593	-	-	-	-	-	-	-	-
122	-2.0	-2.5	933-1	1/2 x 1	0.0005593	2	119	117	0.07	2	10	8	0.0044744
122	-2.5	-3.0	933-1	1/2 x 1	0.0005593	0	79	79	0.04	0	9	9	0.0050337
122	-3.0	-3.5	933-1	1/2 x 1	0.0005593	0	87	87	0.05	0	13	13	0.0072709
122	-3.5	-4.0	933-1	1/2 x 1	0.0005593	2	91	89	0.05	2	12	10	0.005593
122	-4.0	-4.5	933-1	1/2 x 1	0.0005593	1	112	111	0.06	1	10	9	0.0050337
215	-2.0	-2.5	933-1	1/2 x 1	0.0025567	4	79	75	0.19	4	-	-	-
215	-2.5	-3.0	933-1	1/2 x 1	0.0025567	1	66	65	0.17	1	6	5	0.0127835
215	-3.0	-3.5	933-1	1/2 x 1	0.0025567	1	86	85	0.22	1	13	12	0.0306804

MINI-VANE DATA SHEET

Project Name: Wynn Everett
Project Number:3651160042.013
Technicians: B. Weyer & S. Mizusawa
Date: April 4 - 6, 2017

						PEAK STRENGTH				RESIDUAL STRENGTH			
LINER	ELEVATION		SPRING #	VANE	SPRING CONSTANT	START DEG	END DEG	TOTAL DEG	PEAK SHEAR STRENGTH (ksf)	START DEG	END DEG	TOTAL DEG	RESIDUAL SHEAR STRENGTH (ksf)
	Top	Bottom											
215	-3.5	-4.0	933-1	1/2 x 1	0.0025567	0	83	83	0.21	0	14	14	0.0357938
215	-4.0	-4.5	933-1	1/2 x 1	0.0025567	0	180+	-	-	0	-	-	-
215	-4.0	-4.5	933-2	1/2 x 1	0.0043899	38	87	49	0.22	38	44	6	0.0263394
215	-4.5	-5.0	933-2	1/2 x 1	0.0043899	37	139	102	0.45	37	52	15	0.0658485
215	-5.0	-5.5	933-2	1/2 x 1	0.0043899	37	104	67	0.29	37	42	5	0.0219495
215	-5.5	-6.0	933-2	1/2 x 1	0.0043899	36	104	68	0.30	36	42	6	0.0263394
211	-3.0	-3.5	933-2	1/2 x 1	0.0043899	21	81	60	0.26	21	29	8	0.0351192
211	-3.5	-4.0	933-2	1/2 x 1	0.0043899	21	112	91	0.40	21	34	13	0.0570687
211	-4.0	-4.5	933-2	1/2 x 1	0.0043899	21	80	59	0.26	21	31	10	0.043899
211	-4.5	-5.0	933-2	1/2 x 1	0.0043899	21	147	126	0.55	21	36	15	0.0658485
211	-5.0	-5.5	933-2	1/2 x 1	0.0043899	21	121	100	0.44	21	37	16	0.0702384
211	-5.5	-6.0	933-2	1/2 x 1	0.0043899	21	129	108	0.47	21	36	15	0.0658485
211	-6.0	-6.5	933-2	1/2 x 1	0.0043899	21	141	120	0.53	21	40	19	0.0834081
211	-6.5	-7.0	933-2	1/2 x 1	0.0043899	21	87	66	0.29	21	28	7	0.0307293
129	-5.0	-5.5	933-2	1/2 x 1	0.0043899	23	172	149	0.65	23	28	5	0.0219495
129	-5.5	-6.0	933-2	1/2 x 1	0.0043899	21	93	72	0.32	21	39	18	0.0790182
129	-6.0	-6.5	933-2	1/2 x 1	0.0043899	21	65	44	0.19	21	28	7	0.0307293
129	-6.5	-7.0	933-2	1/2 x 1	0.0043899	21	74	53	0.23	21	30	9	0.0395091
129	-7.0	-7.5	933-2	1/2 x 1	0.0043899	21	55	34	0.15	21	27	6	0.0263394
129	-7.5	-8.0	933-2	1/2 x 1	0.0043899	21	44	23	0.10	21	25	4	0.0175596
129	-8.0	-8.5	933-2	1/2 x 1	0.0043899	21	48	27	0.12	21	26	5	0.0219495
110	-3.0	-3.5	933-2	1/2 x 1	0.0043899	21	49	28	0.12	21	24	3	0.0131697
110	-3.5	-4.0	933-2	1/2 x 1	0.0043899	21	74	53	0.23	21	32	11	0.0482889
110	-4.0	-4.5	933-2	1/2 x 1	0.0043899	21	92	71	0.31	21	29	8	0.0351192
110	-4.5	-5.0	933-2	1/2 x 1	0.0043899	21	90	69	0.30	21	32	11	0.0482889
110	-5.0	-5.5	933-2	1/2 x 1	0.0043899	21	90	69	0.30	21	30	9	0.0395091
110	-5.5	-6.0	933-2	1/2 x 1	0.0043899	21	89	68	0.30	21	30	9	0.0395091
110	-6.0	-6.5	933-2	1/2 x 1	0.0043899	21	89	68	0.30	21	32	11	0.0482889
110	-6.5	-7.0	933-2	1/2 x 1	0.0043899	25	83	58	0.25	25	32	7	0.0307293
226	-4.0	-4.5	933-2	1/2 x 1	0.0043899	28	72	44	0.19	28	34	6	0.0263394
226	-4.5	-5.0	933-2	1/2 x 1	0.0043899	25	66	41	0.18	25	29	4	0.0175596
226	-5.0	-5.5	933-2	1/2 x 1	0.0043899	27	73	46	0.20	27	32	5	0.0219495
226	-5.5	-6.0	933-2	1/2 x 1	0.0043899	23	87	64	0.28	23	36	13	0.0570687
226	-6.0	-6.5	933-2	1/2 x 1	0.0043899	24	111	87	0.38	24	37	13	0.0570687

MINI-VANE DATA SHEET

Project Name: Wynn Everett
Project Number:3651160042.013
Technicians: B. Weyer & S. Mizusawa
Date: April 4 - 6, 2017

						PEAK STRENGTH				RESIDUAL STRENGTH			
LINER	ELEVATION		SPRING #	VANE	SPRING CONSTANT	START DEG	END DEG	TOTAL DEG	PEAK SHEAR STRENGTH (ksf)	START DEG	END DEG	TOTAL DEG	RESIDUAL SHEAR STRENGTH (ksf)
	Top	Bottom											
226	-6.5	-7.0	933-2	1/2 x 1	0.0043899	27	126	99	0.43	27	39	12	0.0526788
226	-7.0	-7.5	933-2	1/2 x 1	0.0043899	23	112	89	0.39	23	38	15	0.0658485
205	-11.0	-11.5	933-1	1 x 1	0.0005593	80	151	71	0.04	80	95	15	0.0083895
205	-11.5	-12.0	933-1	1 x 1	0.0005593	80	133	53	0.03	80	90	10	0.005593
205	-12.0	-12.5	933-1	1 x 1	0.0005593	78	223	145	0.08	78	98	20	0.011186
205	-12.5	-13.0	933-1	1/2 x 1	0.0025567	78	180+	-	-	78	-	-	-
205	-13.0	-13.5	933-1	1/2 x 1	0.0025567	78	117	39	0.10	78	85	7	0.0178969
205	-13.5	-14.0	933-1	1/2 x 1	0.0025567	80	140	60	0.15	80	83	3	0.0076701
205	-14.0	-14.5	933-1	1/2 x 1	0.0025567	79	126	47	0.12	79	80	1	0.0025567
205	-14.5	-15.0	933-1	1/2 x 1	0.0025567	79	145	66	0.17	79	-	-	-
205	-15.0	-15.5	933-1	1/2 x 1	0.0025567	78	111	33	0.08	78	79	1	0.0025567
205	-15.5	-16.0	933-1	1/2 x 1	0.0025567	78	178	100	0.26	78	87	9	0.0230103
205	-15.5	-16.0	933-1	1 x 1	0.0005593	79	168	89	0.05	79	93	14	0.0078302
		-						-	-	-		-	-

APPENDIX B

Laboratory Testing Results

GeoTesting EXPRESS

Technologies to manage risk for infrastructure

Boston
Atlanta
Chicago
Los Angeles
New York

www.geotesting.com

Transmittal

TO:

Brian Weyer

AMEC Foster Wheeler

271 Mill Road

Chelmsford, MA 01824

DATE: 5/5/2017	GTX NO: 306274
RE: Wynn Everett	

COPIES	DATE	DESCRIPTION
	5/5/2017	**May 2017 Laboratory Test Report**

REMARKS:

SIGNED:

Ethan Marro, Assistant Laboratory Manager

CC:

APPROVED BY:

Joe Tomei, Laboratory Manager

GeoTesting EXPRESS

Technologies to manage risk for infrastructure

Boston
Atlanta
Chicago
Los Angeles
New York
www.geotesting.com

May 5, 2017

Brian Weyer
AMEC Foster Wheeler
271 Mill Road
Chelmsford, MA 01824

RE: Wynn Everett, Everett, MA (GTX-306274)

Dear Brian:

Enclosed are the test results you requested for the above referenced project. GeoTesting Express, Inc. (GTX) received eight samples from you on 4/14/2017. These samples were labeled as follows:

Boring	Sample	Depth
GZ-2	S1	18-18.5
GZ-2	S2	18.5-19
GZ-6	S1	20-20.5
GZ-6	S2	20.5-21
GZ-12	S1	18-18.5
GZ-12	S2	18.5-19
GZ-17	S1	18.5-19
GZ-17	S2	19-19.5

GTX performed the following tests on these samples:

4 ASTM D2216 - Moisture Contents
4 ASTM D854 - Specific Gravity
4 ASTM D7263 - Density (Unit Weight) of Soil Specimens
4 ASTM D422 - Grain Size Analyses - Sieve and Hydrometer
4 ASTM D4318 - Atterberg Limits
4 ASTM D2435 - Incremental Consolidation tests

A copy of your test request is attached.

The results presented in this report apply only to the items tested. This report shall not be reproduced except in full, without written approval from GeoTesting Express. The remainder of these samples will be retained for a period of sixty (60) days and will then be discarded unless otherwise notified by you. Please call me if you have any questions or require additional information. Thank you for allowing GeoTesting Express the opportunity of providing you with testing services. We look forward to working with you again in the future.

Respectfully yours,

Ethan Marro
Assistant Laboratory Manager

GeoTesting EXPRESS

Technologies to manage risk for infrastructure

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www.geotesting.com

Geotechnical Test Report

5/5/2017

GTX-306274
Wynn Everett
Everett, MA

Prepared for:

AMEC Foster Wheeler

Client:	AMEC Foster Wheeler				
Project:	Wynn Everett				
Location:	Everett, MA			Project No:	GTX-306274
Boring ID:	---	Sample Type:	---	Tested By:	jbr
Sample ID:	---	Test Date:	04/24/17	Checked By:	jdt
Depth :	---	Test Id:	408441		

Moisture Content of Soil and Rock - ASTM D2216

Boring ID	Sample ID	Depth	Description	Moisture Content, %
GZ-2	S1	18-18.5	Wet, dark gray silt	314.7
GZ-6	S1	20-20.5	Wet, very dark gray silt	438.4
GZ-12	S2	18.5-19	Wet, dark gray silt	297.7
GZ-17	S1	18.5-19	Wet, dark gray silt with sand	161.7

Notes: Temperature of Drying : 110º Celsius

Client:	AMEC Foster Wheeler				
Project:	Wynn Everett				
Location:	Everett, MA			Project No:	GTX-306274
Boring ID:	---	Sample Type:	---	Tested By:	md
Sample ID:	---	Test Date:	04/21/17	Checked By:	jdt
Depth :	---	Test Id:	408449		

Laboratory Determination of Density (Unit Weight) of Soil Specimens by ASTM D7263

Boring ID	Sample ID	Depth	Visual Description	Bulk Density pcf	Moisture Content %	Dry Density pcf	*
GZ-2	S1	18-18.5	Wet, dark gray silt	75.61	314.7	18.23	(1)
GZ-6	S1	20-20.5	Wet, very dark gray silt	102.0	438.4	18.95	(2)
GZ-12	S2	18.5-19	Wet, dark gray silt	78.13	297.7	19.65	(3)
GZ-17	S1	18.5-19	Wet, dark gray silt with sand	83.93	161.7	32.07	(4)

* Sample Comments

(1): Method B-Cylinder,

(2): Contains decomposed organic materials

Method B-Cylinder, Intact

(3): Method B-Cylinder, Intact

(4): Method B-Cylinder, Intact

Notes: Moisture Content determined by ASTM D2216.

Client:	AMEC Foster Wheeler				
Project:	Wynn Everett				
Location:	Everett, MA			Project No:	GTX-306274
Boring ID:	---	Sample Type:	---	Tested By:	jbr
Sample ID:	---	Test Date:	04/25/17	Checked By:	jdt
Depth :	---	Test Id:	408445		

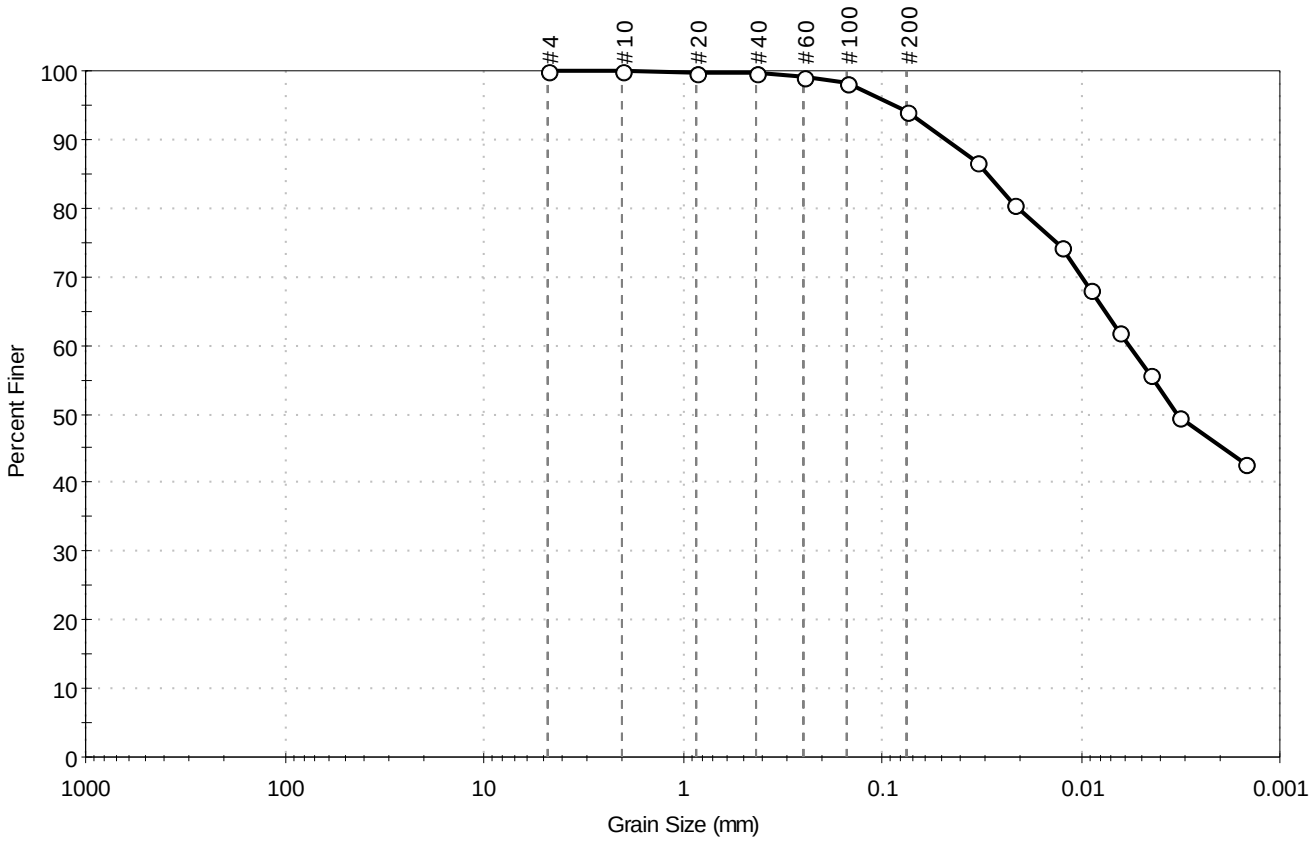
Specific Gravity of Soils by ASTM D854

Boring ID	Sample ID	Depth	Visual Description	Specific Gravity	Comment
GZ-2	S1	18-18.5	Wet, dark gray silt	2.37	
GZ-6	S1	20-20.5	Wet, very dark gray silt	2.35	
GZ-12	S2	18.5-19	Wet, dark gray silt	2.39	
GZ-17	S1	18.5-19	Wet, dark gray silt with sand	2.43	

Notes: Specific Gravity performed by using method B (oven dried specimens) of ASTM D854
Moisture Content determined by ASTM D2216.

Client:	AMEC Foster Wheeler				
Project:	Wynn Everett				
Location:	Everett, MA			Project No:	GTX-306274
Boring ID:	GZ-2	Sample Type:	tube	Tested By:	jbr
Sample ID:	S1	Test Date:	04/25/17	Checked By:	jdt
Depth :	18-18.5	Test Id:	408434		
Test Comment:	---				
Visual Description:	Wet, dark gray silt				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	5.9	94.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	99		
#100	0.15	98		
#200	0.075	94		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0330	87		
---	0.0216	80		
---	0.0126	74		
---	0.0090	68		
---	0.0064	62		
---	0.0045	56		
---	0.0032	49		
---	0.0015	43		

Coefficients

D_{85} = 0.0295 mm	D_{30} = N/A
D_{60} = 0.0058 mm	D_{15} = N/A
D_{50} = 0.0033 mm	D_{10} = N/A
C_u = N/A	C_c = N/A

Classification

ASTM Elastic silt (MH)

AASHTO Clayey Soils (A-7-5 (142))

Sample / Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

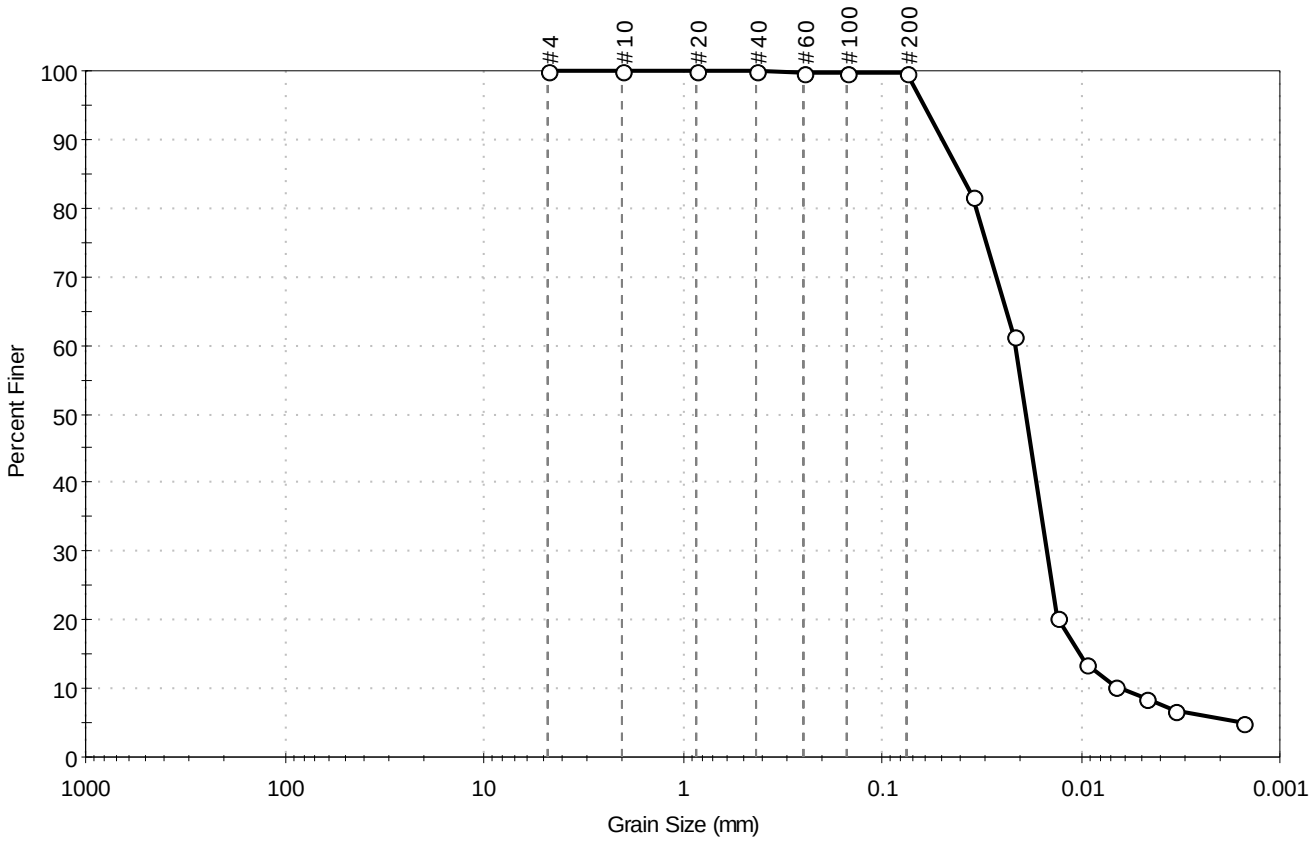
Specific Gravity : 2.65

Separation of Sample: #200 Sieve

GeoTesting EXPRESS

Client:	AMEC Foster Wheeler				
Project:	Wynn Everett				
Location:	Everett, MA			Project No:	GTX-306274
Boring ID:	GZ-6	Sample Type:	tube	Tested By:	jbr
Sample ID:	S1	Test Date:	04/25/17	Checked By:	jdt
Depth :	20-20.5	Test Id:	408435		
Test Comment:	---				
Visual Description:	Wet, very dark gray silt				
Sample Comment:	Contains decomposed organic materials				

Particle Size Analysis - ASTM D422



%Cobble	%Gravel	%Sand	%Silt & Clay Size
---	0.0	0.3	99.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	100		
#100	0.15	100		
#200	0.075	100		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0351	82		
---	0.0218	61		
---	0.0132	20		
---	0.0095	14		
---	0.0067	10		
---	0.0047	9		
---	0.0034	7		
---	0.0015	5		

Coefficients

D_{85} = 0.0404 mm	D_{30} = 0.0149 mm
D_{60} = 0.0215 mm	D_{15} = 0.0101 mm
D_{50} = 0.0190 mm	D_{10} = 0.0064 mm
C_u = 3.359	C_c = 1.613

Classification

ASTM Elastic silt (MH)

AASHTO Clayey Soils (A-7-5 (160))

Sample / Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

Specific Gravity : 2.65

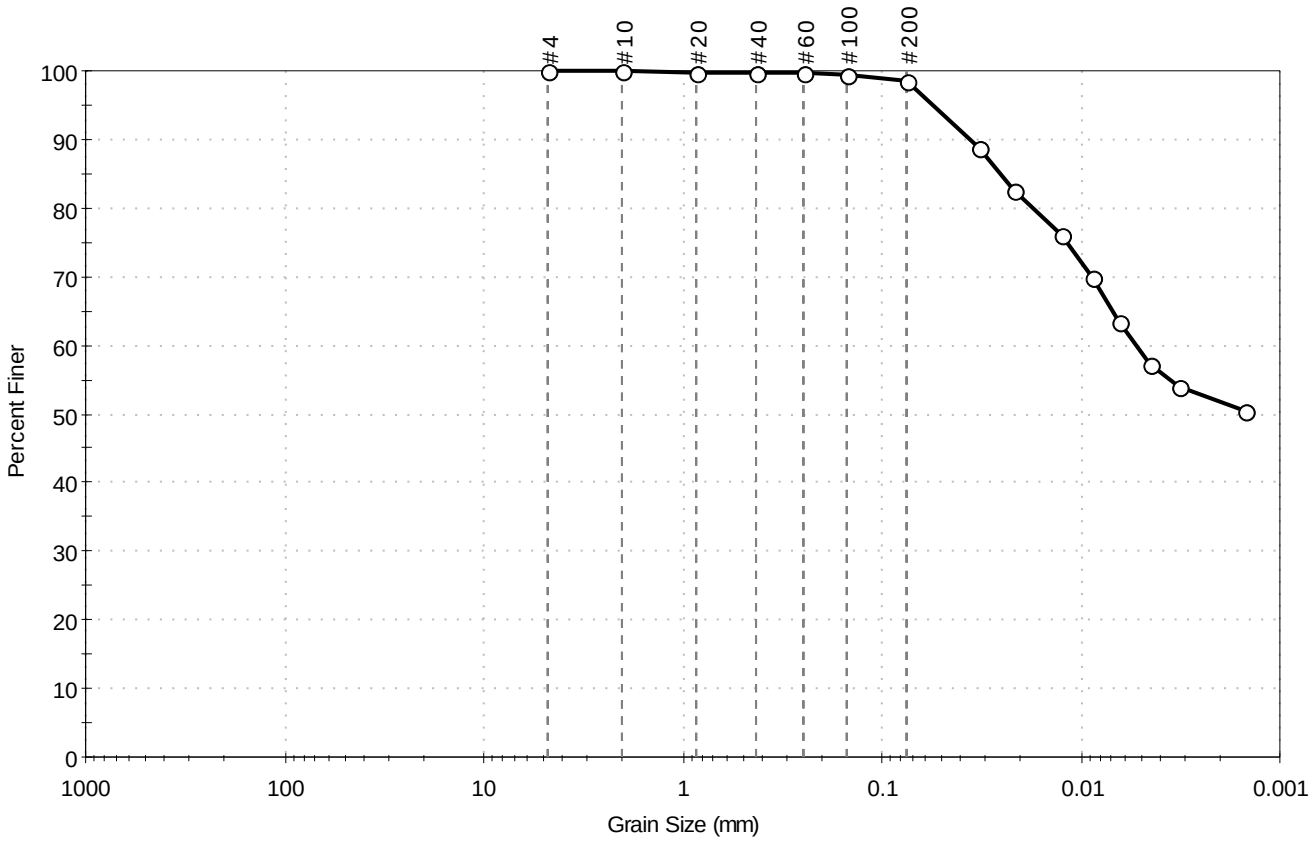
Separation of Sample: #200 Sieve

GeoTesting EXPRESS

Client:	AMEC Foster Wheeler				
Project:	Wynn Everett				
Location:	Everett, MA			Project No:	GTX-306274
Boring ID:	GZ-12	Sample Type:	tube	Tested By:	jbr
Sample ID:	S2	Test Date:	04/25/17	Checked By:	jdt
Depth :	18.5-19	Test Id:	408436		

Test Comment: ---
Visual Description: Wet, dark gray silt
Sample Comment: ---

Particle Size Analysis - ASTM D422



%Cobble	%Gravel	%Sand	%Silt & Clay Size
---	0.0	1.5	98.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	100		
#100	0.15	99		
#200	0.075	99		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0328	89		
---	0.0219	83		
---	0.0125	76		
---	0.0088	70		
---	0.0064	64		
---	0.0045	57		
---	0.0032	54		
---	0.0015	50		

Coefficients

D_{85} = 0.0256 mm D_{30} = N/A
D_{60} = 0.0053 mm D_{15} = N/A
D_{50} = N/A D_{10} = N/A
C_u = N/A C_c = N/A

Classification

ASTM Elastic silt (MH)

AASHTO Clayey Soils (A-7-5 (163))

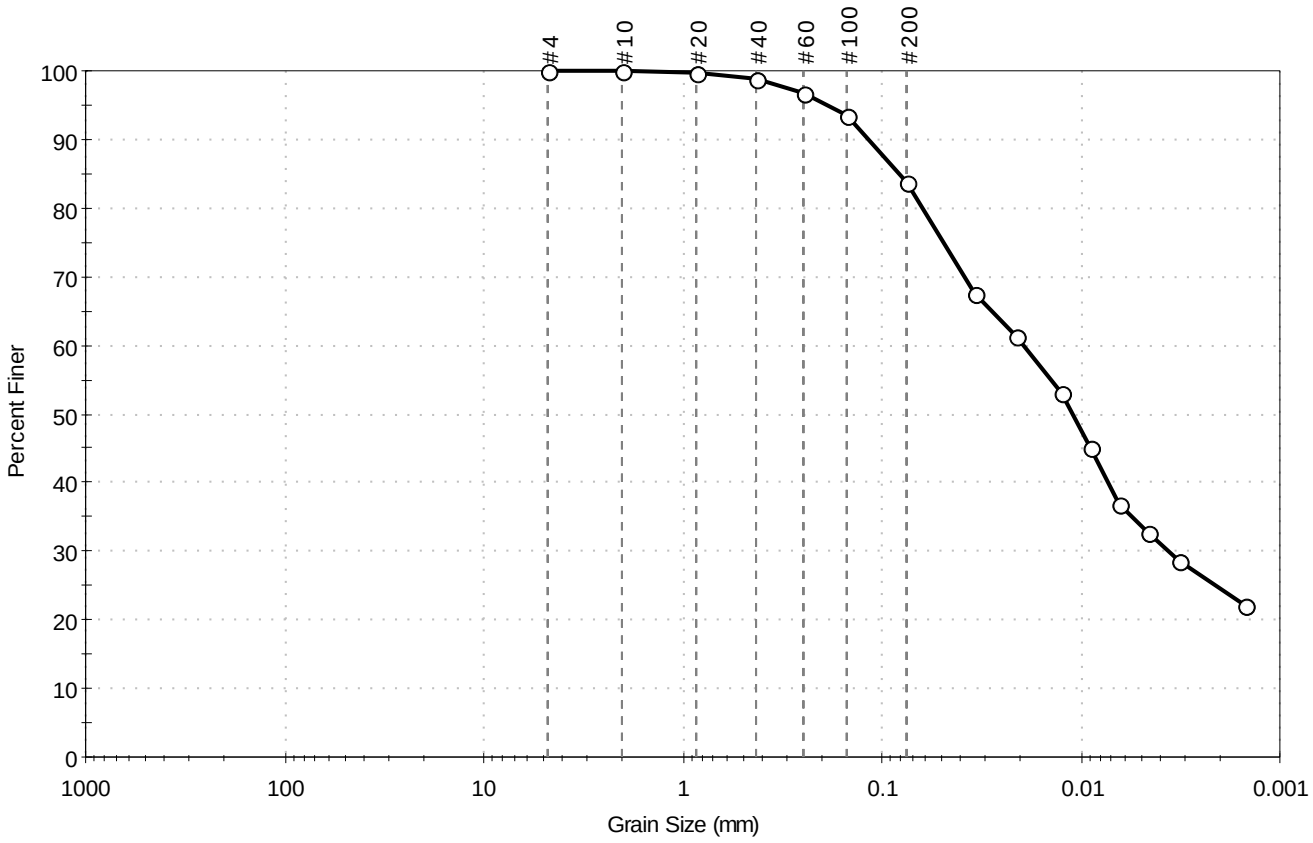
Sample / Test Description

Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Specific Gravity : 2.65
Separation of Sample: #200 Sieve

GeoTesting EXPRESS

Client:	AMEC Foster Wheeler				
Project:	Wynn Everett				
Location:	Everett, MA			Project No:	GTX-306274
Boring ID:	GZ-17	Sample Type:	tube	Tested By:	jbr
Sample ID:	S1	Test Date:	04/25/17	Checked By:	jdt
Depth :	18.5-19	Test Id:	408437		
Test Comment:	---				
Visual Description:	Wet, dark gray silt with sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



%Cobble	%Gravel	%Sand	%Silt & Clay Size
---	0.0	16.1	83.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	99		
#60	0.25	97		
#100	0.15	94		
#200	0.075	84		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0339	68		
---	0.0210	61		
---	0.0124	53		
---	0.0089	45		
---	0.0064	37		
---	0.0046	33		
---	0.0032	29		
---	0.0015	22		

Coefficients

D_{85} = 0.0813 mm	D_{30} = 0.0036 mm
D_{60} = 0.0192 mm	D_{15} = N/A
D_{50} = 0.0109 mm	D_{10} = N/A
C_u = N/A	C_c = N/A

Classification

ASTM Elastic silt with sand (MH)

AASHTO Clayey Soils (A-7-5 (66))

Sample / Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

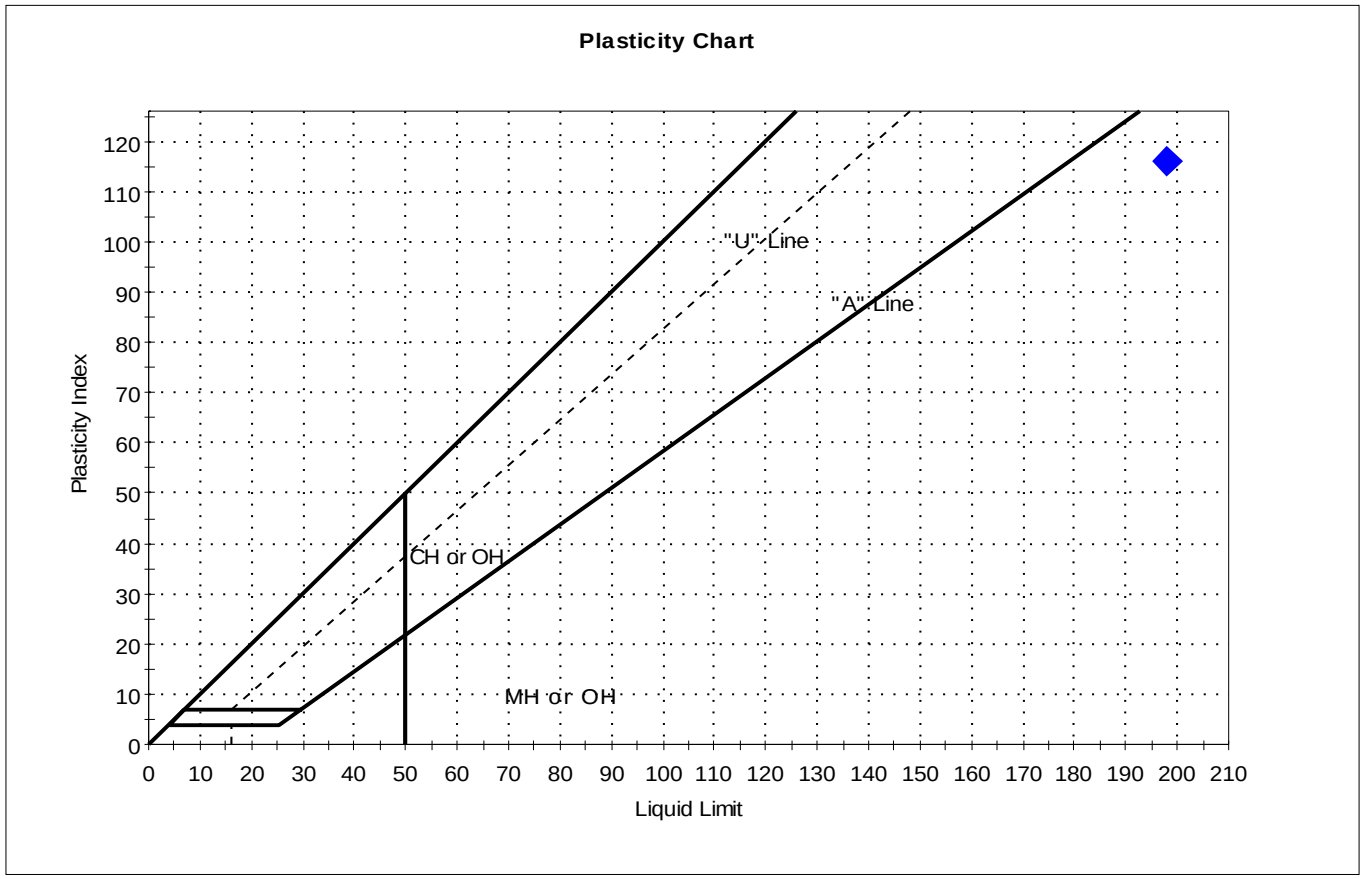
Dispersion Period : 1 minute

Specific Gravity : 2.65

Separation of Sample: #200 Sieve

Client:	AMEC Foster Wheeler				
Project:	Wynn Everett				
Location:	Everett, MA			Project No:	GTX-306274
Boring ID:	GZ-2	Sample Type:	tube	Tested By:	cam
Sample ID:	S1	Test Date:	04/24/17	Checked By:	jdt
Depth :	18-18.5	Test Id:	408430		
Test Comment:	---				
Visual Description:	Wet, dark gray silt				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	S1	GZ-2	18-18.5	315	198	82	116	2	Elastic silt (MH)

Sample Prepared using the WET method

0% Retained on #40 Sieve

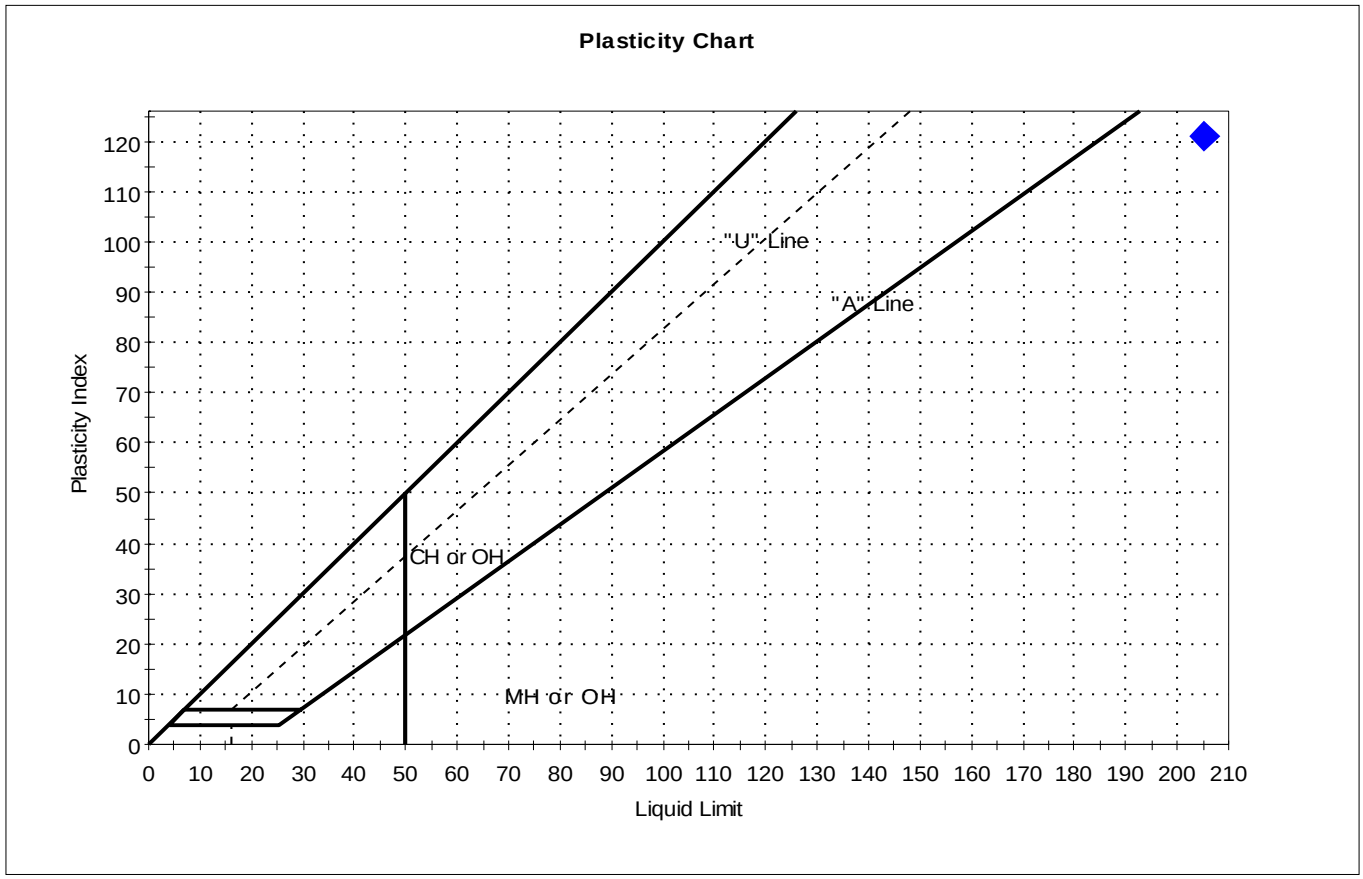
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	AMEC Foster Wheeler				
Project:	Wynn Everett				
Location:	Everett, MA			Project No:	GTX-306274
Boring ID:	GZ-6	Sample Type:	tube	Tested By:	cam
Sample ID:	S1	Test Date:	04/24/17	Checked By:	jdt
Depth :	20-20.5	Test Id:	408431		
Test Comment:	---				
Visual Description:	Wet, very dark gray silt				
Sample Comment:	Contains decomposed organic materials				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	S1	GZ-6	20-20.5	438	205	84	121	2.9	Elastic silt (MH)

Sample Prepared using the WET method

0% Retained on #40 Sieve

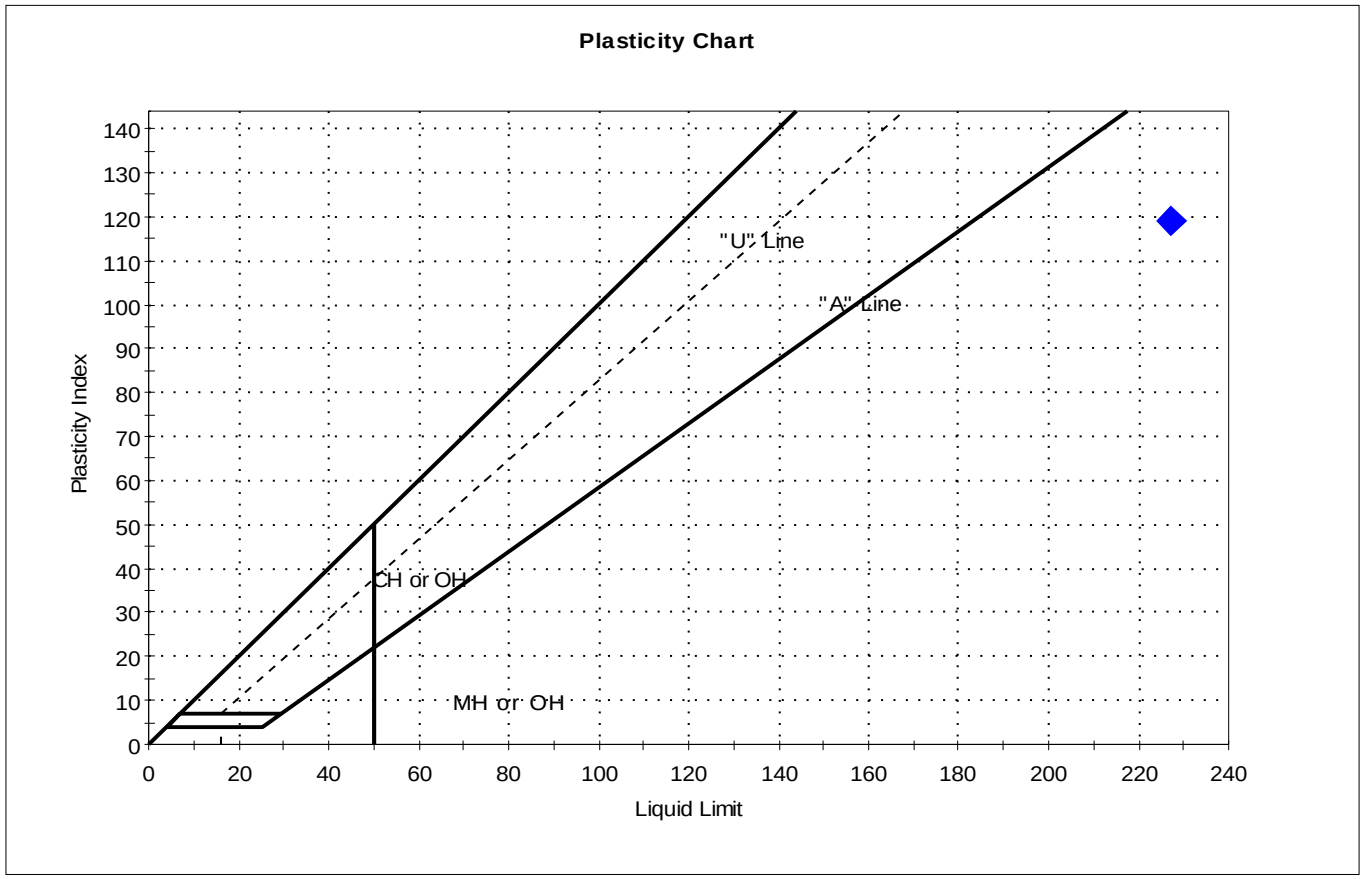
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	AMEC Foster Wheeler				
Project:	Wynn Everett				
Location:	Everett, MA			Project No:	GTX-306274
Boring ID:	GZ-12	Sample Type:	tube	Tested By:	cam
Sample ID:	S2	Test Date:	04/24/17	Checked By:	jdt
Depth :	18.5-19	Test Id:	408432		
Test Comment:	---				
Visual Description:	Wet, dark gray silt				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	S2	GZ-12	18.5-19	298	227	108	119	1.6	Elastic silt (MH)

Sample Prepared using the WET method

0% Retained on #40 Sieve

Dry Strength: VERY HIGH

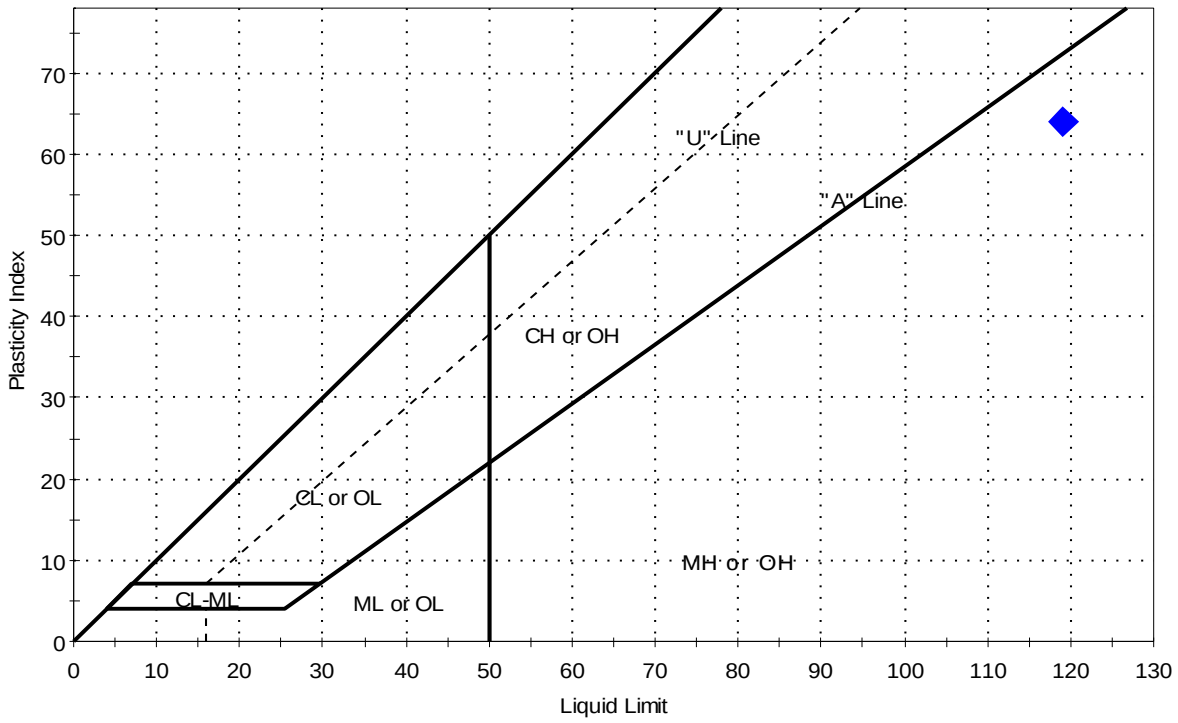
Dilatancy: SLOW

Toughness: LOW

Client:	AMEC Foster Wheeler				
Project:	Wynn Everett				
Location:	Everett, MA			Project No:	GTX-306274
Boring ID:	GZ-17	Sample Type:	tube	Tested By:	cam
Sample ID:	S1	Test Date:	04/24/17	Checked By:	jdt
Depth :	18.5-19	Test Id:	408433		
Test Comment:	---				
Visual Description:	Wet, dark gray silt with sand				
Sample Comment:	---				

Atterberg Limits - ASTM D4318

Plasticity Chart

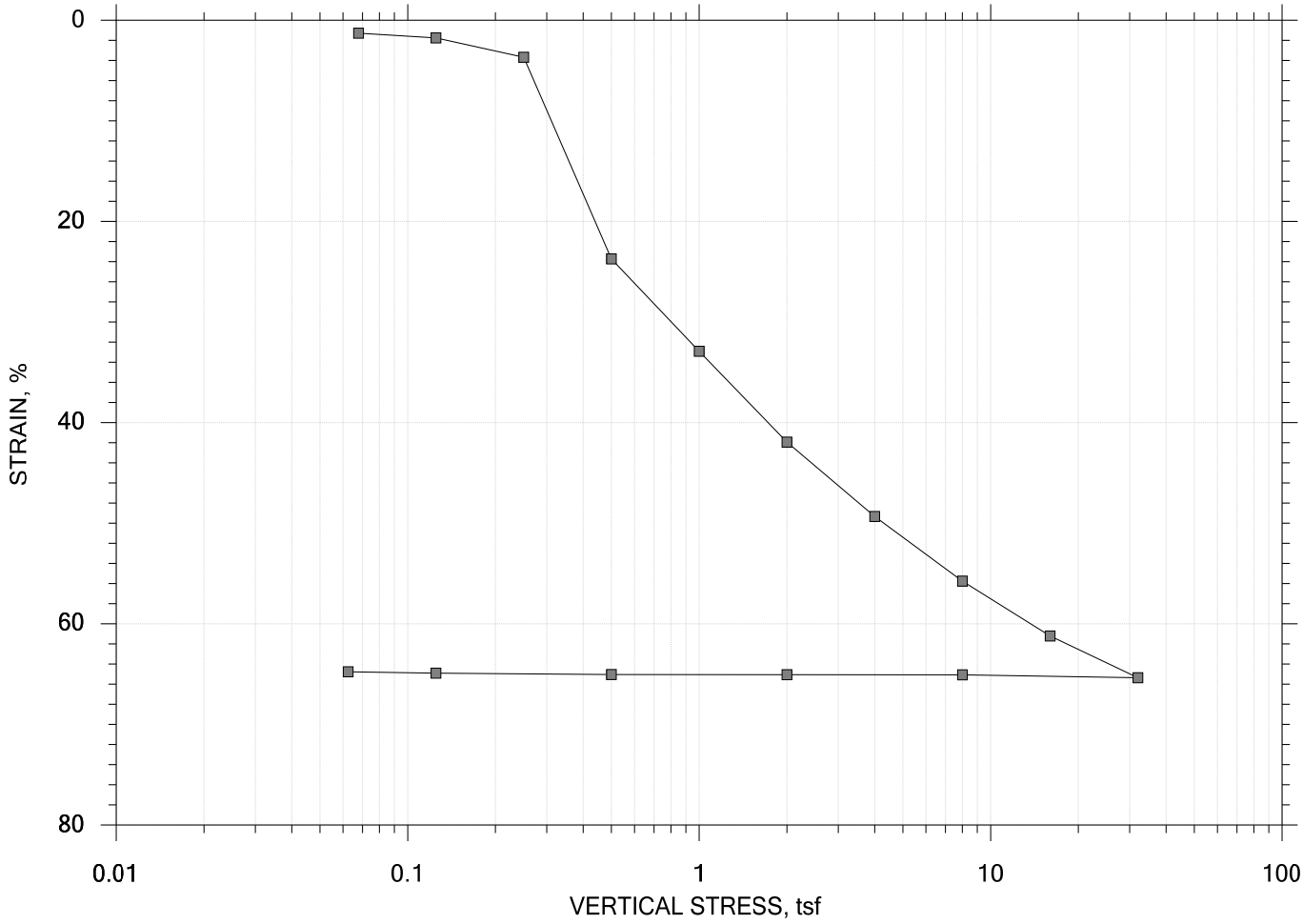


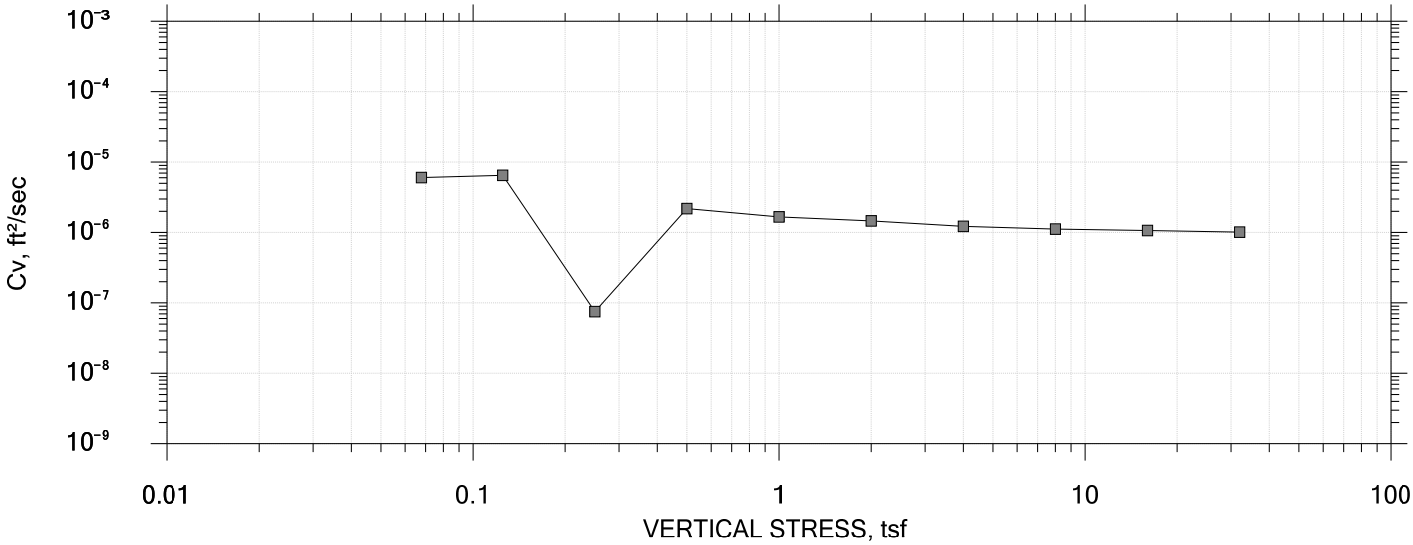
Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	S1	GZ-17	18.5-19	162	119	55	64	1.7	Elastic silt with sand (MH)

Sample Prepared using the WET method
1% Retained on #40 Sieve
Dry Strength: VERY HIGH
Dilatancy: SLOW
Toughness: LOW

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT

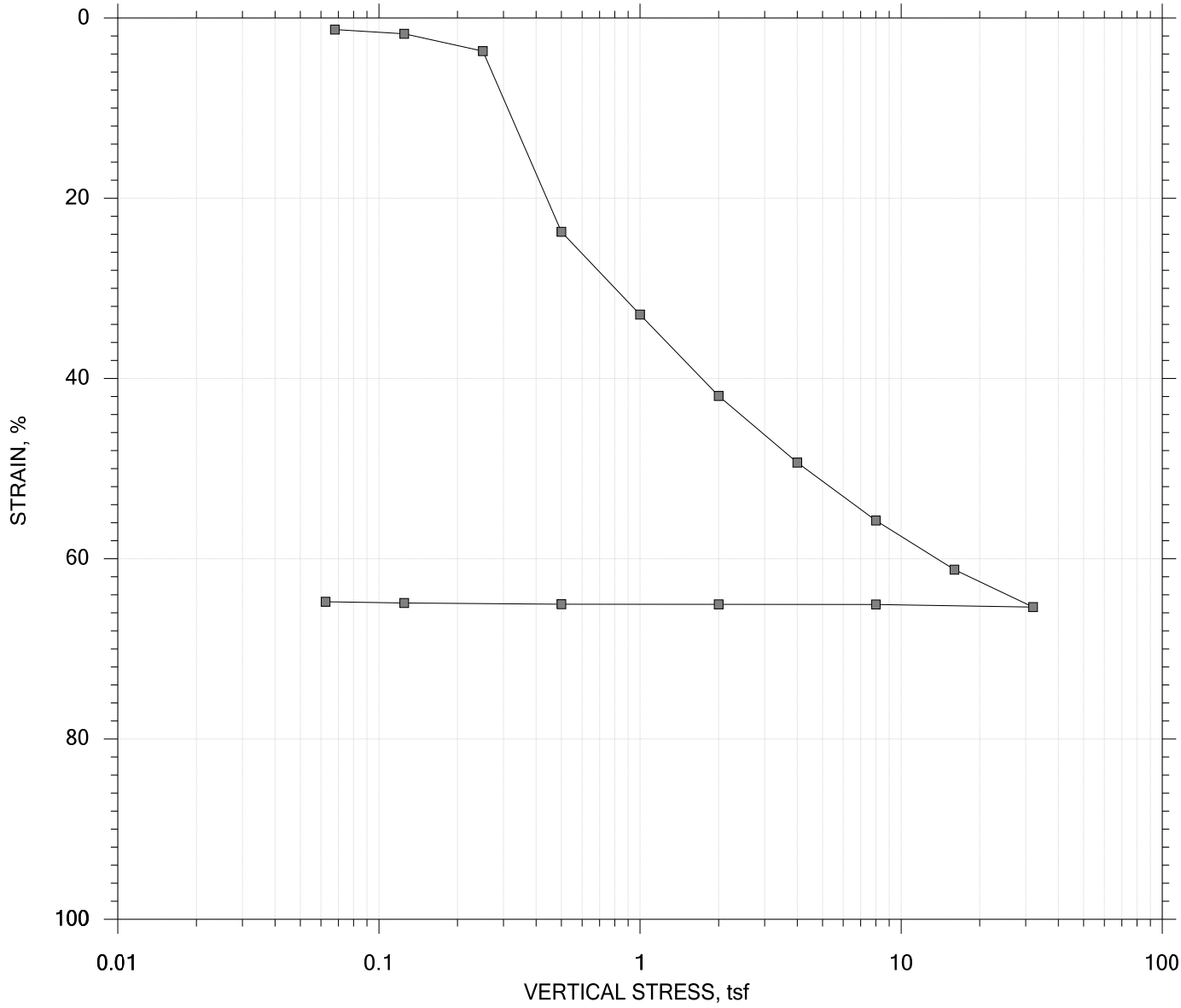




GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-2	Tested By: md	Checked By: njh
	Sample No.: S-1	Test Date: 04/12/17	Test No.: IP-2
	Depth: 18-18.5 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System X, Swell Pressure = 0.0678 tsf		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT



					Before Test	After Test
Current Vertical Effective Stress: ---				Water Content, %	355.85	77.22
Preconsolidation Stress: ---				Dry Unit Weight, pcf	15.682	52.273
Compression Ratio: ---				Saturation, %	99.99	99.98
Diameter: 2.5 in		Height: 1 in		Void Ratio	8.43	1.83
LL: 198	PL: 82	PI: 116	GS: 2.37			

GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-2	Tested By: md	Checked By: njh
	Sample No.: S-1	Test Date: 04/12/17	Test No.: IP-2
	Depth: 18-18.5 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System X, Swell Pressure = 0.0678 tsf		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
Boring No.: GZ-2	Tested By: md	Checked By: njh
Sample No.: S-1	Test Date: 04/12/17	Depth: 18-18.5 ft
Test No.: IP-2	Sample Type: intact	Elevation: ---

Soil Description: Wet, dark gray silt
Remarks: System X, Swell Pressure = 0.0678 tsf

Measured Specific Gravity: 2.37	Liquid Limit: 198	Specimen Diameter: 2.50 in
Initial Void Ratio: 8.43	Plastic Limit: 82	Initial Height: 1.00 in
Final Void Ratio: 1.83	Plasticity Index: 116	Final Height: 0.30 in

	Before Consolidation		After Consolidation	
	Trimmings	Specimen+Ring	Specimen+Ring	Trimmings
Container ID	C-879	RING		C-1287
Wt. Container + Wet Soil, gm	72.680	203.62	147.32	47.800
Wt. Container + Dry Soil, gm	23.800	131.72	131.72	30.680
Wt. Container, gm	8.2700	111.51	111.51	8.5100
Wt. Dry Soil, gm	15.530	20.206	20.206	22.170
Water Content, %	314.75	355.85	77.22	77.22
Void Ratio	---	8.43	1.83	---
Degree of Saturation, %	---	99.99	99.98	---
Dry Unit Weight, pcf	---	15.682	52.273	---

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Wynn Everett | Location: Everett, MA | Project No.: GTX-306274
Boring No.: GZ-2 | Tested By: md | Checked By: njh
Sample No.: S-1 | Test Date: 04/12/17 | Depth: 18-18.5 ft
Test No.: IP-2 | Sample Type: intact | Elevation: ---

Soil Description: Wet, dark gray silt
Remarks: System X, Swell Pressure = 0.0678 tsf

Displacement at End of Increment

	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt T90 min	Cv ft²/sec	Mv 1/tsf	k ft/day
1	0.0678	0.01288	8.31	1.29	15.599	1.55e-006	1.90e-001	7.95e-004
2	0.125	0.01755	8.27	1.75	9.003	2.64e-006	8.17e-002	5.82e-004
3	0.250	0.03672	8.09	3.67	159.039	1.46e-007	1.53e-001	6.04e-005
4	0.500	0.2371	6.20	23.7	18.943	9.65e-007	8.02e-001	2.09e-003
5	1.00	0.3290	5.33	32.9	19.039	6.62e-007	1.84e-001	3.28e-004
6	2.00	0.4193	4.48	41.9	18.204	5.28e-007	9.02e-002	1.28e-004
7	4.00	0.4933	3.78	49.3	17.521	4.14e-007	3.70e-002	4.13e-005
8	8.00	0.5575	3.17	55.8	17.388	3.18e-007	1.61e-002	1.38e-005
9	16.0	0.6120	2.66	61.2	17.026	2.48e-007	6.81e-003	4.56e-006
10	32.0	0.6535	2.27	65.3	17.290	1.91e-007	2.59e-003	1.34e-006
11	8.00	0.6508	2.30	65.1	21.006	1.41e-007	1.14e-004	4.35e-008
12	2.00	0.6505	2.30	65.1	0.000	0.00e+000	3.78e-005	0.00e+000
13	0.500	0.6504	2.30	65.0	162.892	1.84e-008	9.16e-005	4.55e-009
14	0.125	0.6490	2.31	64.9	552.241	5.45e-009	3.84e-003	5.65e-008
15	0.0625	0.6476	2.32	64.8	0.000	0.00e+000	2.08e-002	0.00e+000

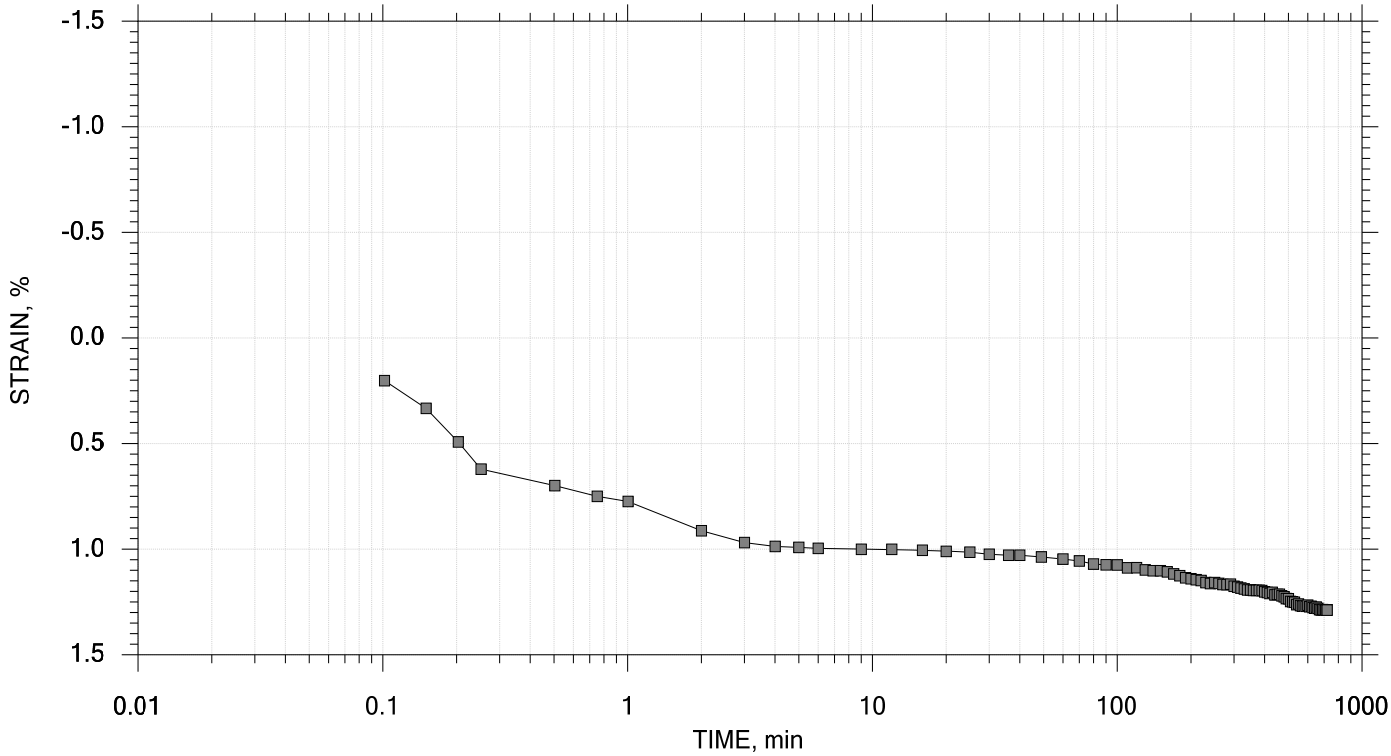
	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Log T50 min	Cv ft²/sec	Mv 1/tsf	k ft/day	Ca %
1	0.0678	0.01288	8.31	1.29	0.000	0.00e+000	1.90e-001	0.00e+000	0.00e+000
2	0.125	0.01755	8.27	1.75	0.000	0.00e+000	8.17e-002	0.00e+000	0.00e+000
3	0.250	0.03672	8.09	3.67	0.000	0.00e+000	1.53e-001	0.00e+000	0.00e+000
4	0.500	0.2371	6.20	23.7	1.801	2.36e-006	8.02e-001	5.10e-003	0.00e+000
5	1.00	0.3290	5.33	32.9	1.539	1.90e-006	1.84e-001	9.43e-004	0.00e+000
6	2.00	0.4193	4.48	41.9	1.363	1.64e-006	9.02e-002	3.99e-004	0.00e+000
7	4.00	0.4933	3.78	49.3	0.000	0.00e+000	3.70e-002	0.00e+000	0.00e+000
8	8.00	0.5575	3.17	55.8	0.000	0.00e+000	1.61e-002	0.00e+000	0.00e+000
9	16.0	0.6120	2.66	61.2	0.000	0.00e+000	6.81e-003	0.00e+000	0.00e+000
10	32.0	0.6535	2.27	65.3	0.575	1.34e-006	2.59e-003	9.35e-006	0.00e+000
11	8.00	0.6508	2.30	65.1	0.000	0.00e+000	1.14e-004	0.00e+000	0.00e+000
12	2.00	0.6505	2.30	65.1	587.233	1.18e-009	3.78e-005	1.21e-010	0.00e+000
13	0.500	0.6504	2.30	65.0	144.206	4.83e-009	9.16e-005	1.19e-009	0.00e+000
14	0.125	0.6490	2.31	64.9	0.000	0.00e+000	3.84e-003	0.00e+000	0.00e+000
15	0.0625	0.6476	2.32	64.8	0.000	0.00e+000	2.08e-002	0.00e+000	0.00e+000

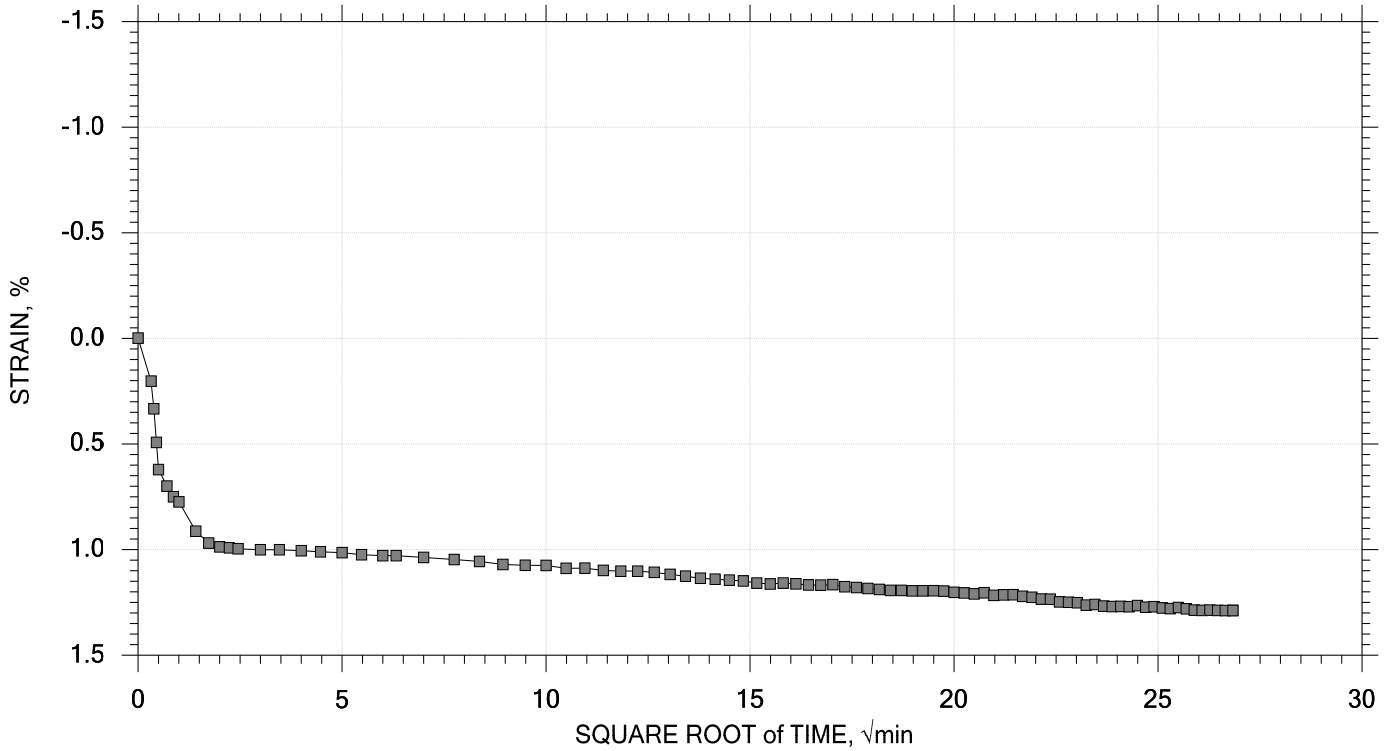
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Volume Step 1 of 15

Stress: 0.067822 tsf





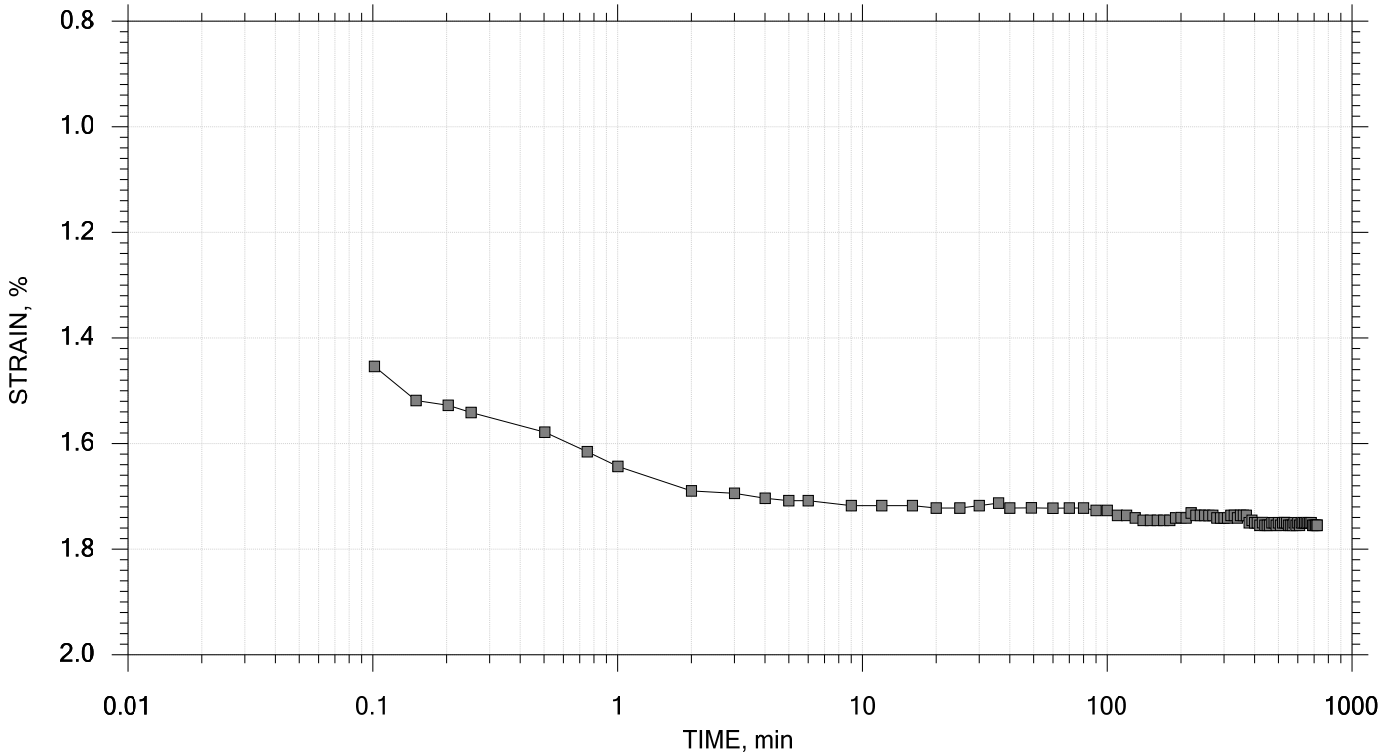
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-2	Tested By: md	Checked By: njh
	Sample No.: S-1	Test Date: 04/12/17	Test No.: IP-2
	Depth: 18-18.5 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System X, Swell Pressure = 0.0678 tsf		

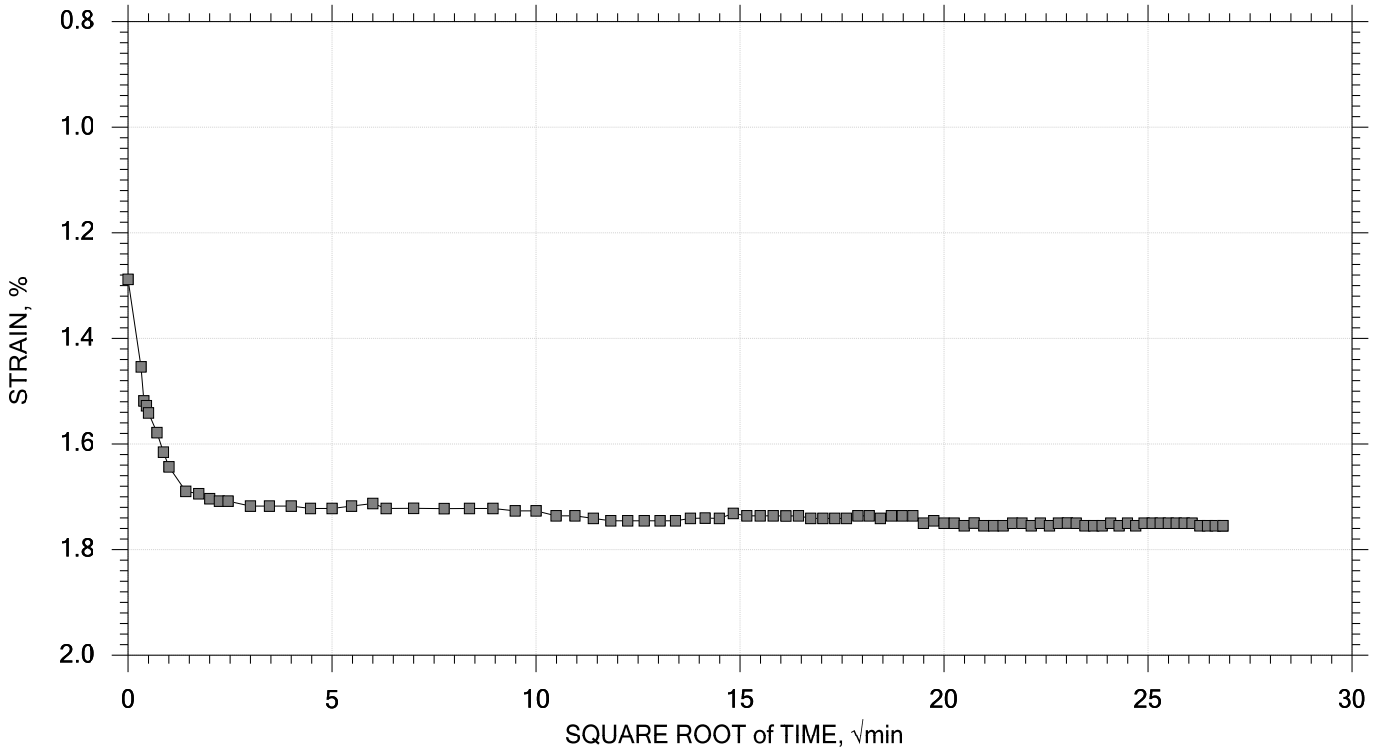
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 2 of 15

Stress: 0.125 tsf





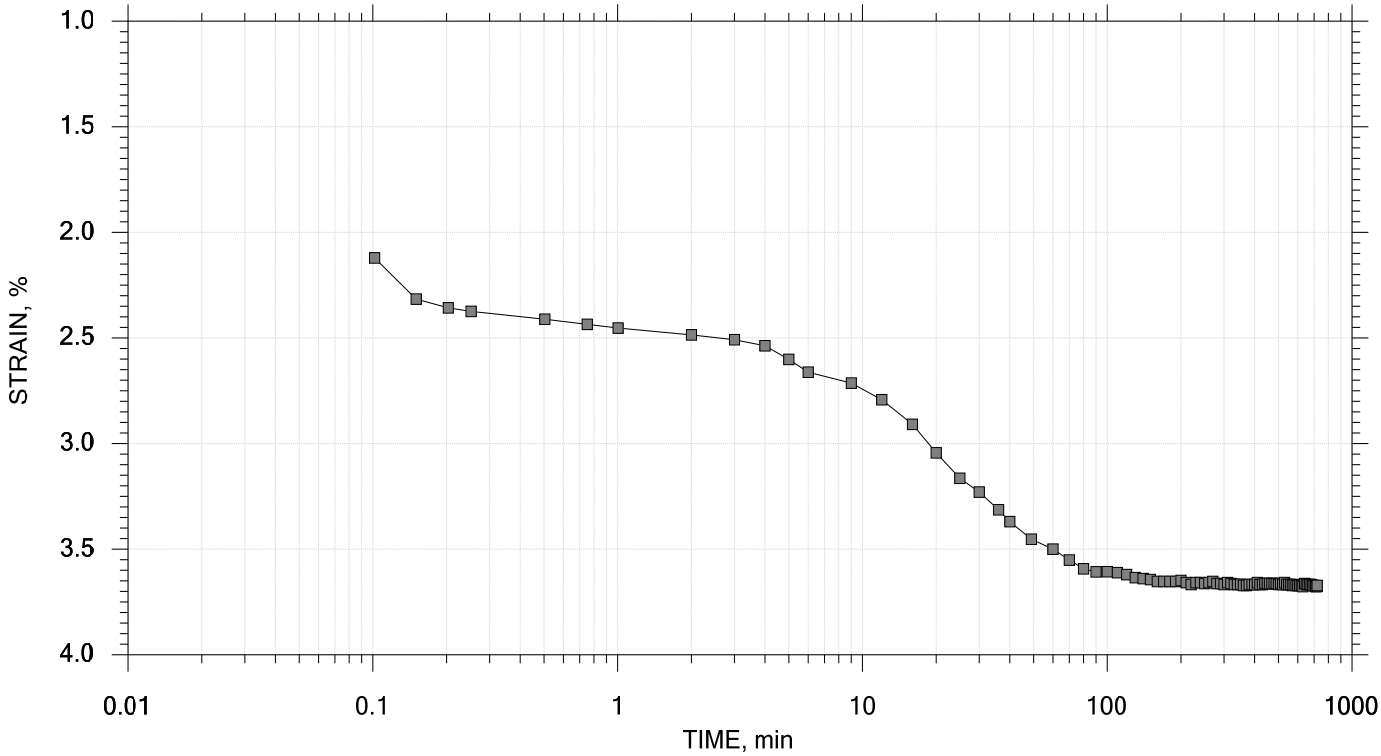
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-2	Tested By: md	Checked By: njh
	Sample No.: S-1	Test Date: 04/12/17	Test No.: IP-2
	Depth: 18-18.5 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System X, Swell Pressure = 0.0678 tsf		

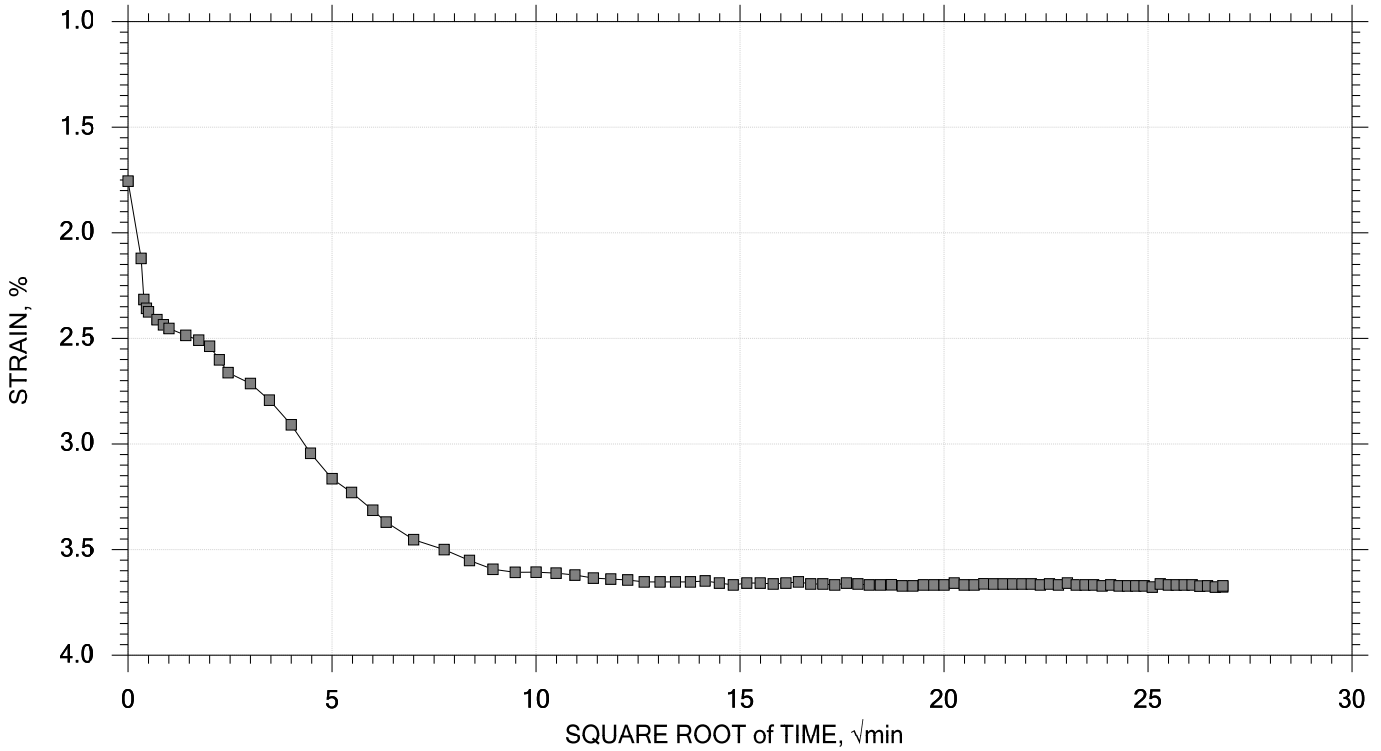
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 3 of 15

Stress: 0.25 tsf





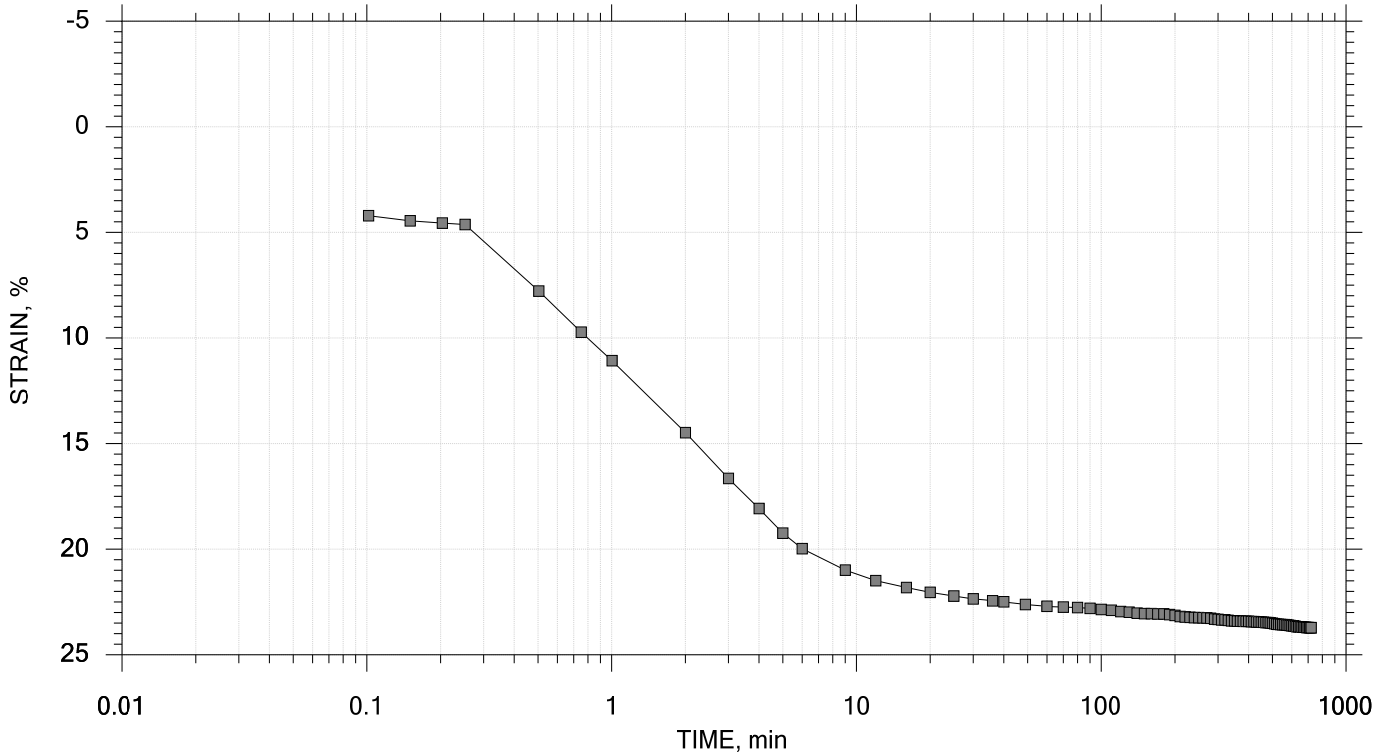
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-2	Tested By: md	Checked By: njh
	Sample No.: S-1	Test Date: 04/12/17	Test No.: IP-2
	Depth: 18-18.5 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System X, Swell Pressure = 0.0678 tsf		

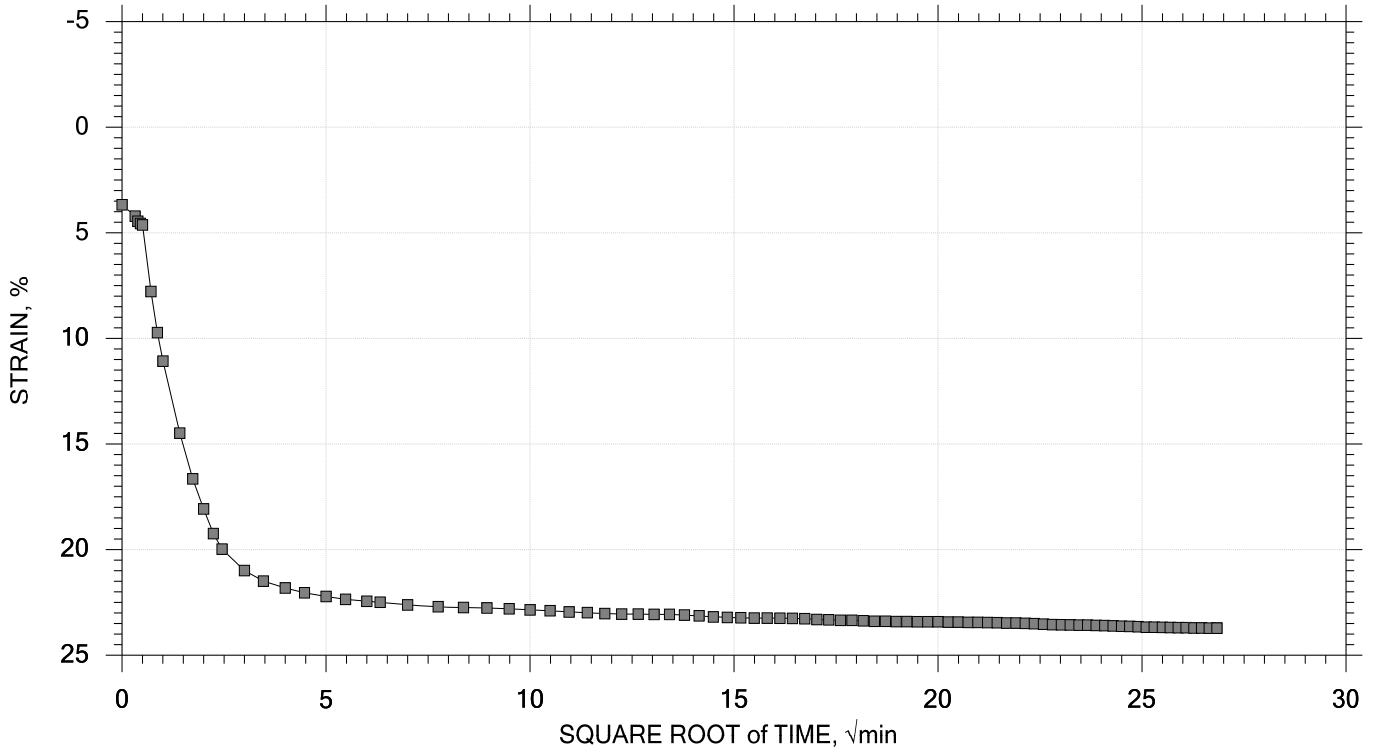
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 4 of 15

Stress: 0.5 tsf





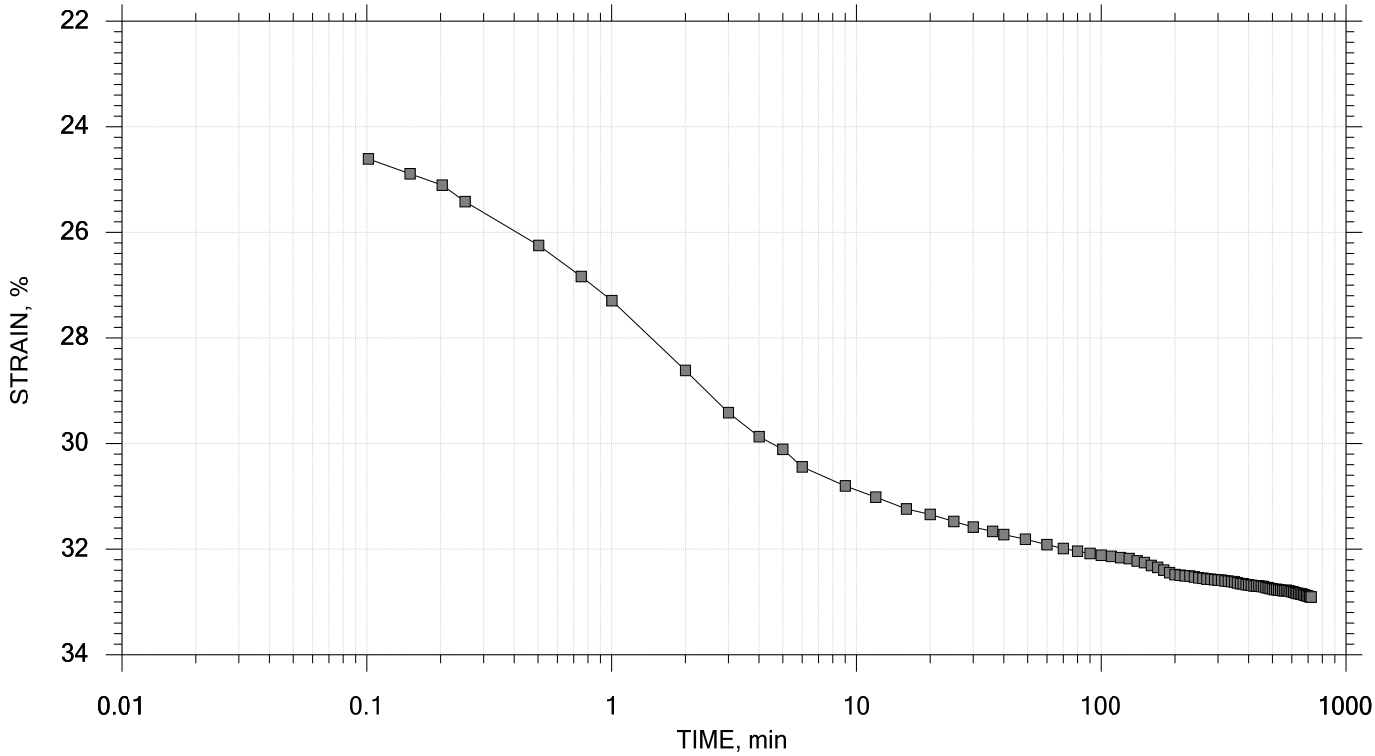
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-2	Tested By: md	Checked By: njh
	Sample No.: S-1	Test Date: 04/12/17	Test No.: IP-2
	Depth: 18-18.5 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System X, Swell Pressure = 0.0678 tsf		

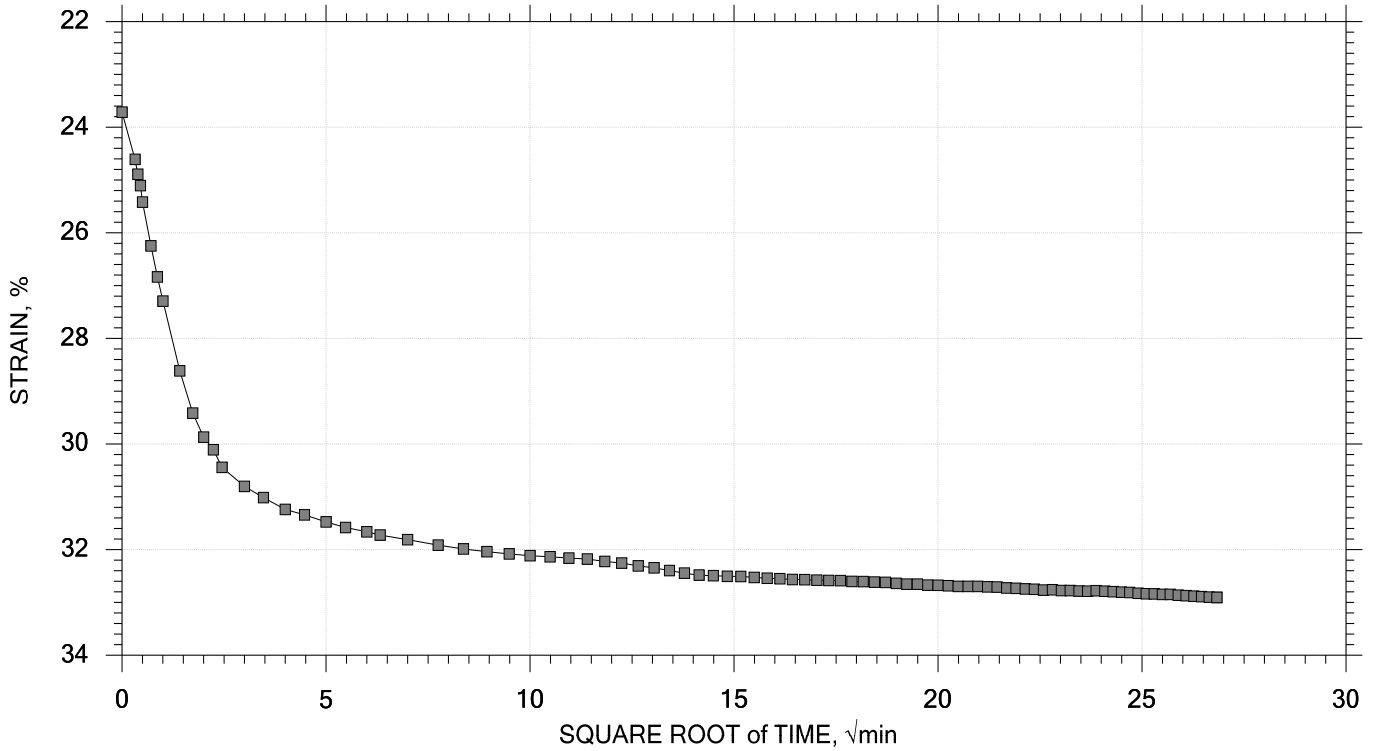
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 5 of 15

Stress: 1 tsf





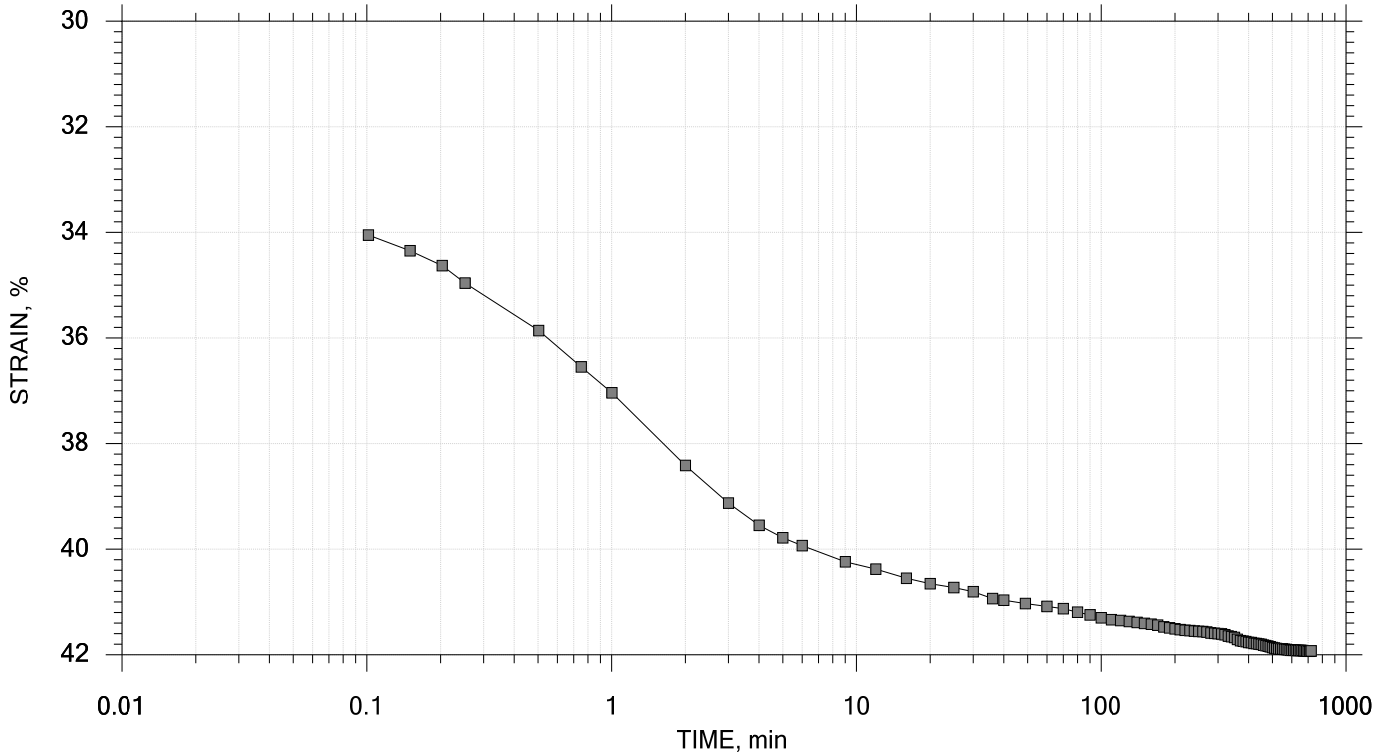
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-2	Tested By: md	Checked By: njh
	Sample No.: S-1	Test Date: 04/12/17	Test No.: IP-2
	Depth: 18-18.5 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System X, Swell Pressure = 0.0678 tsf		

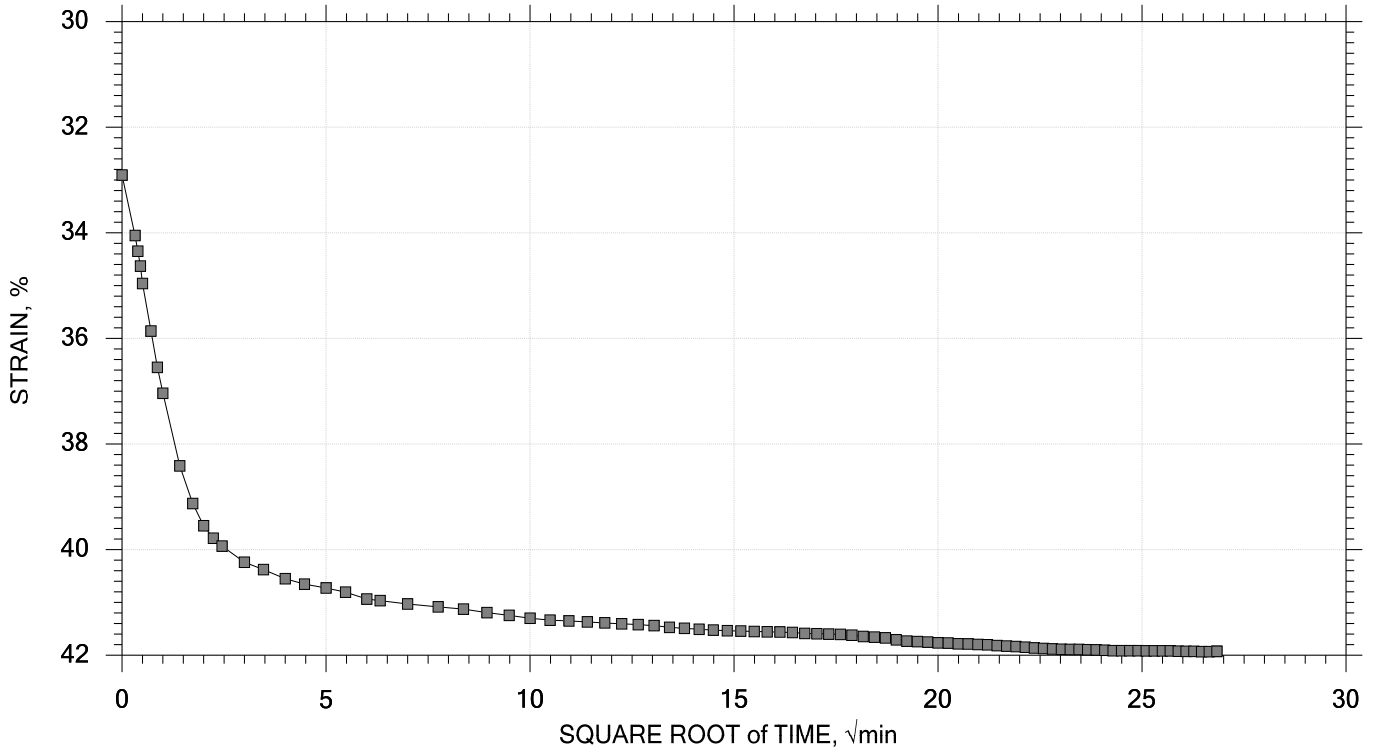
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 6 of 15

Stress: 2 tsf





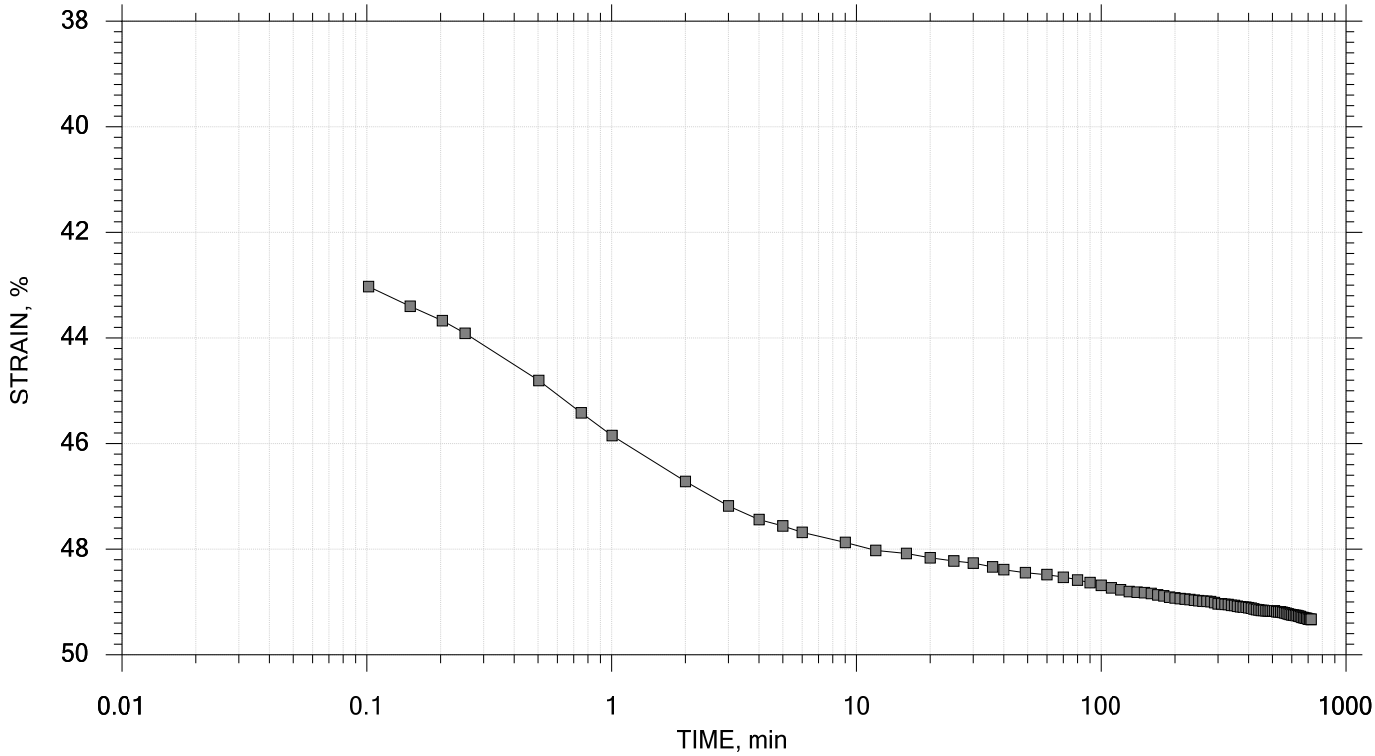
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-2	Tested By: md	Checked By: njh
	Sample No.: S-1	Test Date: 04/12/17	Test No.: IP-2
	Depth: 18-18.5 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System X, Swell Pressure = 0.0678 tsf		

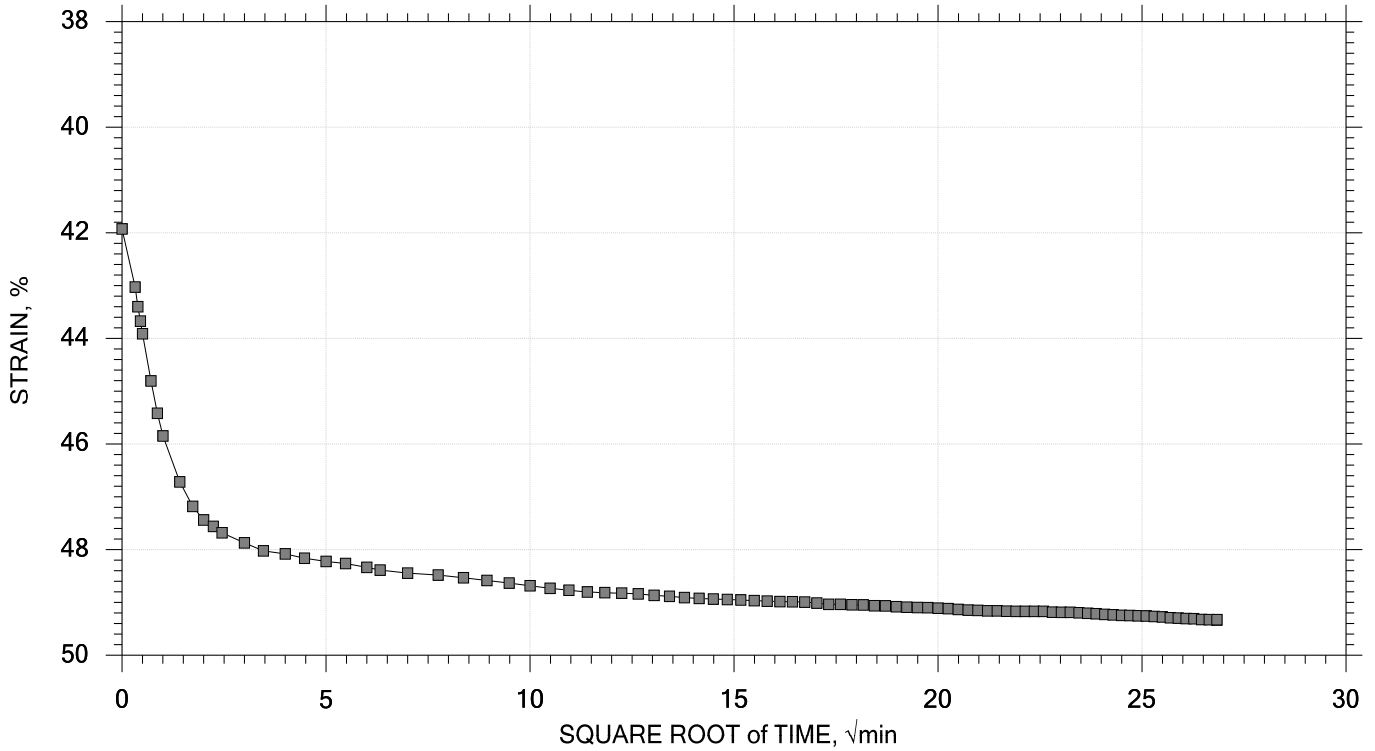
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 7 of 15

Stress: 4 tsf





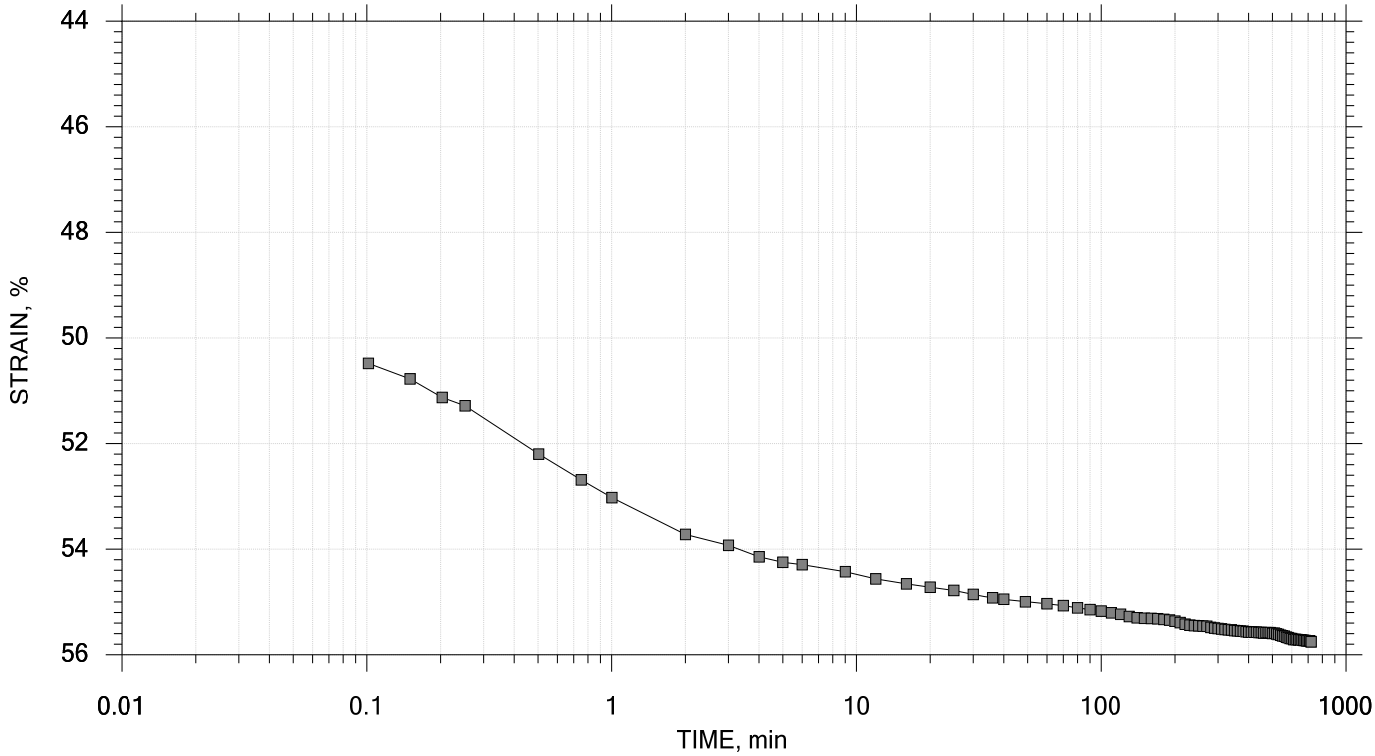
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-2	Tested By: md	Checked By: njh
	Sample No.: S-1	Test Date: 04/12/17	Test No.: IP-2
	Depth: 18-18.5 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System X, Swell Pressure = 0.0678 tsf		

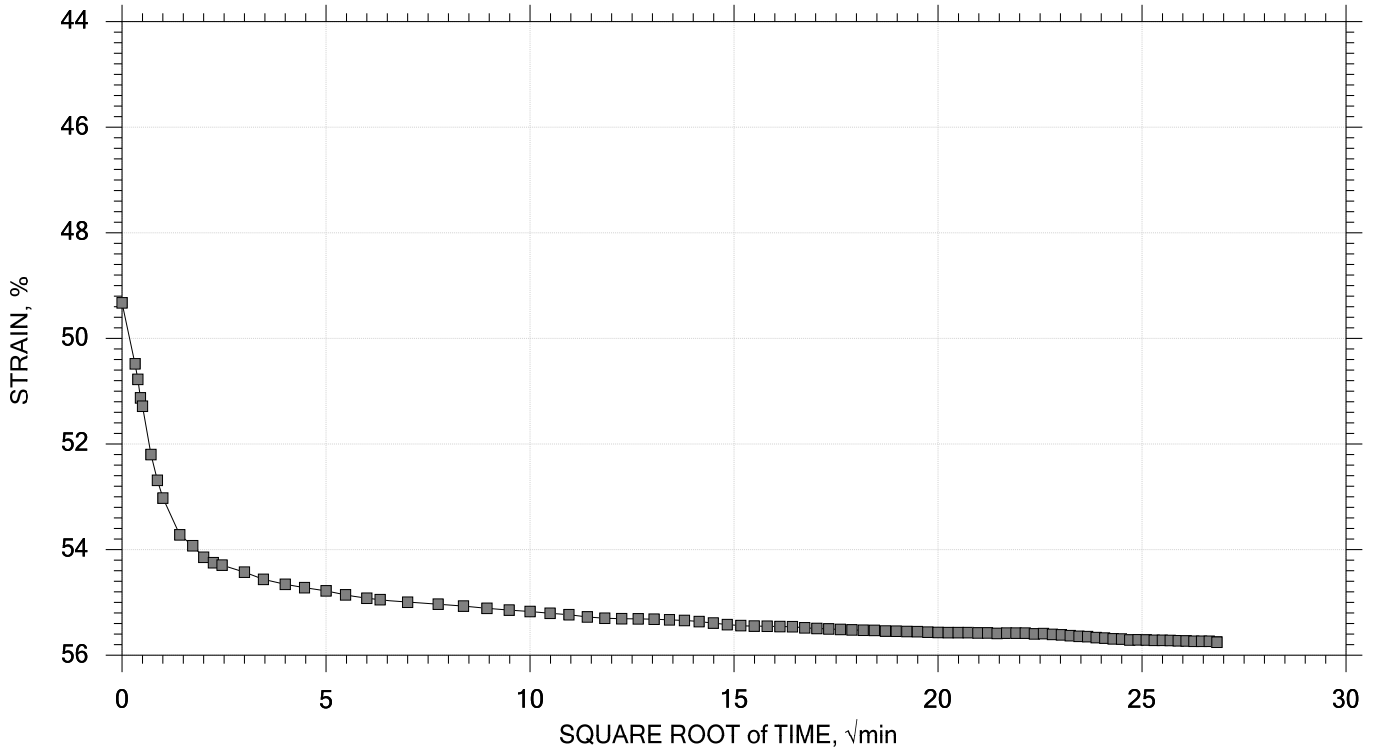
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 8 of 15

Stress: 8 tsf





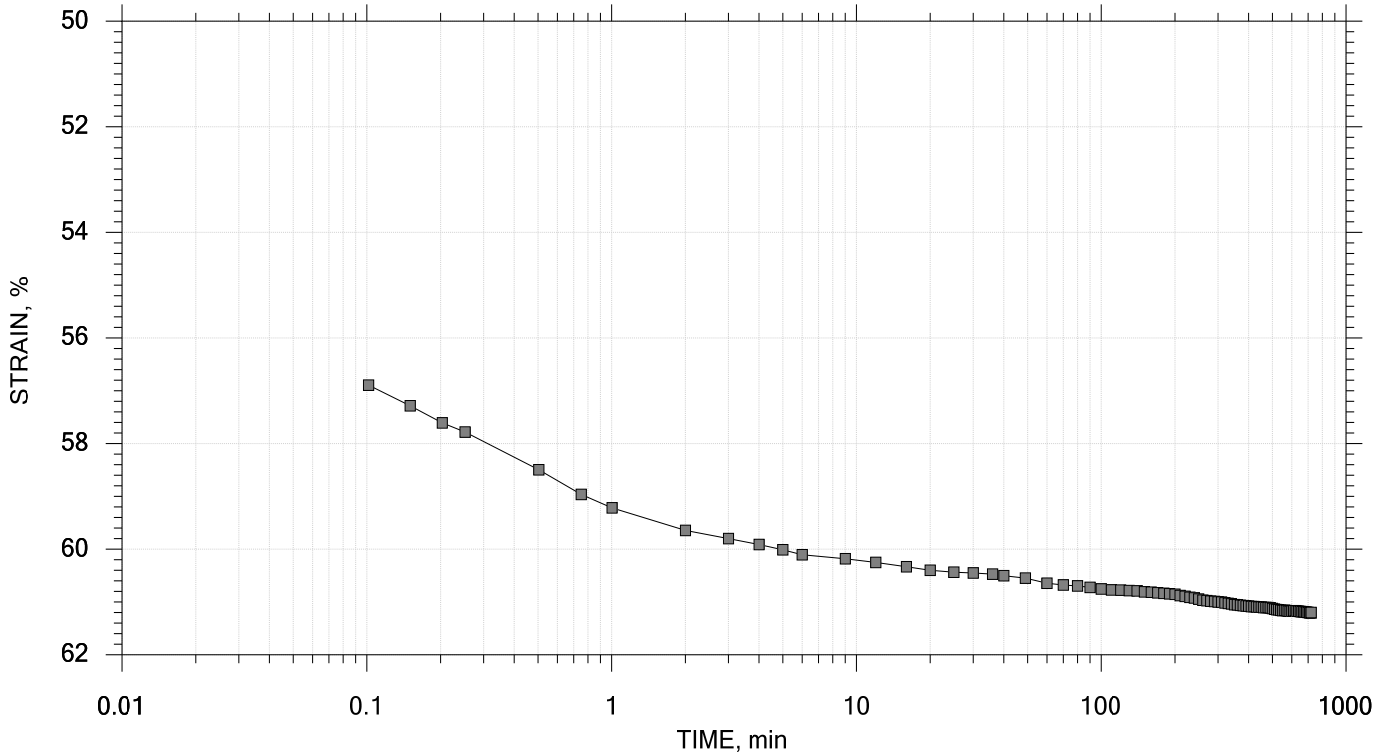
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-2	Tested By: md	Checked By: njh
	Sample No.: S-1	Test Date: 04/12/17	Test No.: IP-2
	Depth: 18-18.5 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System X, Swell Pressure = 0.0678 tsf		

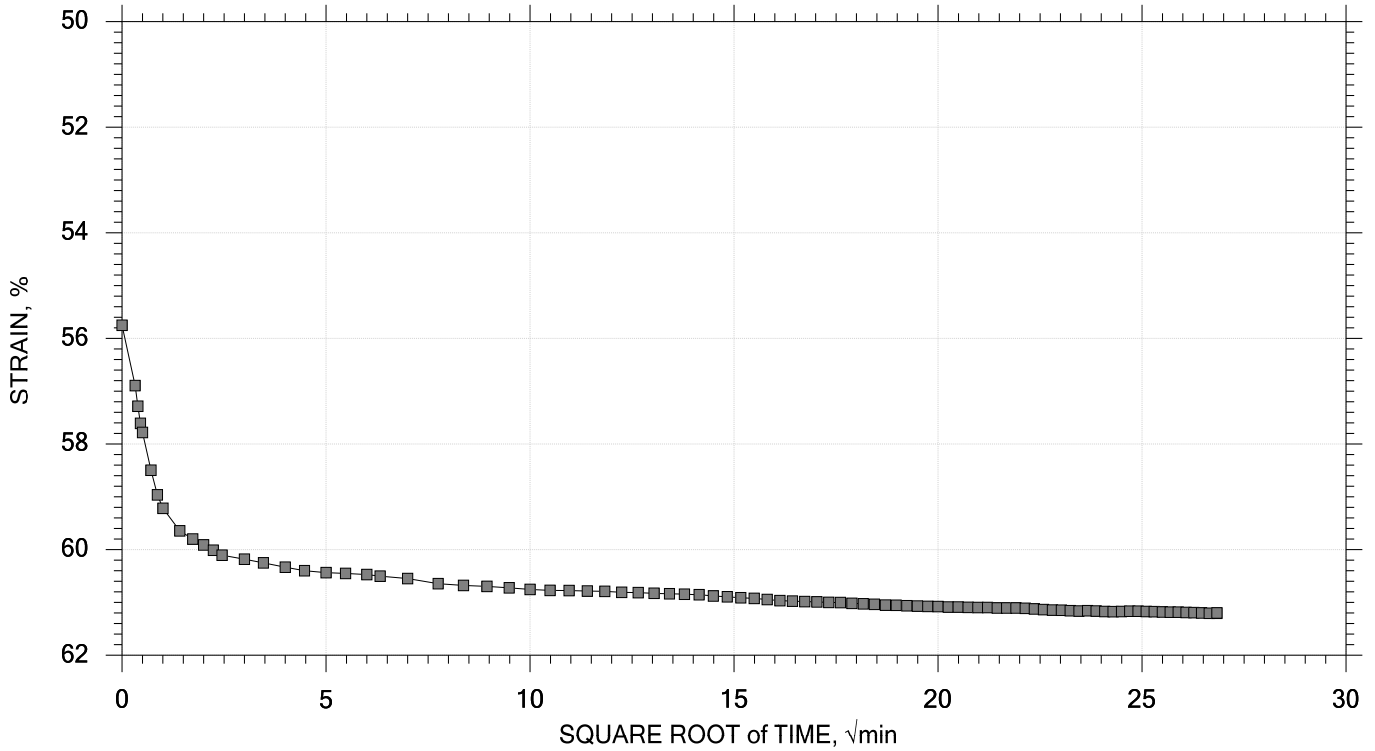
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 9 of 15

Stress: 16 tsf





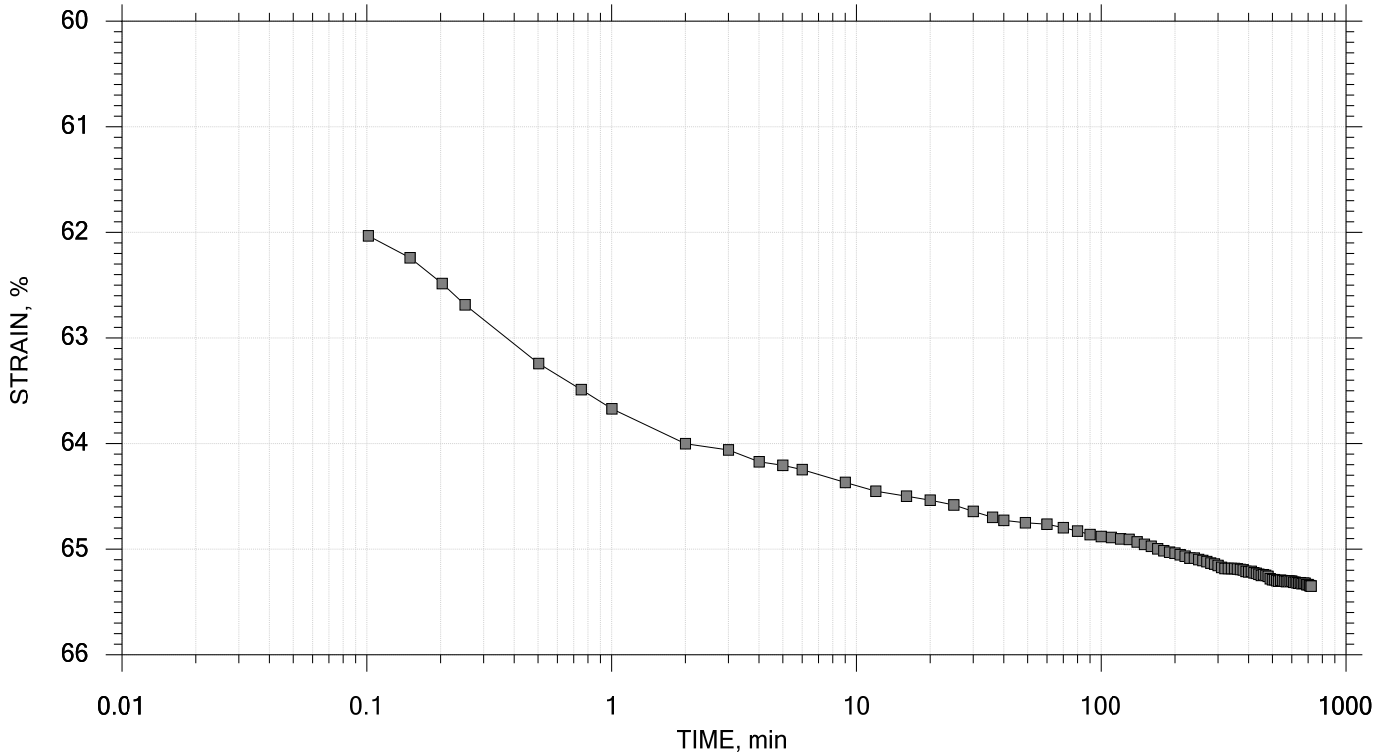
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-2	Tested By: md	Checked By: njh
	Sample No.: S-1	Test Date: 04/12/17	Test No.: IP-2
	Depth: 18-18.5 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System X, Swell Pressure = 0.0678 tsf		

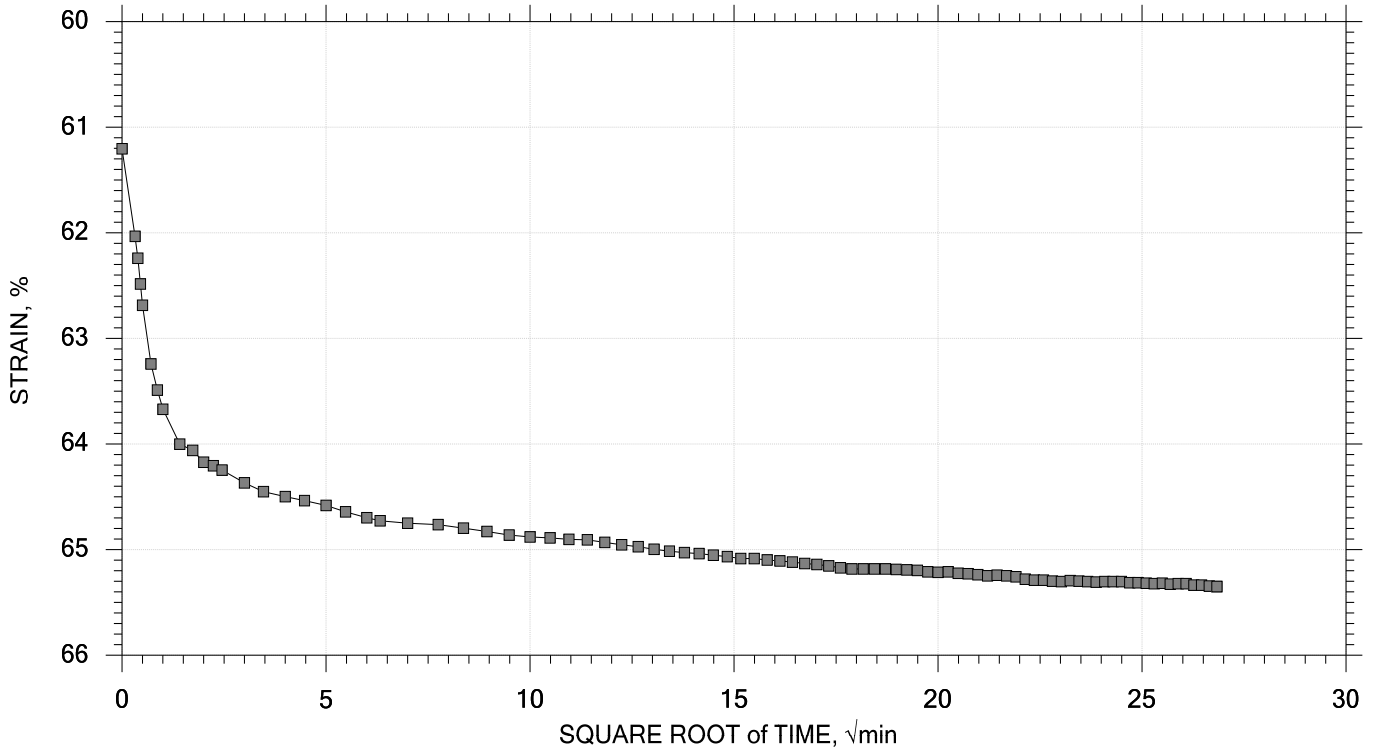
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 10 of 15

Stress: 32 tsf





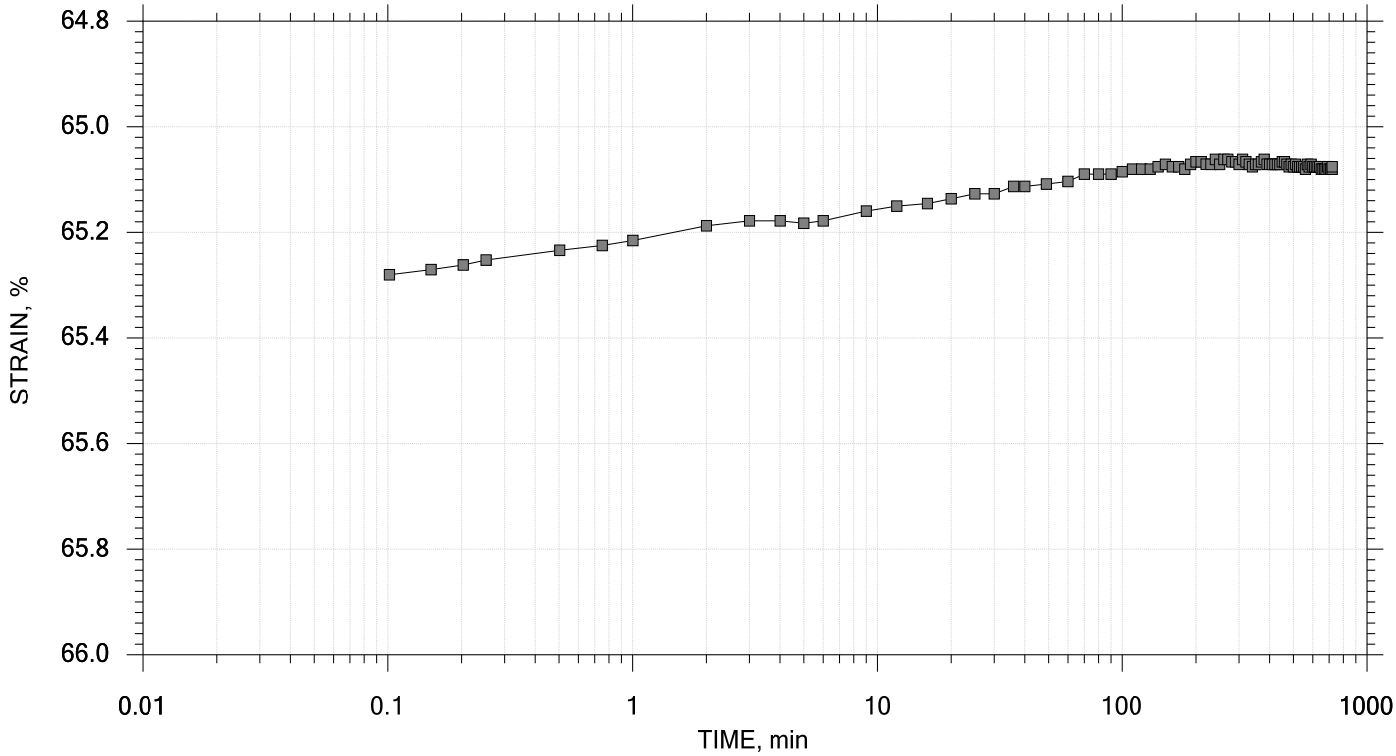
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-2	Tested By: md	Checked By: njh
	Sample No.: S-1	Test Date: 04/12/17	Test No.: IP-2
	Depth: 18-18.5 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System X, Swell Pressure = 0.0678 tsf		

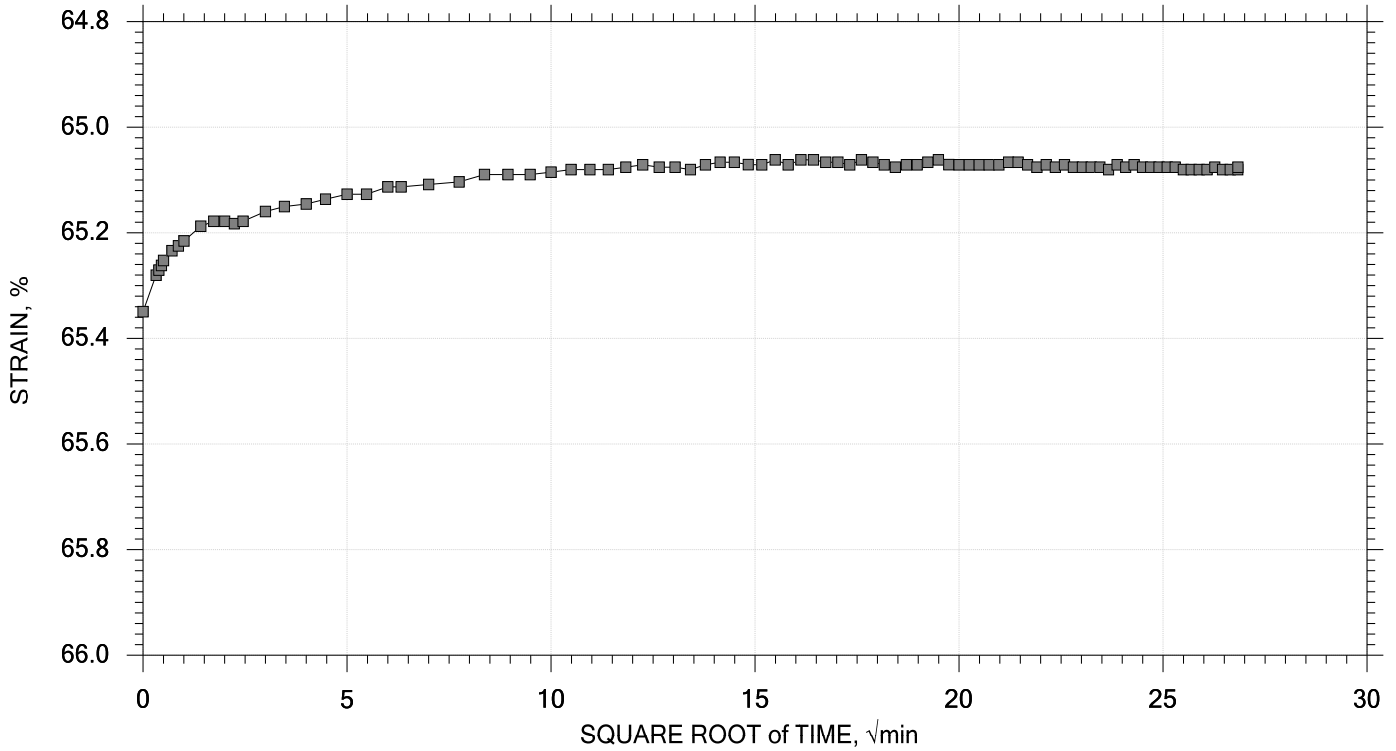
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 11 of 15

Stress: 8 tsf





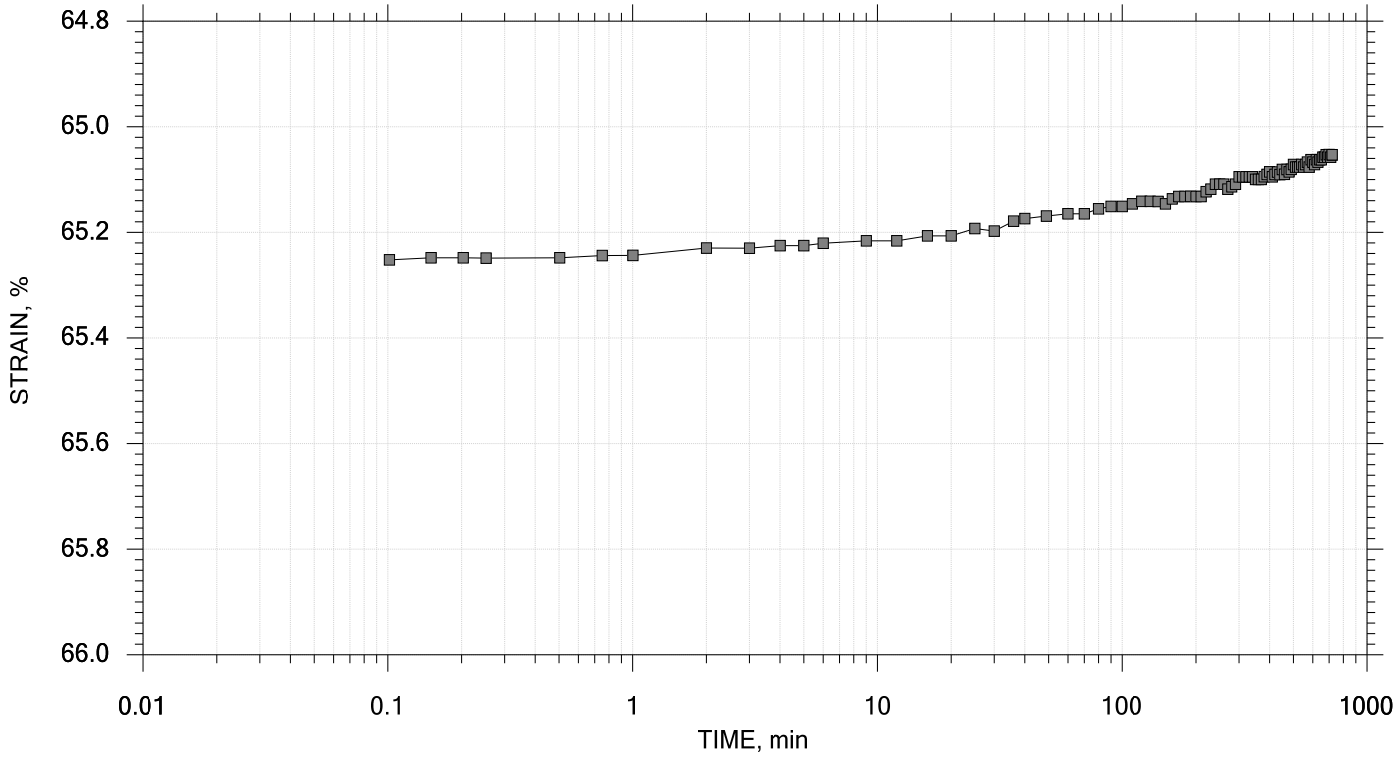
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-2	Tested By: md	Checked By: njh
	Sample No.: S-1	Test Date: 04/12/17	Test No.: IP-2
	Depth: 18-18.5 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System X, Swell Pressure = 0.0678 tsf		

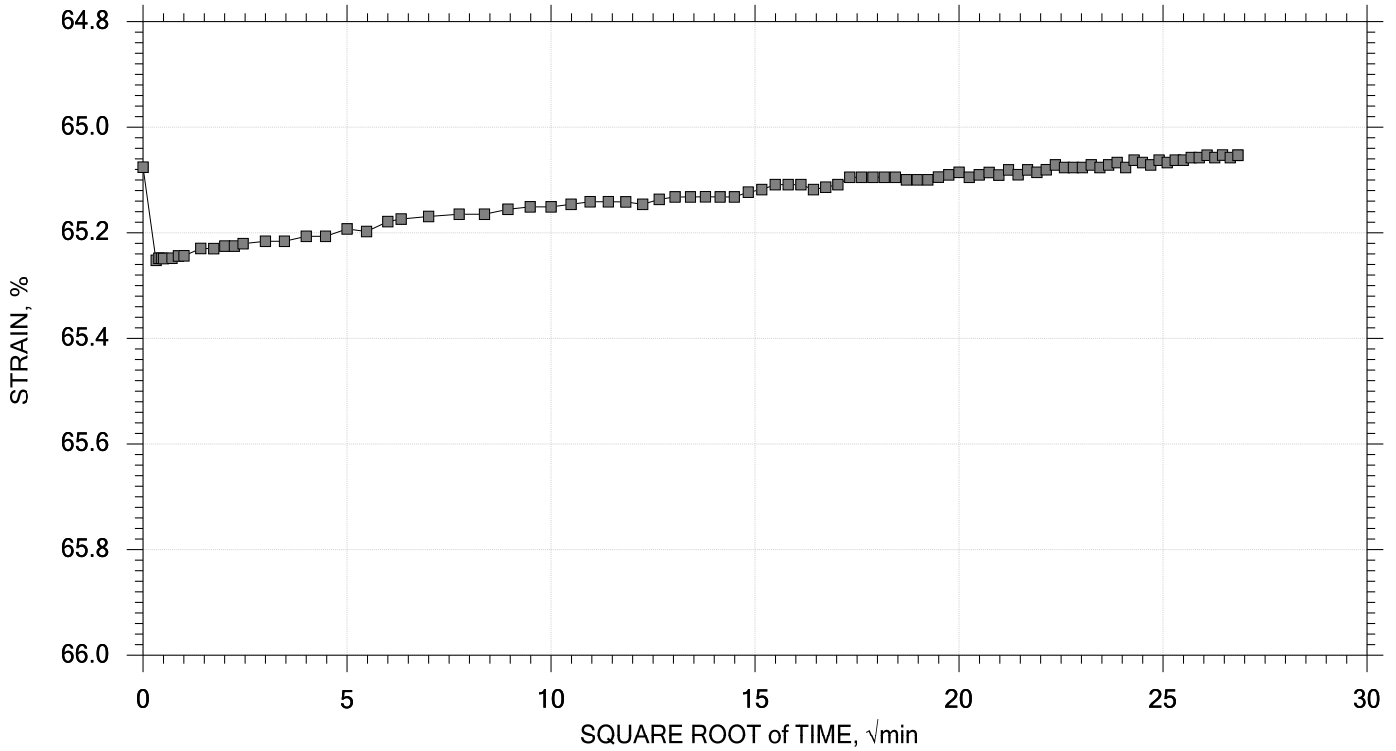
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 12 of 15

Stress: 2 tsf





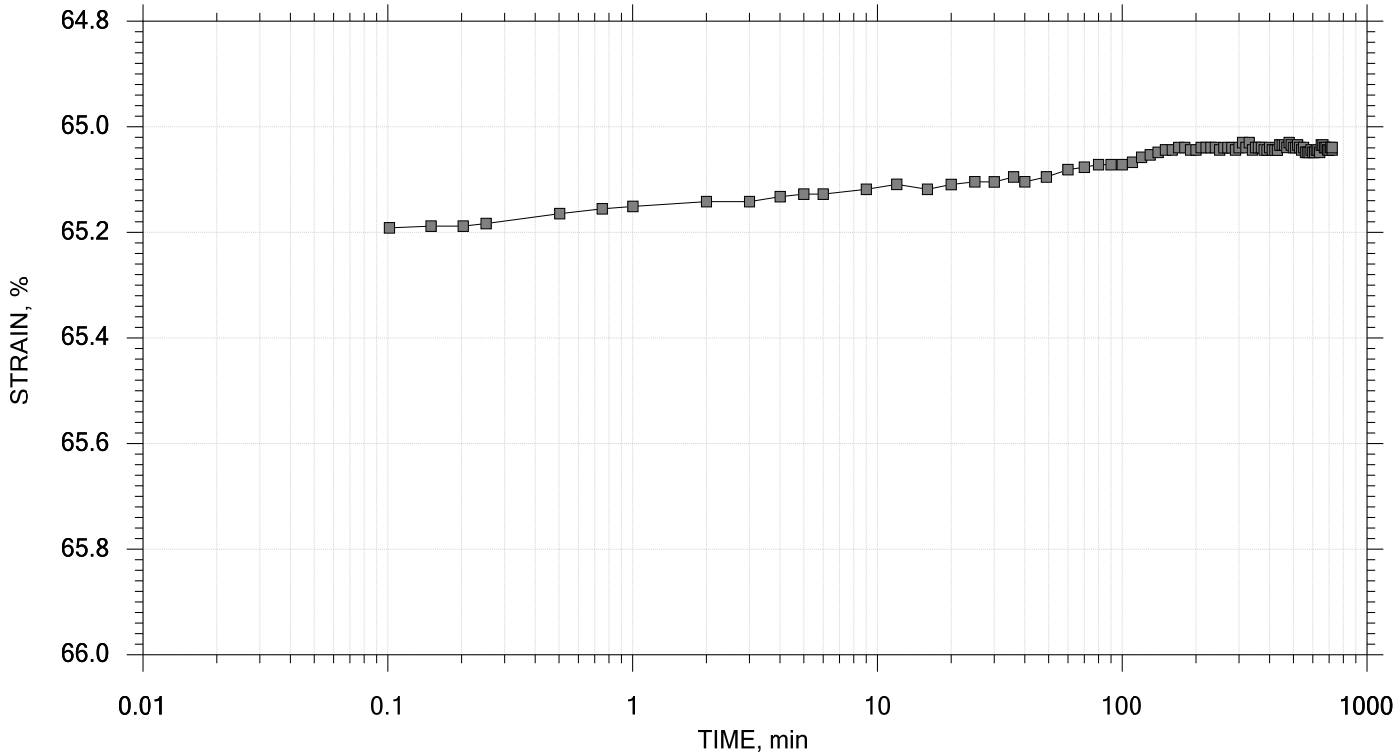
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-2	Tested By: md	Checked By: njh
	Sample No.: S-1	Test Date: 04/12/17	Test No.: IP-2
	Depth: 18-18.5 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System X, Swell Pressure = 0.0678 tsf		

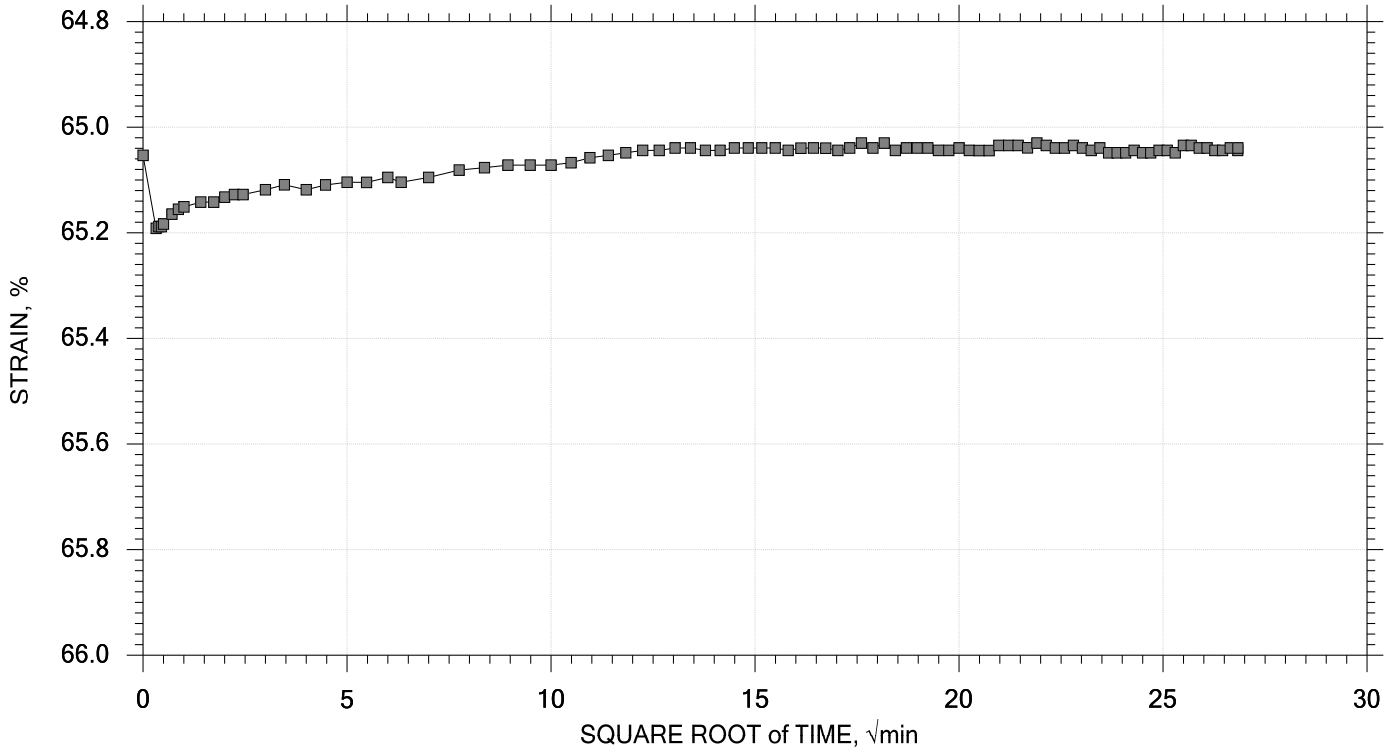
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 13 of 15

Stress: 0.5 tsf





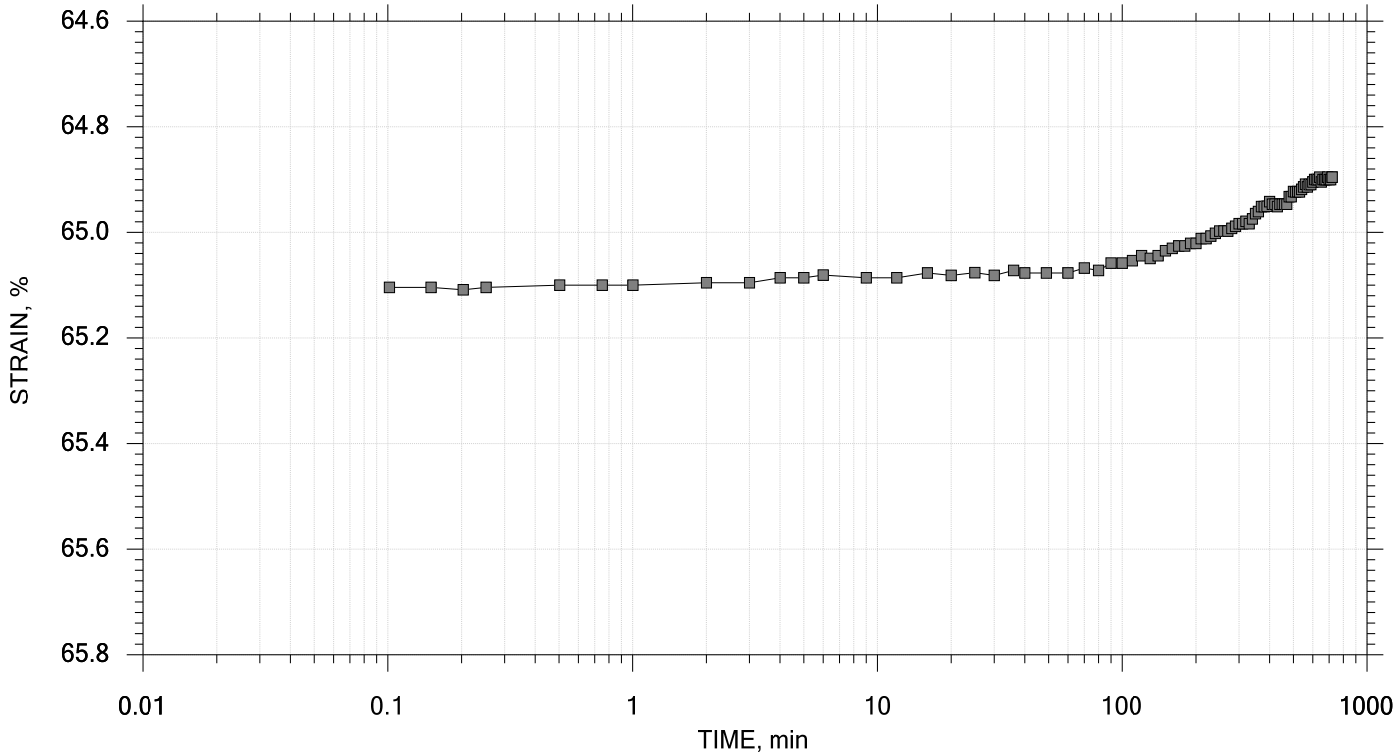
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-2	Tested By: md	Checked By: njh
	Sample No.: S-1	Test Date: 04/12/17	Test No.: IP-2
	Depth: 18-18.5 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System X, Swell Pressure = 0.0678 tsf		

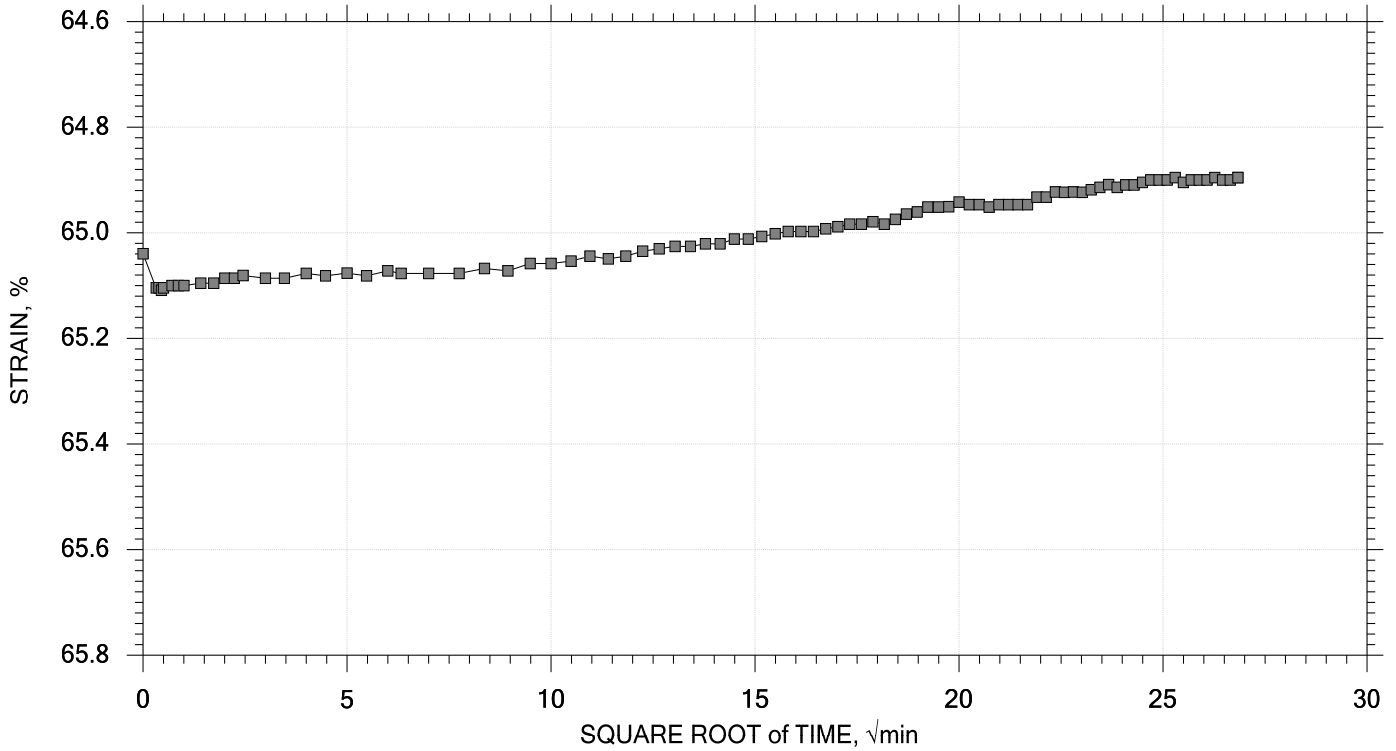
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 14 of 15

Stress: 0.125 tsf





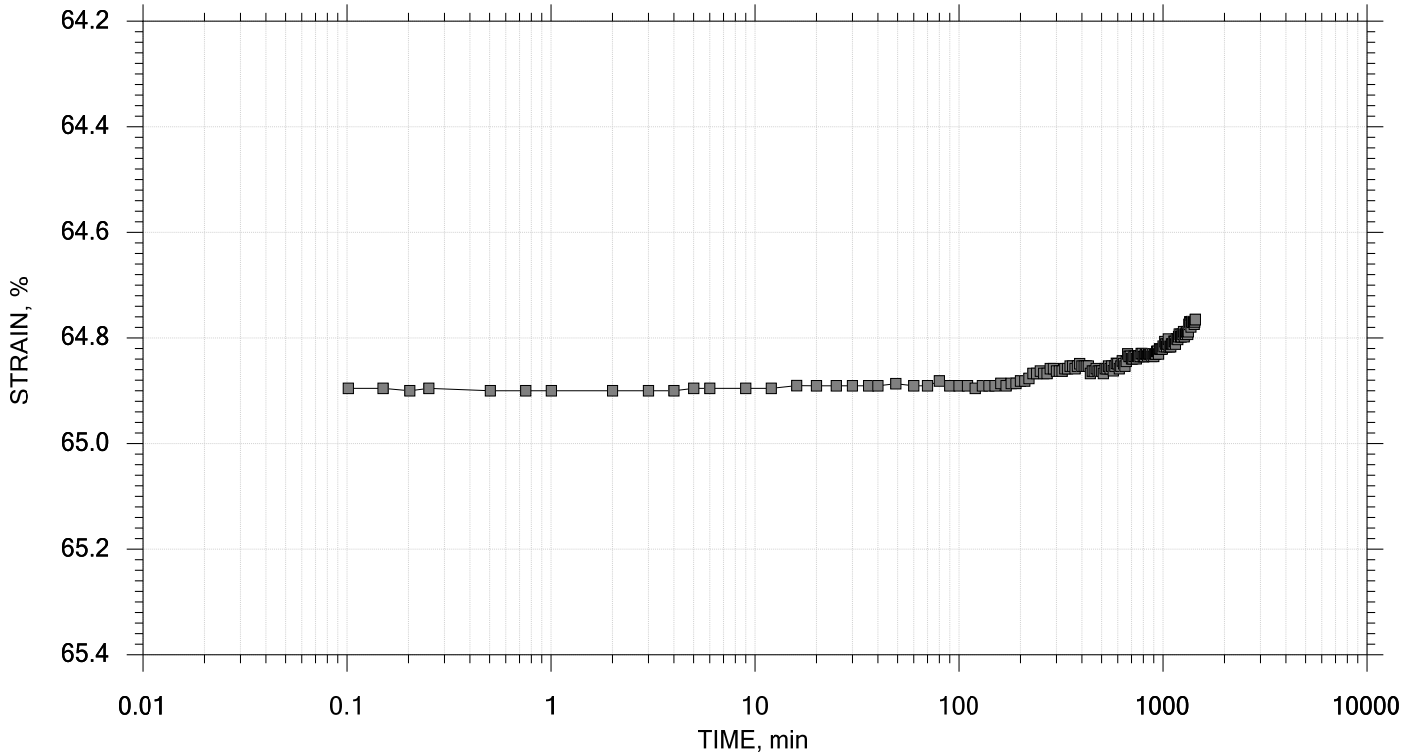
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-2	Tested By: md	Checked By: njh
	Sample No.: S-1	Test Date: 04/12/17	Test No.: IP-2
	Depth: 18-18.5 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System X, Swell Pressure = 0.0678 tsf		

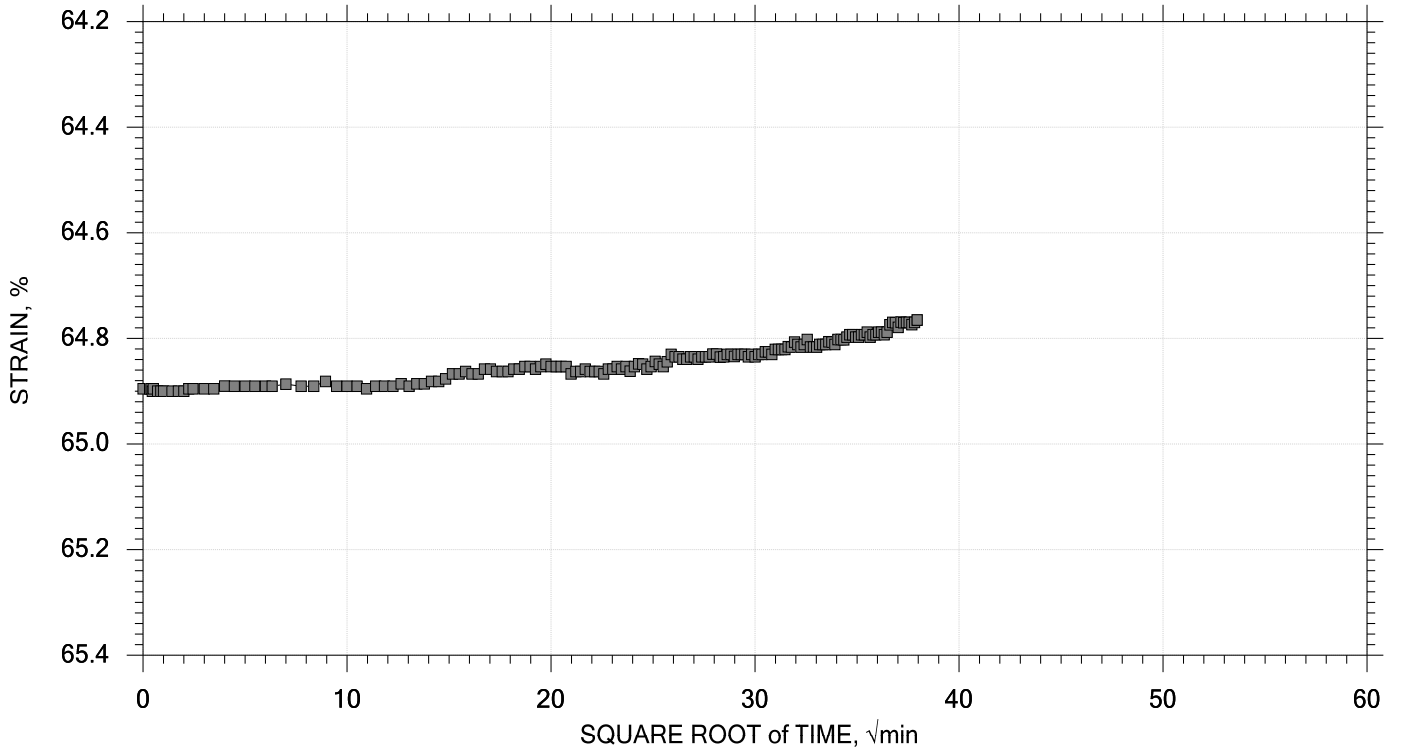
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 15 of 15

Stress: 0.0625 tsf

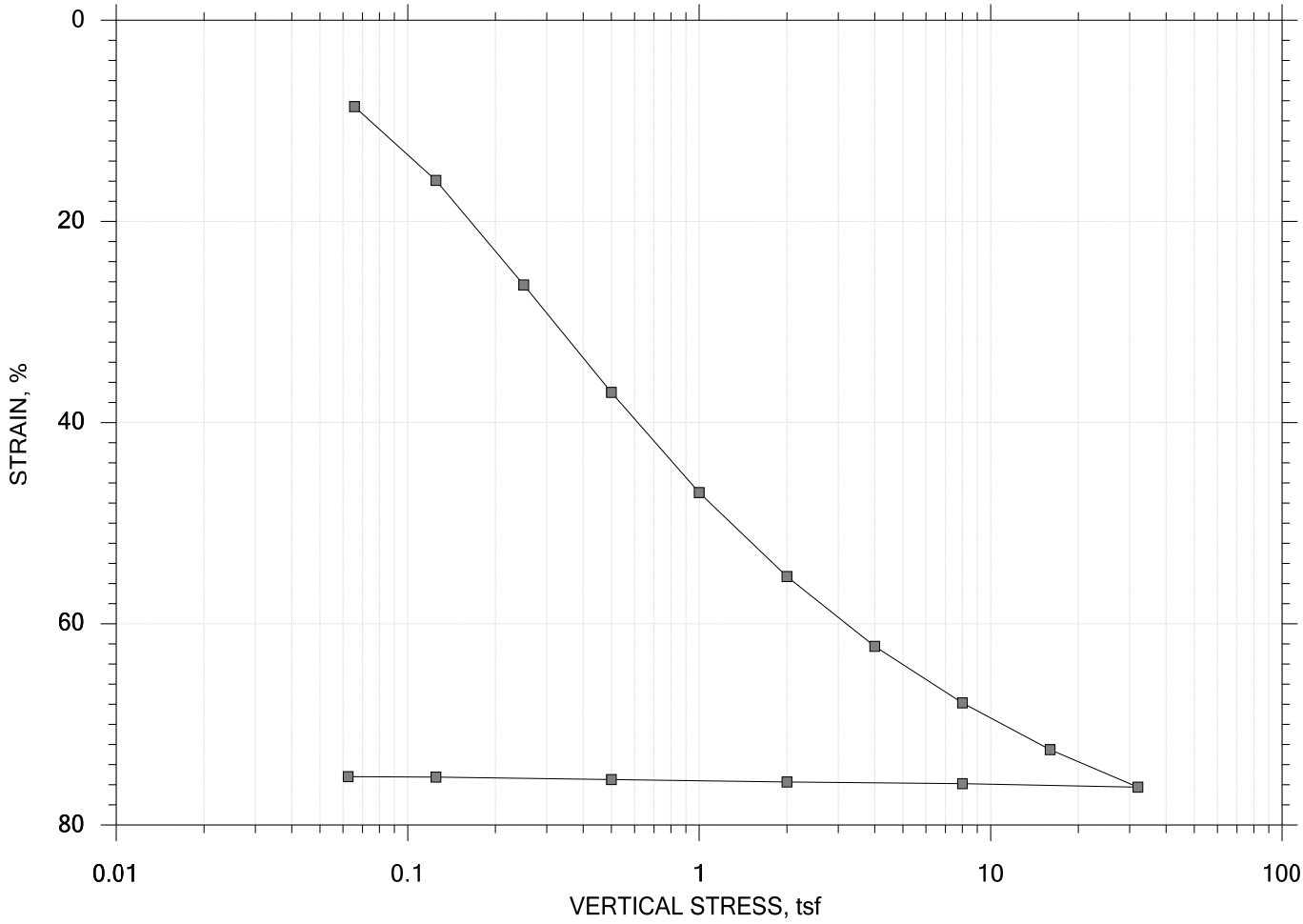


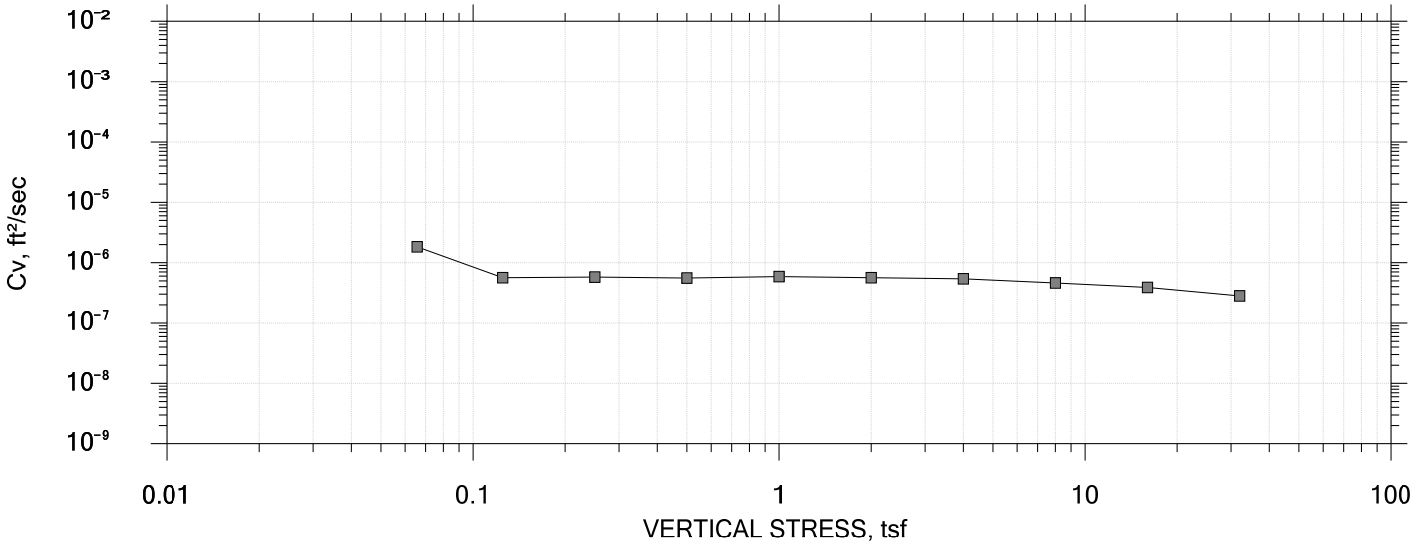


GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-2	Tested By: md	Checked By: njh
	Sample No.: S-1	Test Date: 04/12/17	Test No.: IP-2
	Depth: 18-18.5 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System X, Swell Pressure = 0.0678 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT

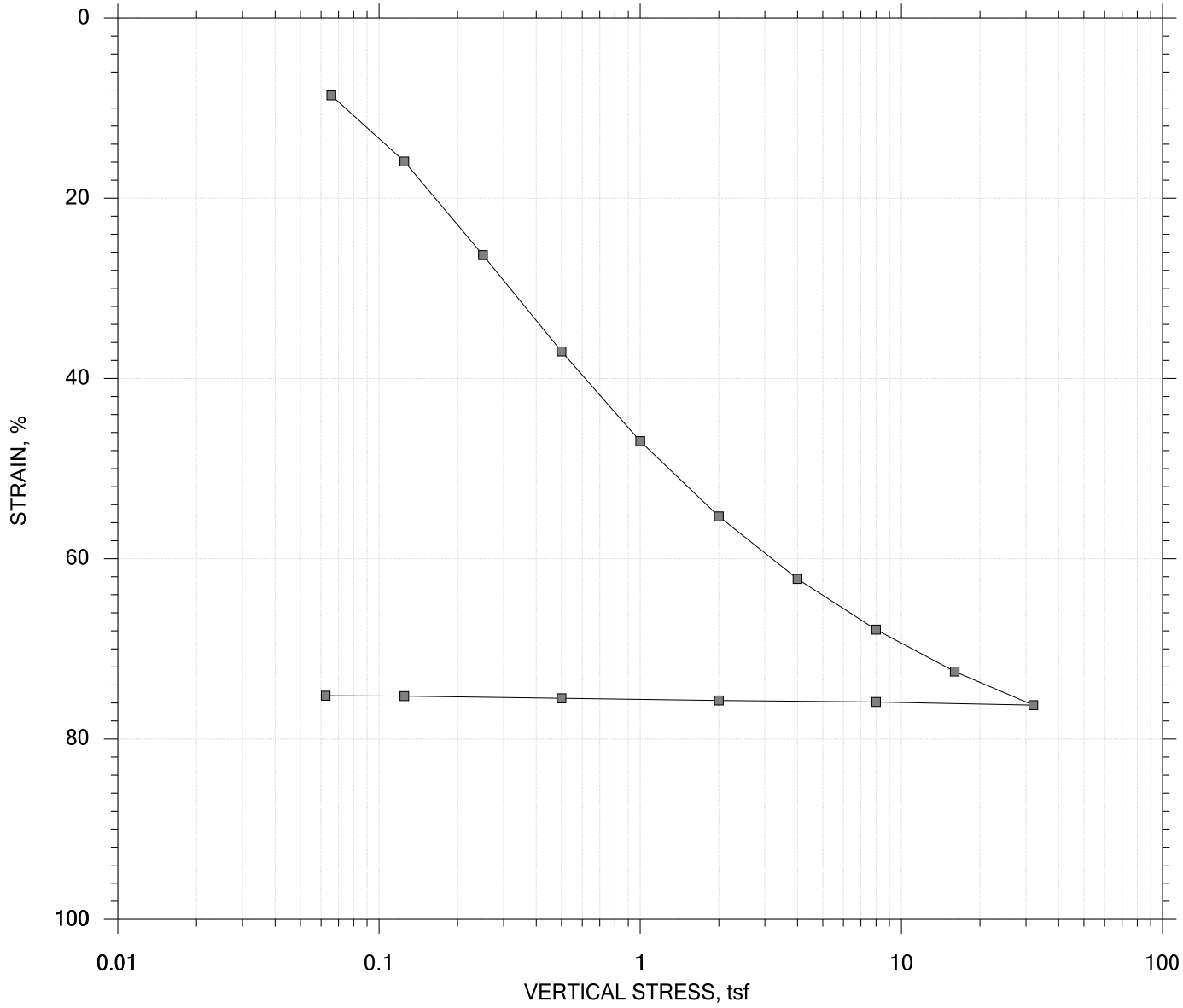




GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-6	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/21/17	Test No.: IP-4
	Depth: 20-20.5	Sample Type: intact	Elevation: ---
	Description: Wet, very dark gray silt		
	Remarks: System O, Swell Pressure = 0.0656 tsf		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT



				Before Test	After Test
Current Vertical Effective Stress: ---			Water Content, %	613.85	101.98
Preconsolidation Stress: ---			Dry Unit Weight, pcf	9.502	43.191
Compression Ratio: ---			Saturation, %	99.90	100.00
Diameter: 2.5 in		Height: 1 in	Void Ratio	14.44	2.40
LL: 205	PL: 84	PI: 121	GS: 2.35		

GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-6	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/21/17	Test No.: IP-4
	Depth: 20-20.5	Sample Type: intact	Elevation: ---
	Description: Wet, very dark gray silt		
	Remarks: System O, Swell Pressure = 0.0656 tsf		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
Boring No.: GZ-6	Tested By: md	Checked By: njh
Sample No.: S1	Test Date: 04/21/17	Depth: 20-20.5
Test No.: IP-4	Sample Type: intact	Elevation: ---

Soil Description: Wet, very dark gray silt
Remarks: System O, Swell Pressure = 0.0656 tsf

Measured Specific Gravity: 2.35	Liquid Limit: 205	Specimen Diameter: 2.50 in
Initial Void Ratio: 14.4	Plastic Limit: 84	Initial Height: 1.00 in
Final Void Ratio: 2.40	Plasticity Index: 121	Final Height: 0.22 in

	Before Consolidation		After Consolidation	
	Trimmings	Specimen+Ring	Specimen+Ring	Trimmings
Container ID	C-1470	RING		B-320
Wt. Container + Wet Soil, gm	90.310	196.42	133.75	35.810
Wt. Container + Dry Soil, gm	23.540	121.26	121.26	21.930
Wt. Container, gm	8.3100	109.02	109.02	8.3200
Wt. Dry Soil, gm	15.230	12.244	12.244	13.610
Water Content, %	438.41	613.85	101.98	101.98
Void Ratio	---	14.4	2.40	---
Degree of Saturation, %	---	99.90	100.00	---
Dry Unit Weight, pcf	---	9.5020	43.191	---

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Wynn Everett | Location: Everett, MA | Project No.: GTX-306274
Boring No.: GZ-6 | Tested By: md | Checked By: njh
Sample No.: S1 | Test Date: 04/21/17 | Depth: 20-20.5
Test No.: IP-4 | Sample Type: intact | Elevation: ---

Soil Description: Wet, very dark gray silt
Remarks: System O, Swell Pressure = 0.0656 tsf

Displacement at End of Increment

	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt T90 min	Cv ft²/sec	Mv 1/tsf	k ft/day
1	0.0656	0.08588	13.1	8.59	21.657	1.04e-006	1.31e+000	3.66e-003
2	0.125	0.1591	12.0	15.9	30.813	6.13e-007	1.23e+000	2.04e-003
3	0.250	0.2630	10.4	26.3	27.736	5.51e-007	8.31e-001	1.23e-003
4	0.500	0.3699	8.73	37.0	24.386	4.70e-007	4.27e-001	5.42e-004
5	1.00	0.4694	7.19	46.9	21.677	3.81e-007	1.99e-001	2.05e-004
6	2.00	0.5529	5.90	55.3	19.975	2.94e-007	8.35e-002	6.61e-005
7	4.00	0.6223	4.83	62.2	18.483	2.26e-007	3.47e-002	2.11e-005
8	8.00	0.6785	3.96	67.9	18.339	1.64e-007	1.41e-002	6.20e-006
9	16.0	0.7251	3.24	72.5	17.943	1.22e-007	5.82e-003	1.91e-006
10	32.0	0.7623	2.67	76.2	18.201	8.86e-008	2.33e-003	5.56e-007
11	8.00	0.7589	2.72	75.9	3.669	3.83e-007	1.40e-004	1.45e-007
12	2.00	0.7572	2.75	75.7	696.390	2.06e-009	2.95e-004	1.64e-009
13	0.500	0.7548	2.79	75.5	430.137	3.40e-009	1.56e-003	1.43e-008
14	0.125	0.7523	2.82	75.2	789.814	1.89e-009	6.62e-003	3.37e-008
15	0.0625	0.7519	2.83	75.2	0.000	0.00e+000	6.17e-003	0.00e+000

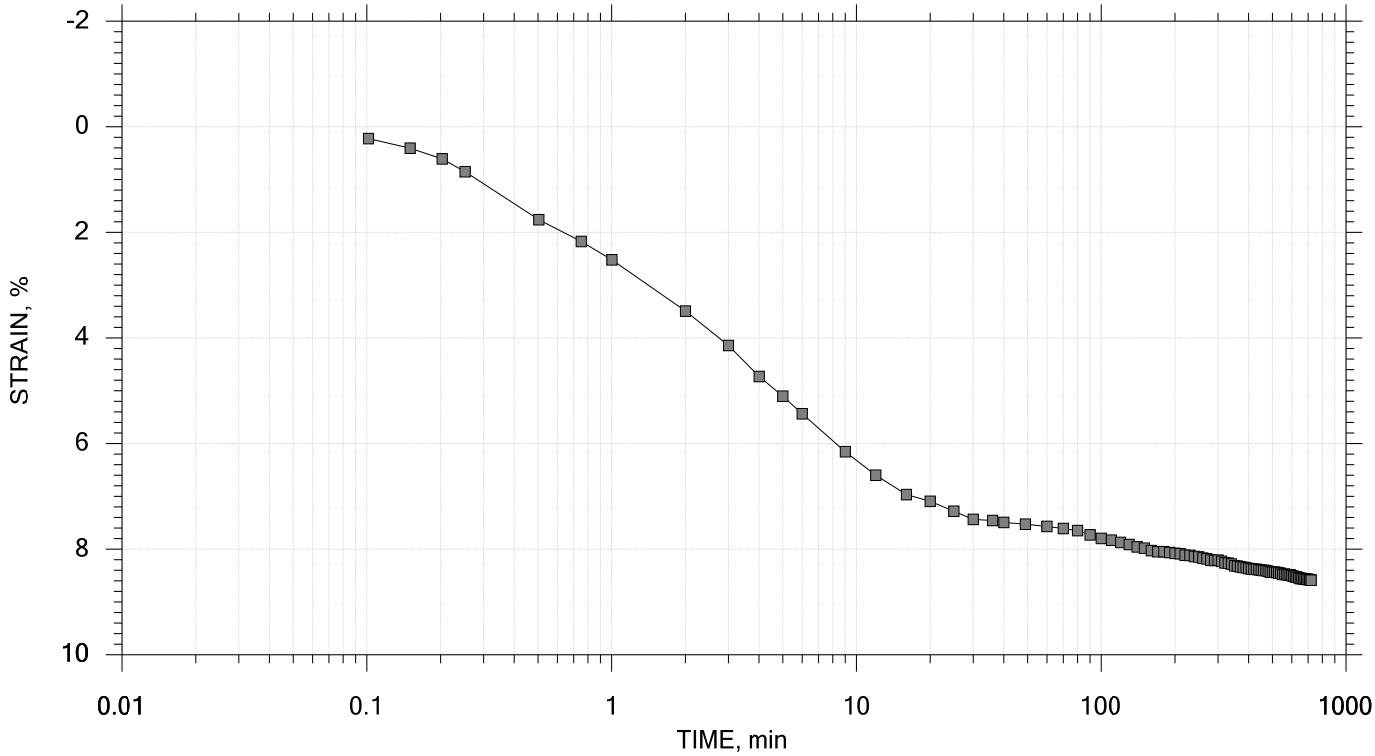
	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Log T50 min	Cv ft²/sec	Mv 1/tsf	k ft/day	Ca %
1	0.0656	0.08588	13.1	8.59	2.554	2.04e-006	1.31e+000	7.22e-003	0.00e+000
2	0.125	0.1591	12.0	15.9	9.372	4.68e-007	1.23e+000	1.56e-003	0.00e+000
3	0.250	0.2630	10.4	26.3	6.979	5.08e-007	8.31e-001	1.14e-003	0.00e+000
4	0.500	0.3699	8.73	37.0	5.208	5.11e-007	4.27e-001	5.89e-004	0.00e+000
5	1.00	0.4694	7.19	46.9	3.422	5.61e-007	1.99e-001	3.01e-004	0.00e+000
6	2.00	0.5529	5.90	55.3	2.281	5.97e-007	8.35e-002	1.34e-004	0.00e+000
7	4.00	0.6223	4.83	62.2	1.659	5.84e-007	3.47e-002	5.47e-005	0.00e+000
8	8.00	0.6785	3.96	67.9	1.389	5.01e-007	1.41e-002	1.90e-005	0.00e+000
9	16.0	0.7251	3.24	72.5	1.151	4.40e-007	5.82e-003	6.91e-006	0.00e+000
10	32.0	0.7623	2.67	76.2	0.000	0.00e+000	2.33e-003	0.00e+000	0.00e+000
11	8.00	0.7589	2.72	75.9	0.000	0.00e+000	1.40e-004	0.00e+000	0.00e+000
12	2.00	0.7572	2.75	75.7	0.000	0.00e+000	2.95e-004	0.00e+000	0.00e+000
13	0.500	0.7548	2.79	75.5	0.000	0.00e+000	1.56e-003	0.00e+000	0.00e+000
14	0.125	0.7523	2.82	75.2	0.000	0.00e+000	6.62e-003	0.00e+000	0.00e+000
15	0.0625	0.7519	2.83	75.2	0.000	0.00e+000	6.17e-003	0.00e+000	0.00e+000

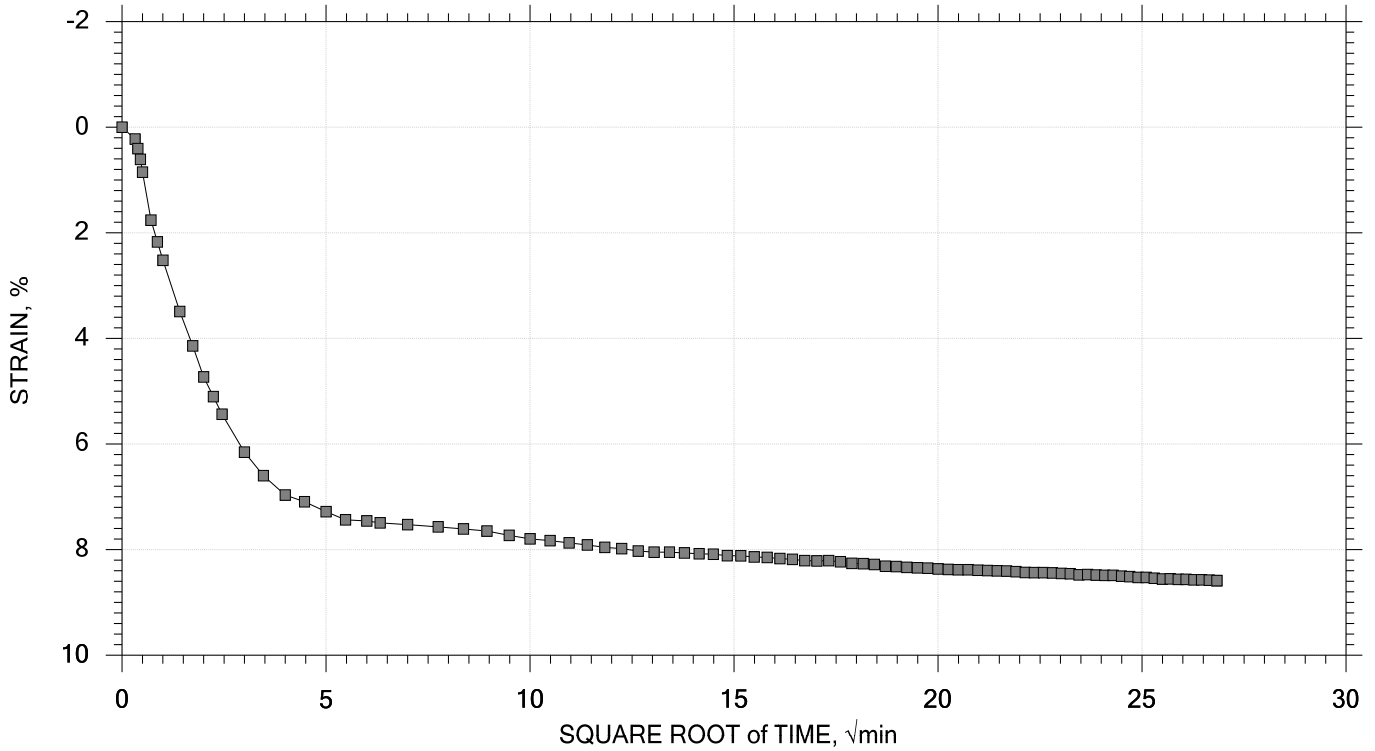
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Volume Step 1 of 15

Stress: 0.065608 tsf





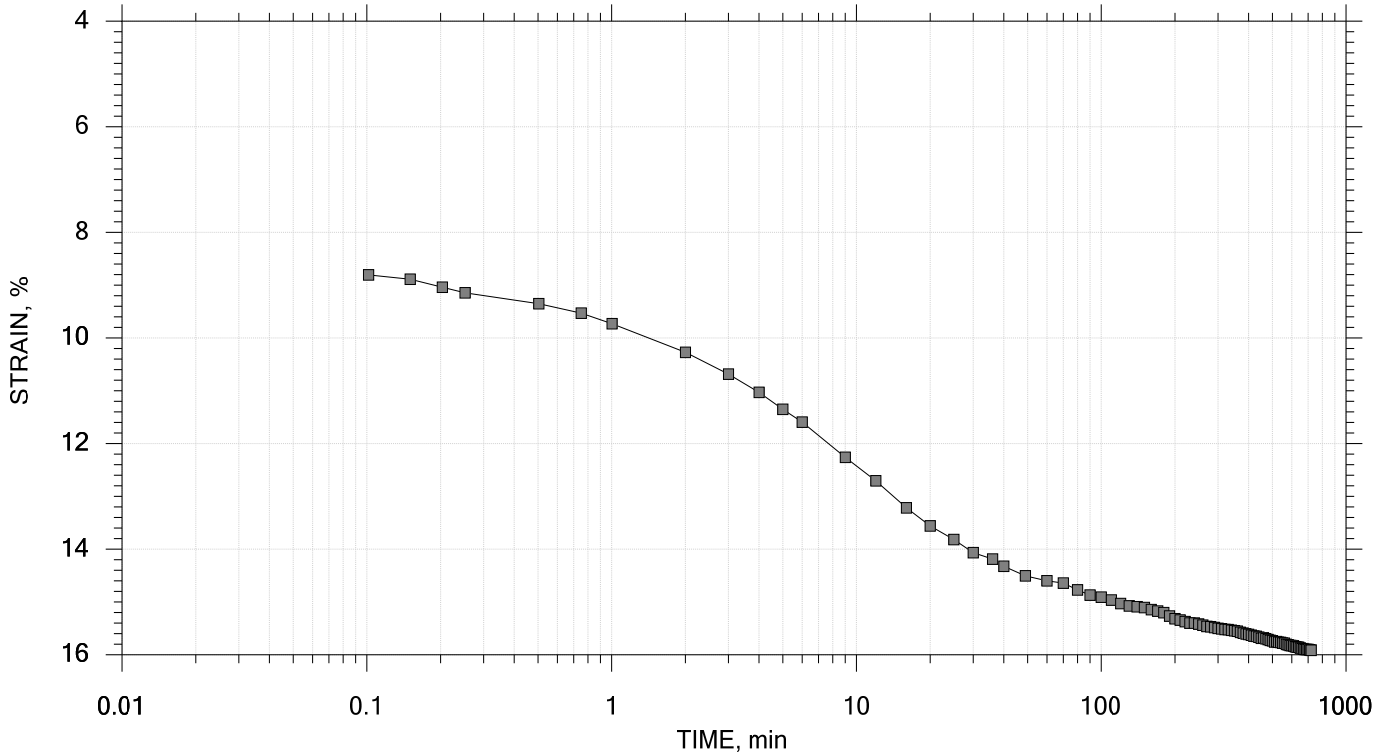
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-6	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/21/17	Test No.: IP-4
	Depth: 20-20.5	Sample Type: intact	Elevation: ---
	Description: Wet, very dark gray silt		
	Remarks: System O, Swell Pressure = 0.0656 tsf		

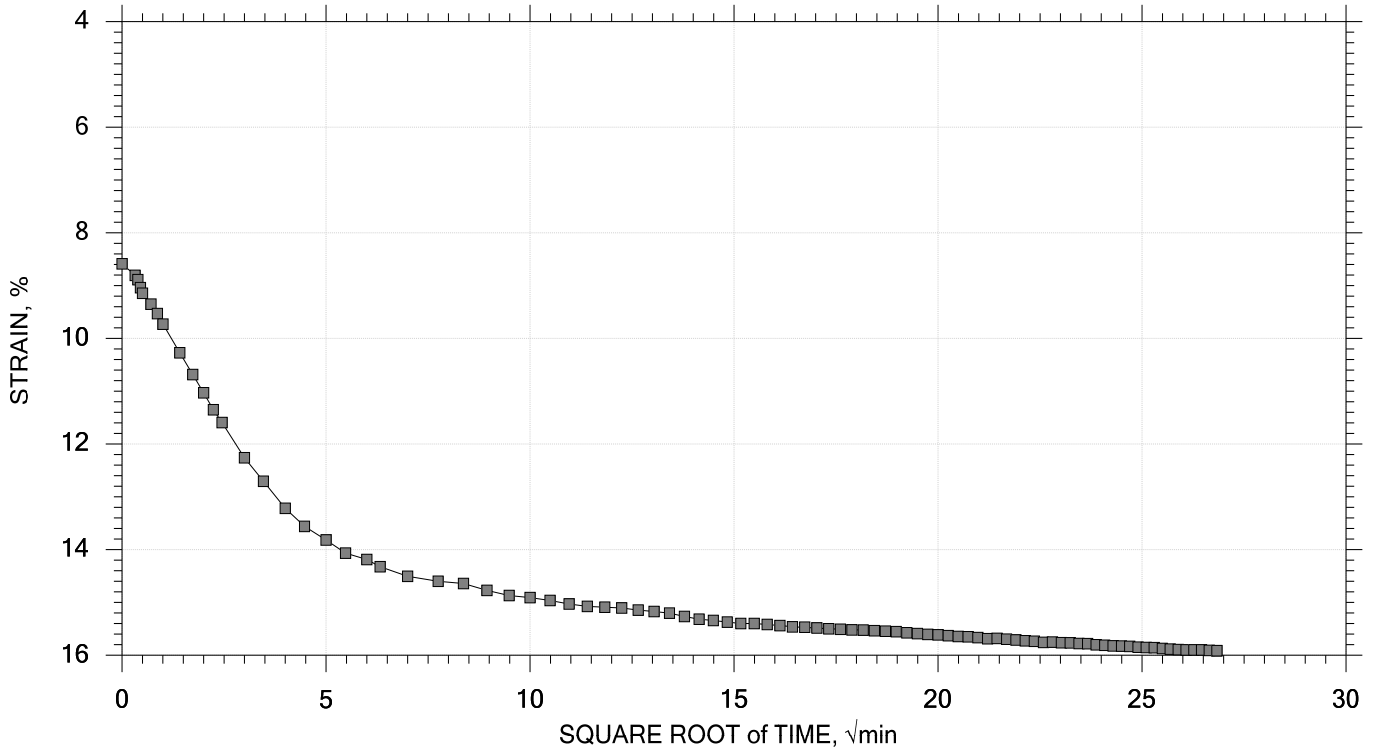
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 2 of 15

Stress: 0.125 tsf





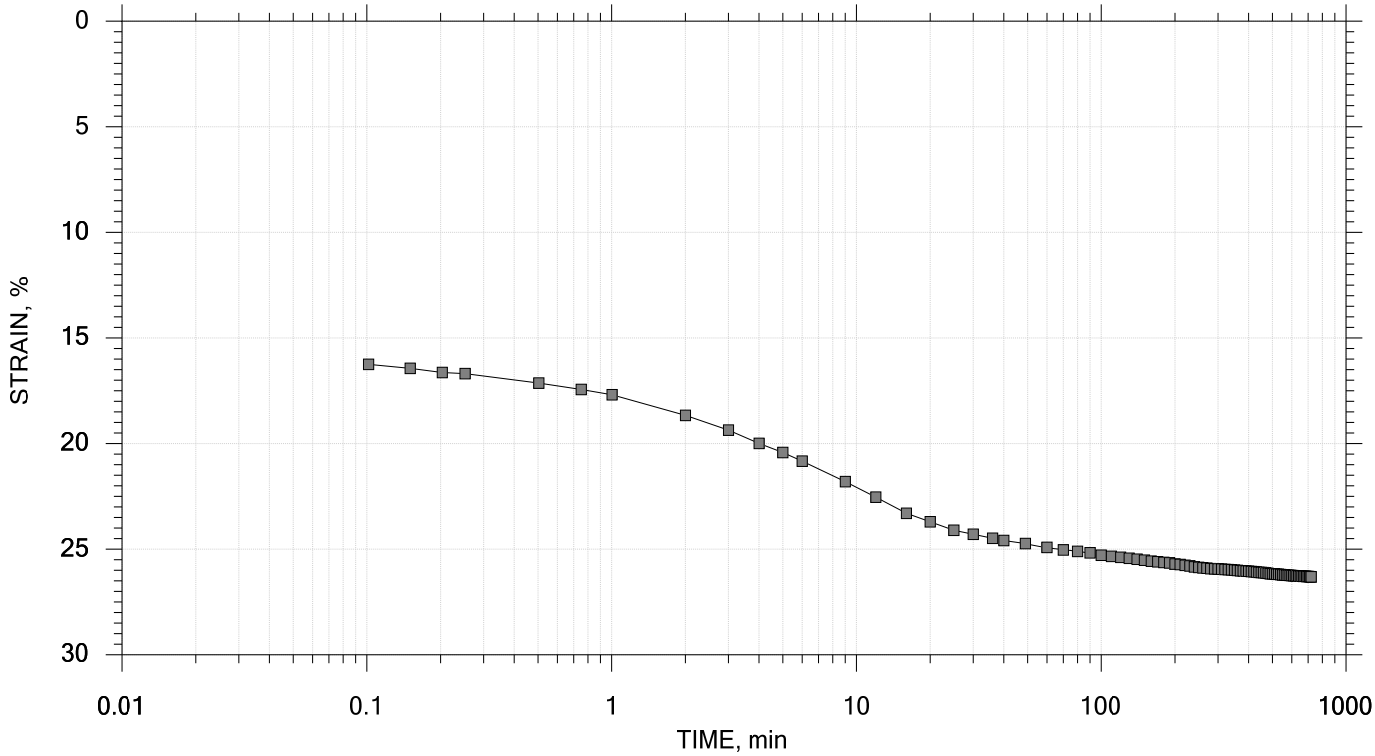
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-6	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/21/17	Test No.: IP-4
	Depth: 20-20.5	Sample Type: intact	Elevation: ---
	Description: Wet, very dark gray silt		
	Remarks: System O, Swell Pressure = 0.0656 tsf		

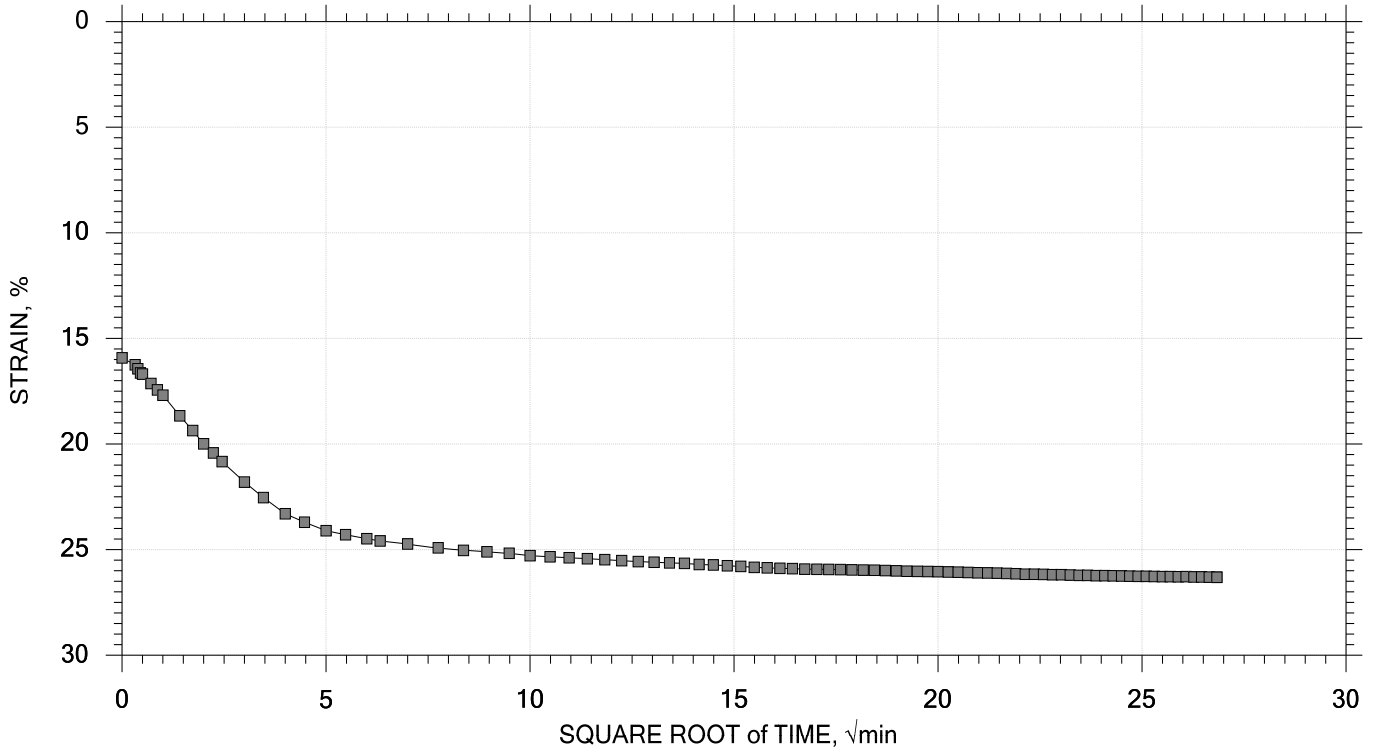
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 3 of 15

Stress: 0.25 tsf





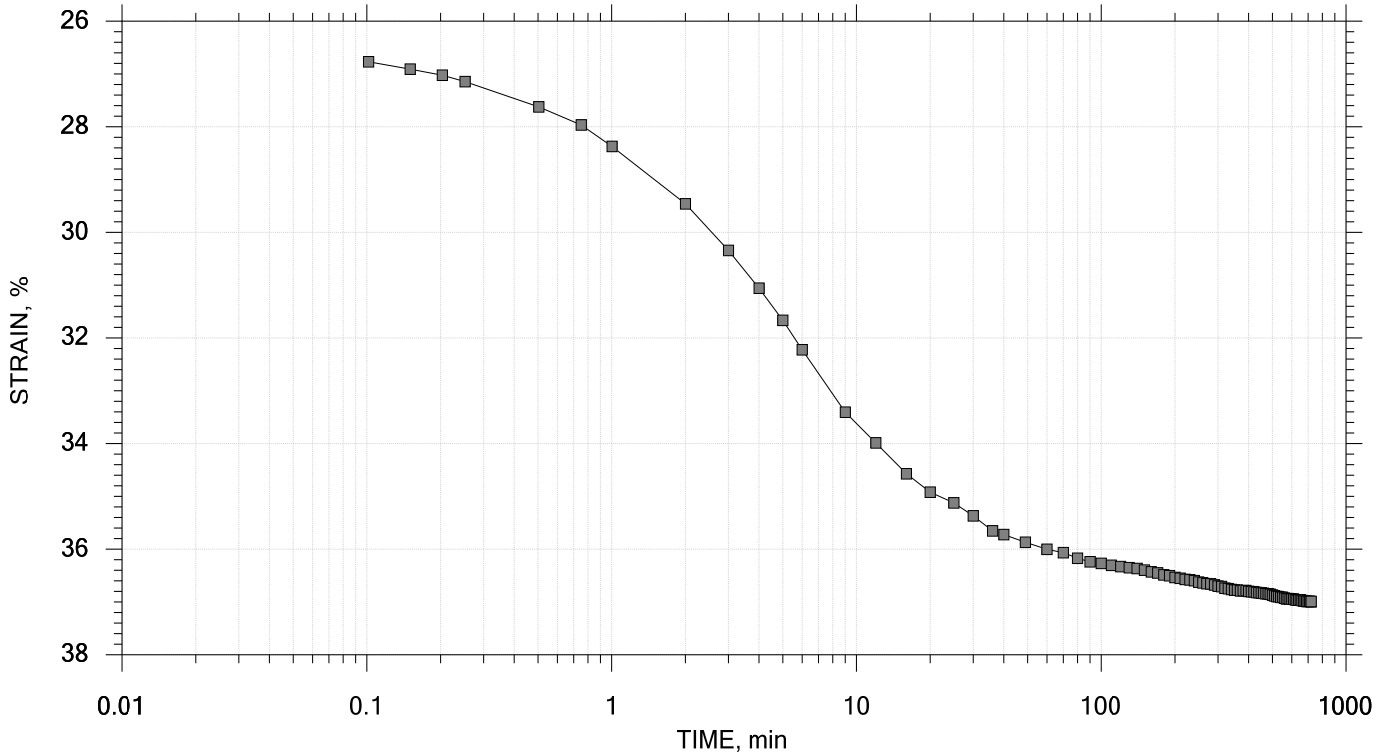
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-6	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/21/17	Test No.: IP-4
	Depth: 20-20.5	Sample Type: intact	Elevation: ---
	Description: Wet, very dark gray silt		
	Remarks: System O, Swell Pressure = 0.0656 tsf		

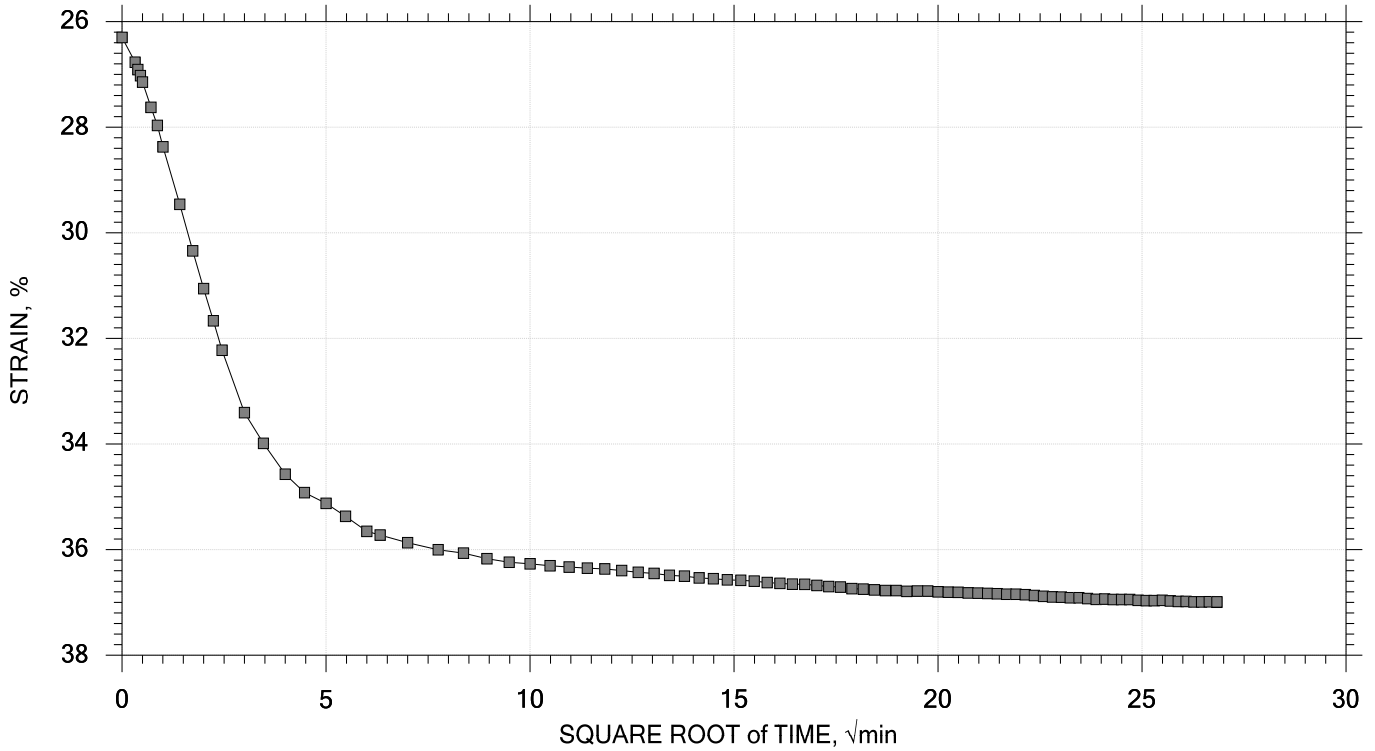
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 4 of 15

Stress: 0.5 tsf





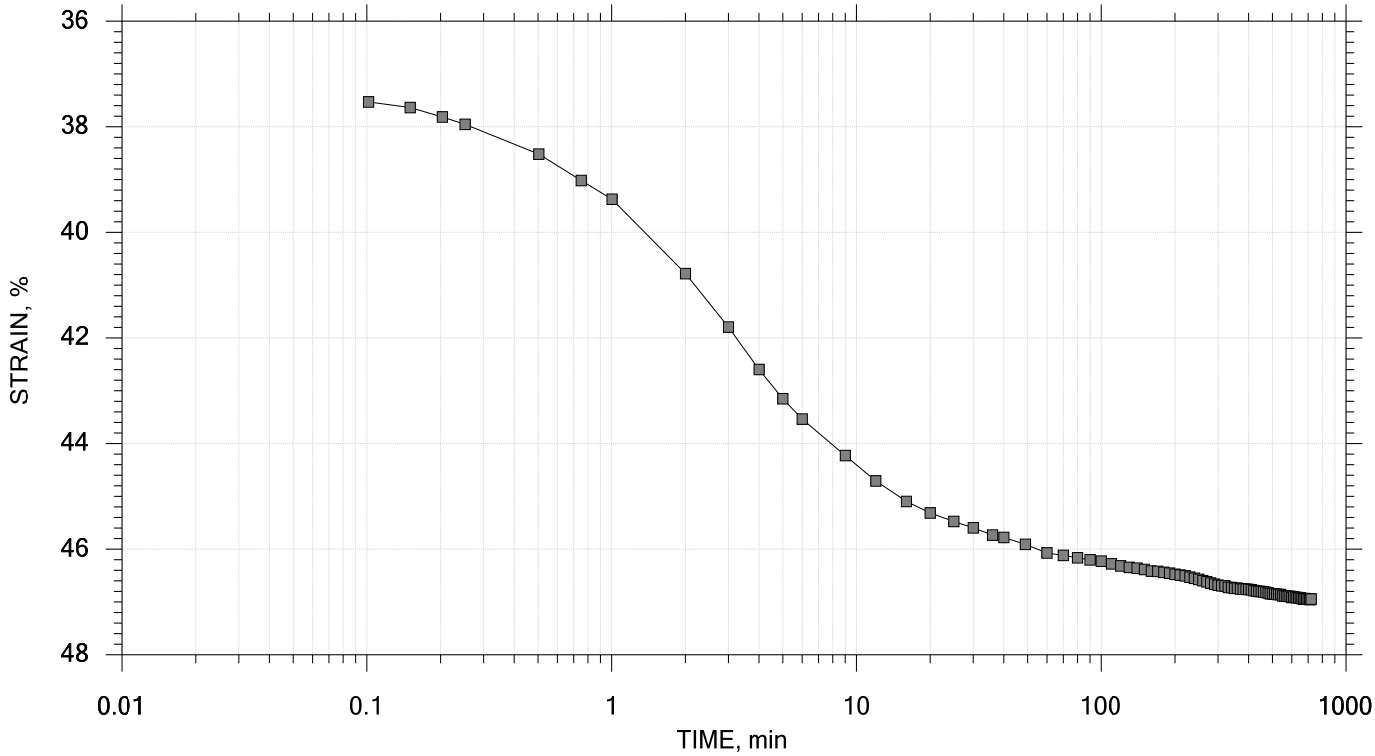
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-6	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/21/17	Test No.: IP-4
	Depth: 20-20.5	Sample Type: intact	Elevation: ---
	Description: Wet, very dark gray silt		
	Remarks: System O, Swell Pressure = 0.0656 tsf		

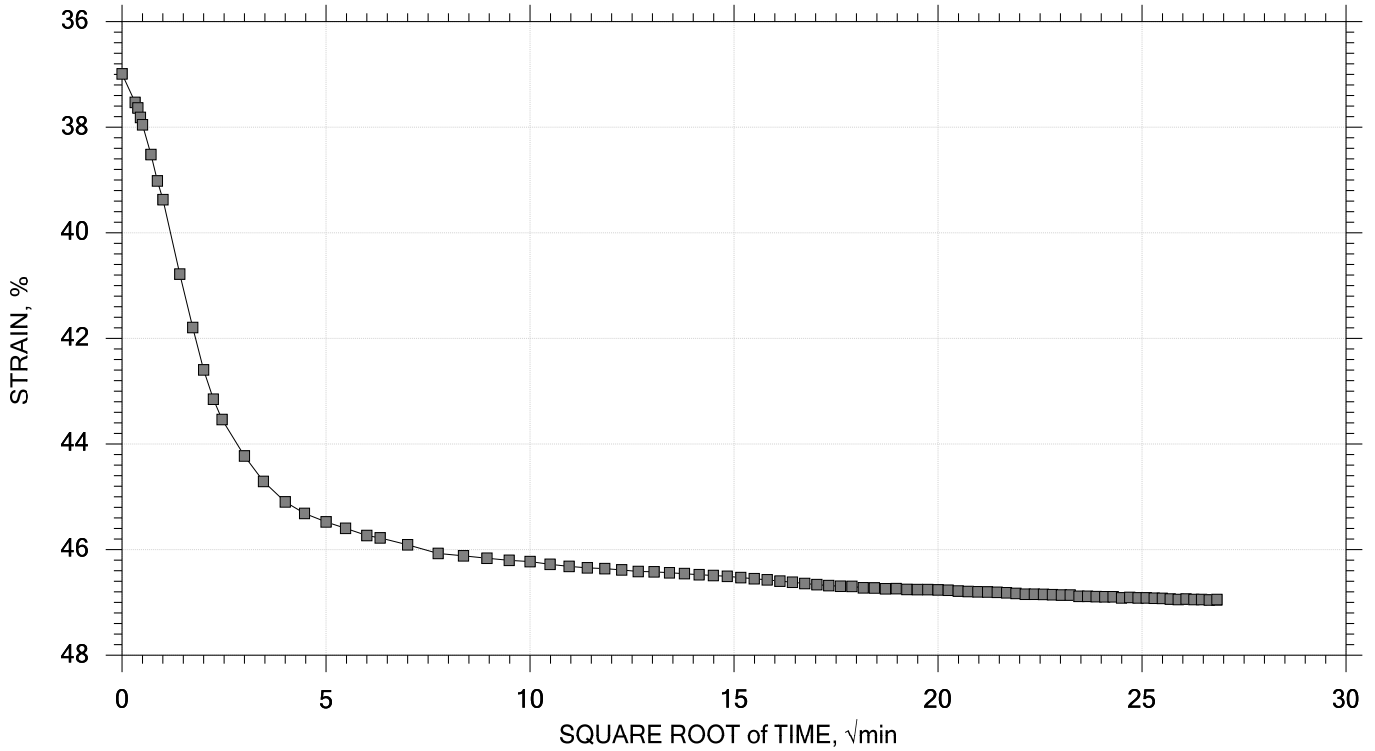
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 5 of 15

Stress: 1 tsf





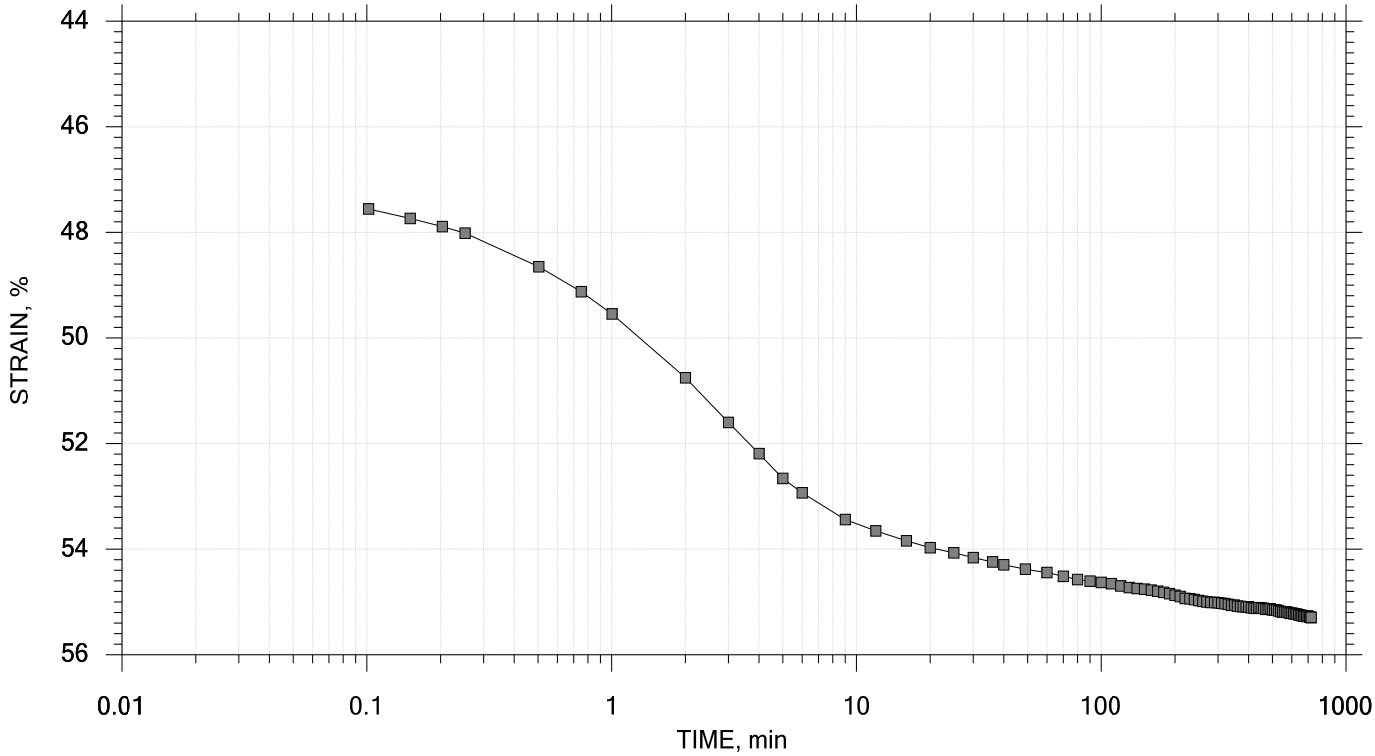
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-6	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/21/17	Test No.: IP-4
	Depth: 20-20.5	Sample Type: intact	Elevation: ---
	Description: Wet, very dark gray silt		
	Remarks: System O, Swell Pressure = 0.0656 tsf		

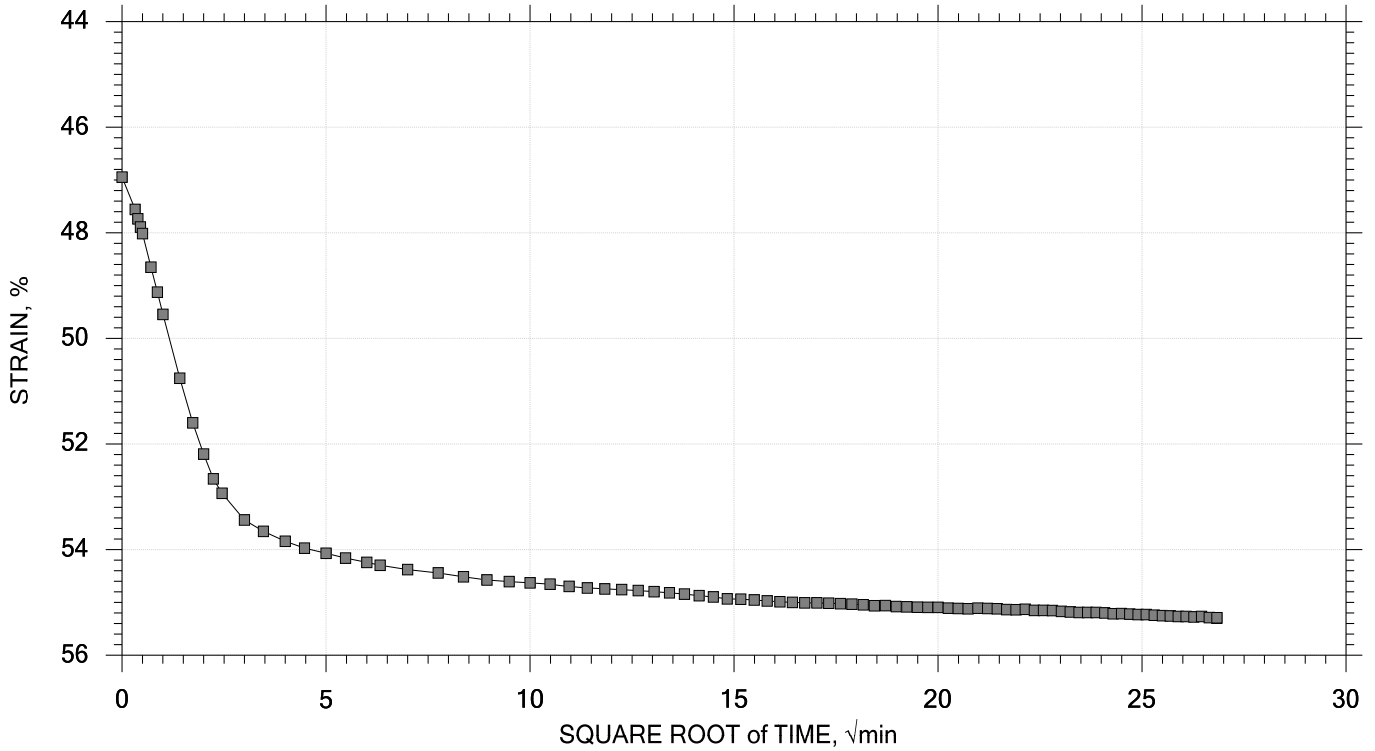
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 6 of 15

Stress: 2 tsf





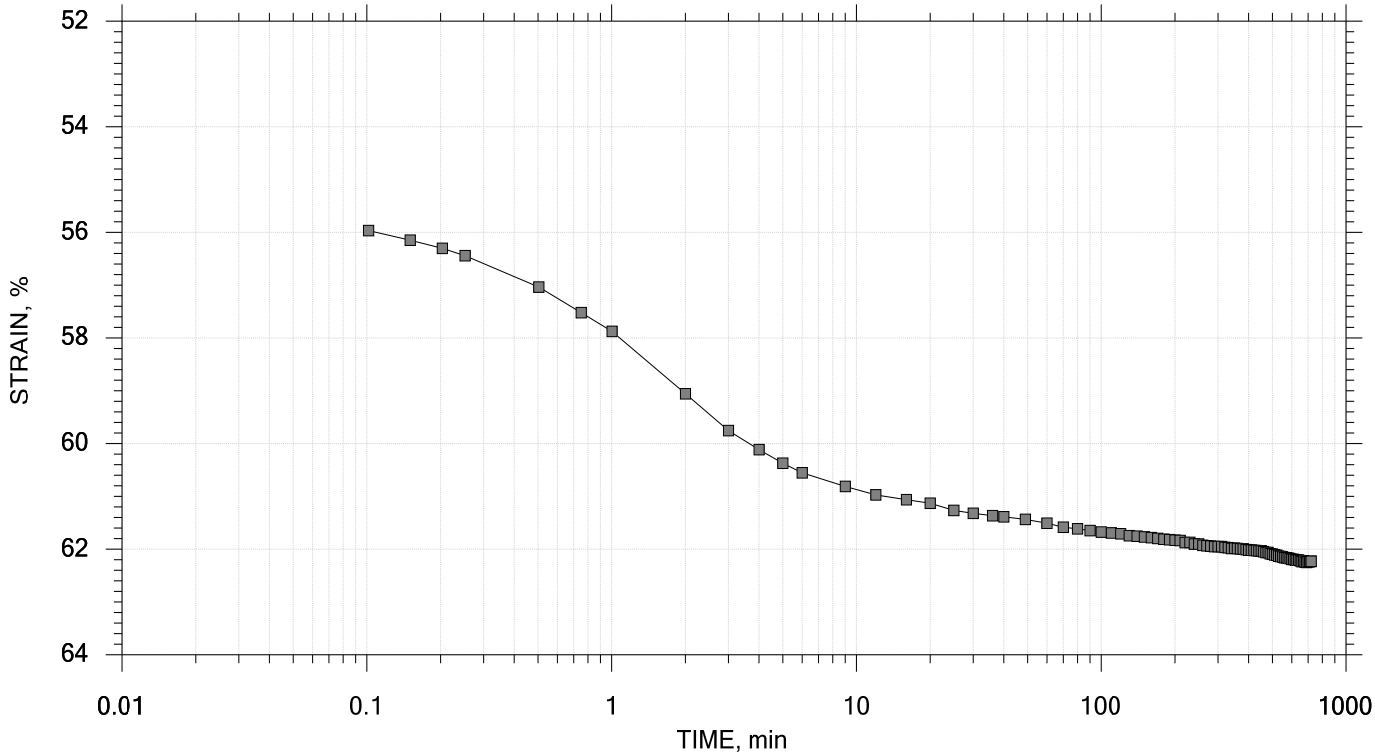
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-6	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/21/17	Test No.: IP-4
	Depth: 20-20.5	Sample Type: intact	Elevation: ---
	Description: Wet, very dark gray silt		
	Remarks: System O, Swell Pressure = 0.0656 tsf		

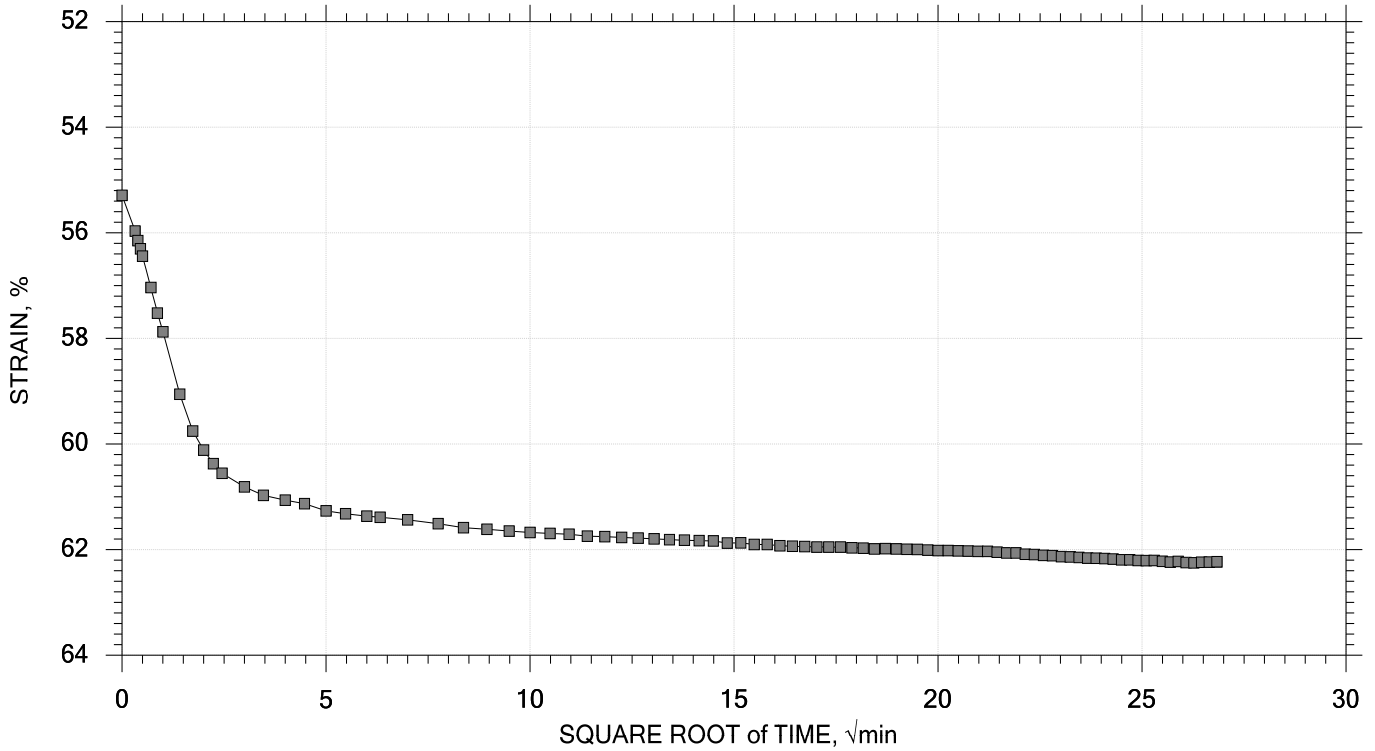
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 7 of 15

Stress: 4 tsf





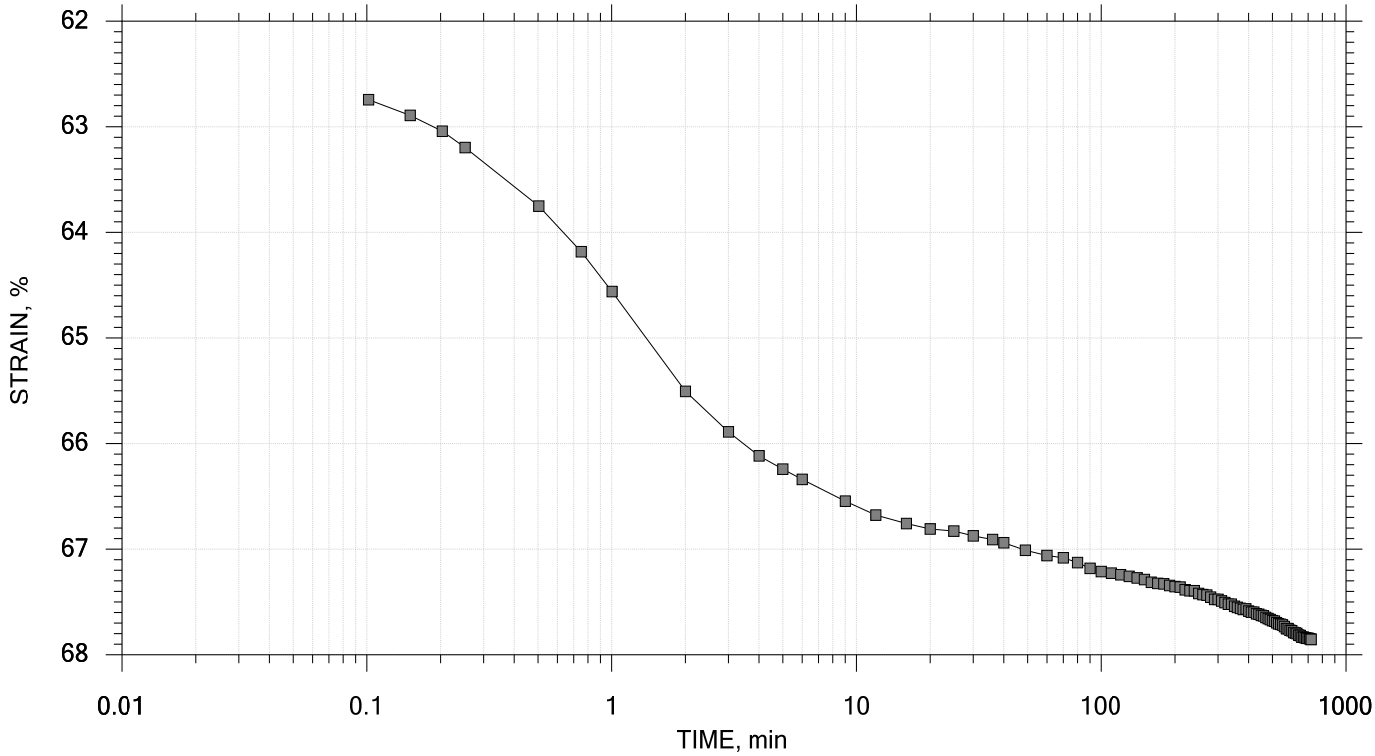
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-6	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/21/17	Test No.: IP-4
	Depth: 20-20.5	Sample Type: intact	Elevation: ---
	Description: Wet, very dark gray silt		
	Remarks: System O, Swell Pressure = 0.0656 tsf		

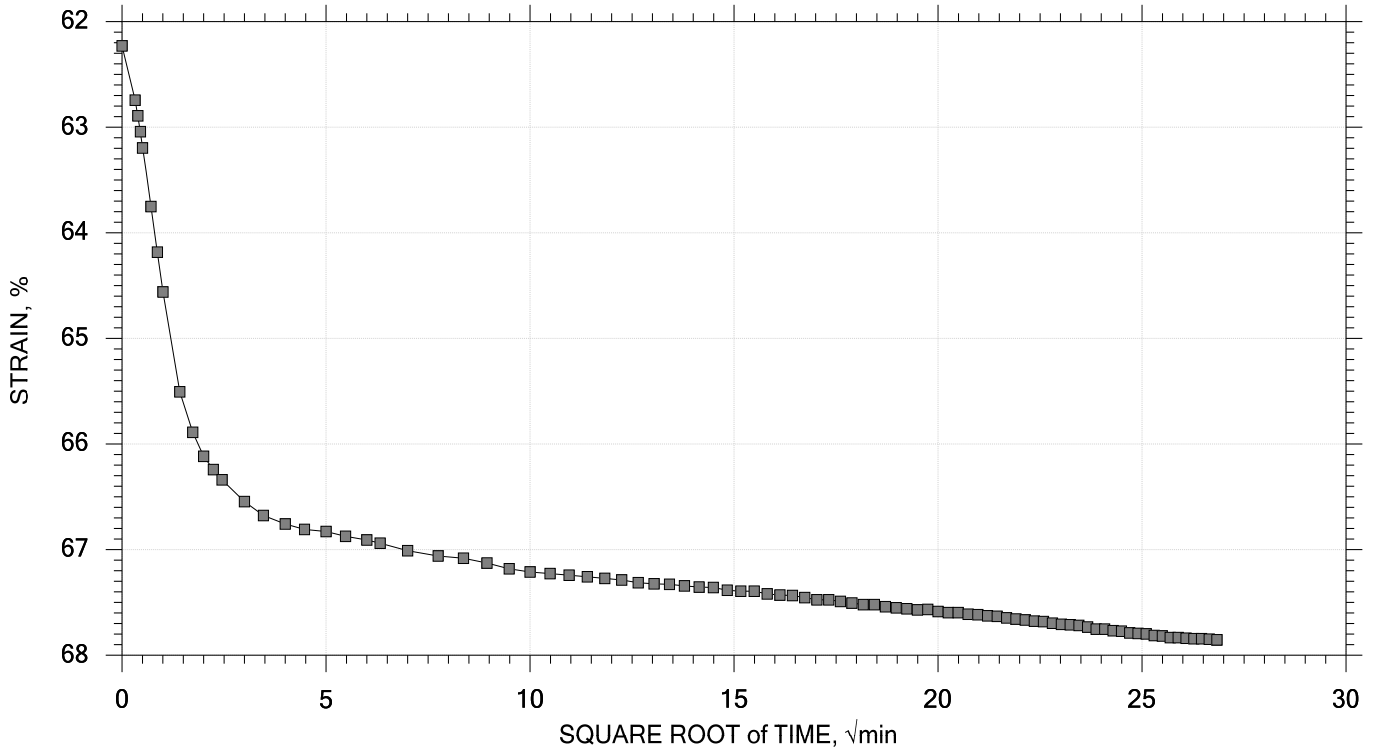
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 8 of 15

Stress: 8 tsf





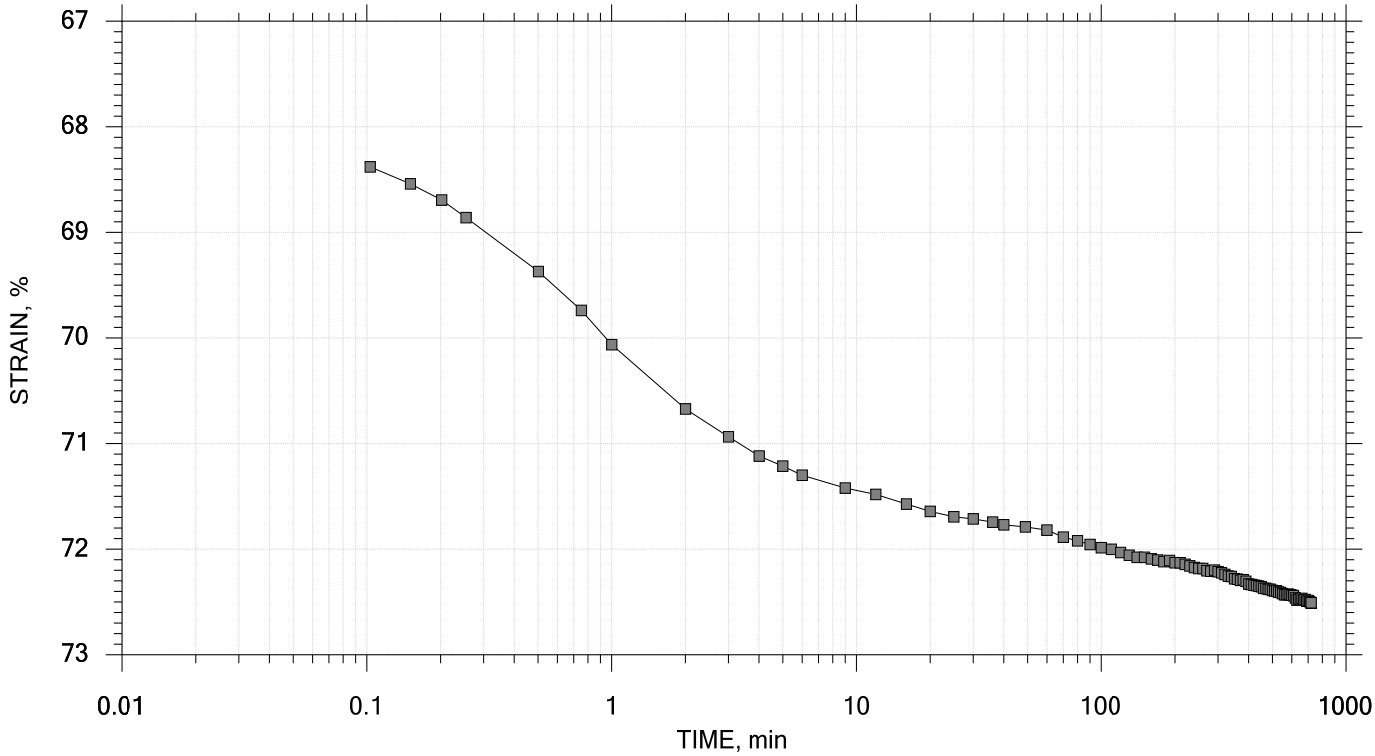
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-6	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/21/17	Test No.: IP-4
	Depth: 20-20.5	Sample Type: intact	Elevation: ---
	Description: Wet, very dark gray silt		
	Remarks: System O, Swell Pressure = 0.0656 tsf		

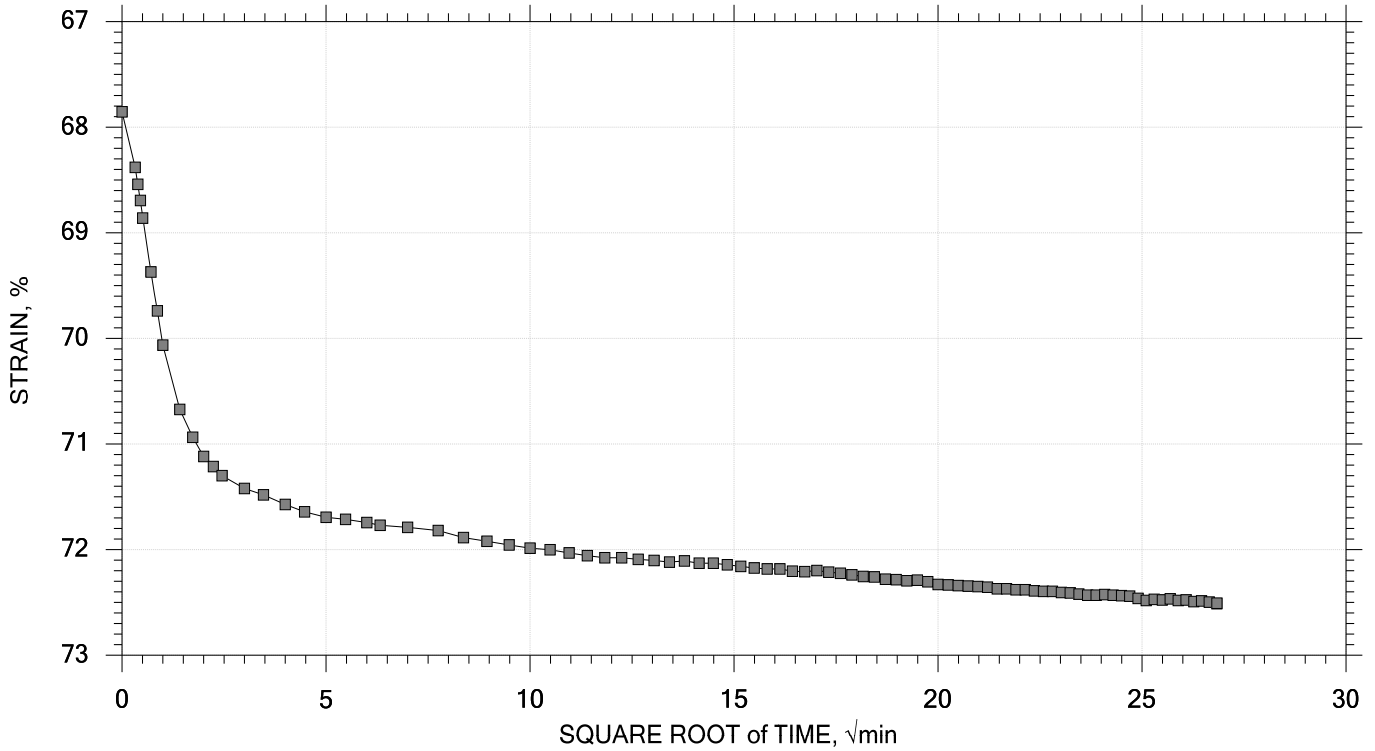
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 9 of 15

Stress: 16 tsf





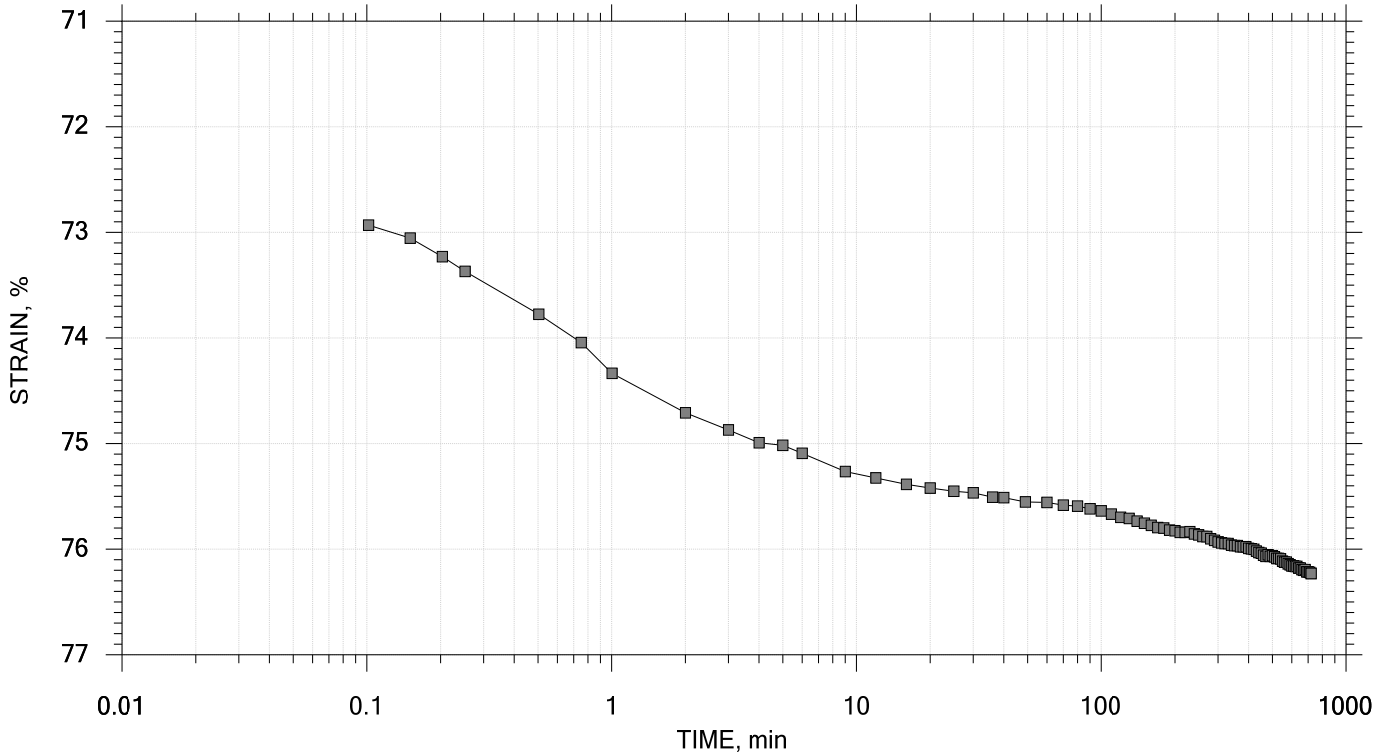
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-6	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/21/17	Test No.: IP-4
	Depth: 20-20.5	Sample Type: intact	Elevation: ---
	Description: Wet, very dark gray silt		
	Remarks: System O, Swell Pressure = 0.0656 tsf		

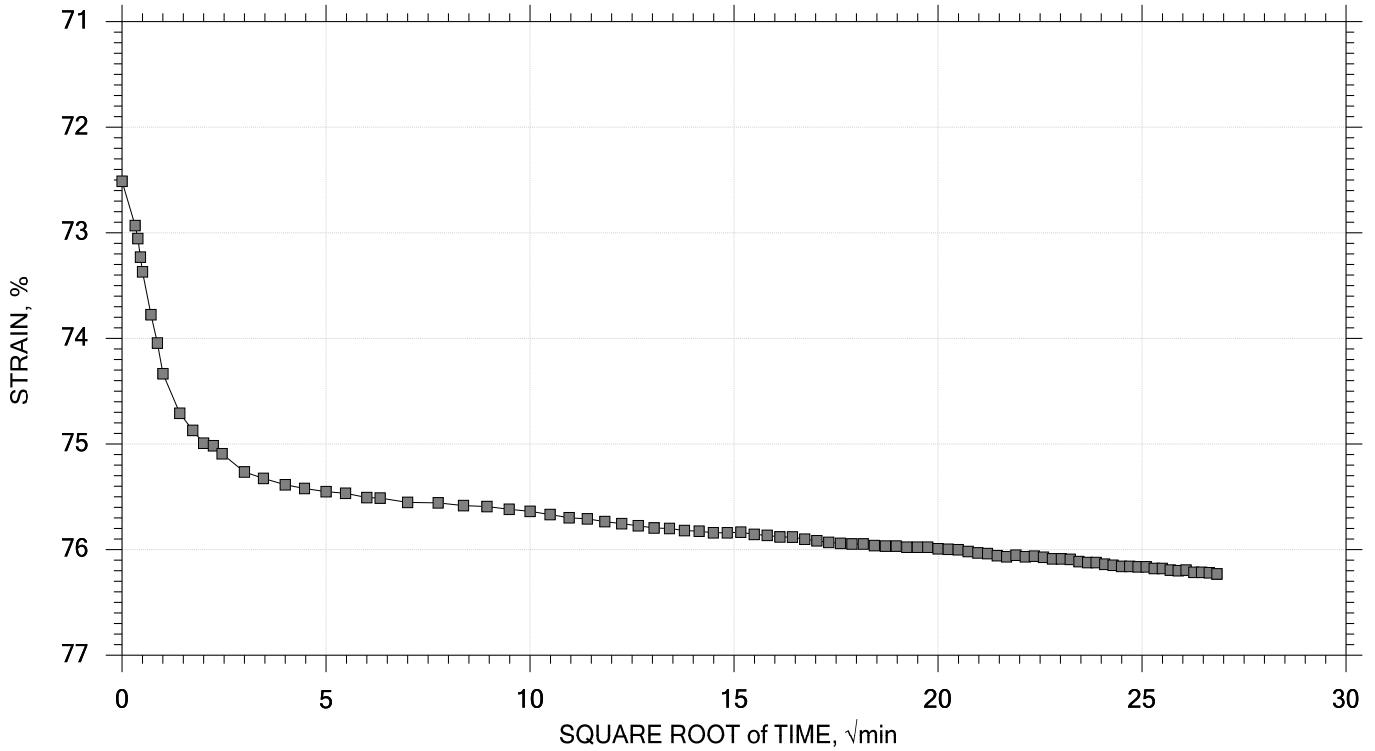
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 10 of 15

Stress: 32 tsf





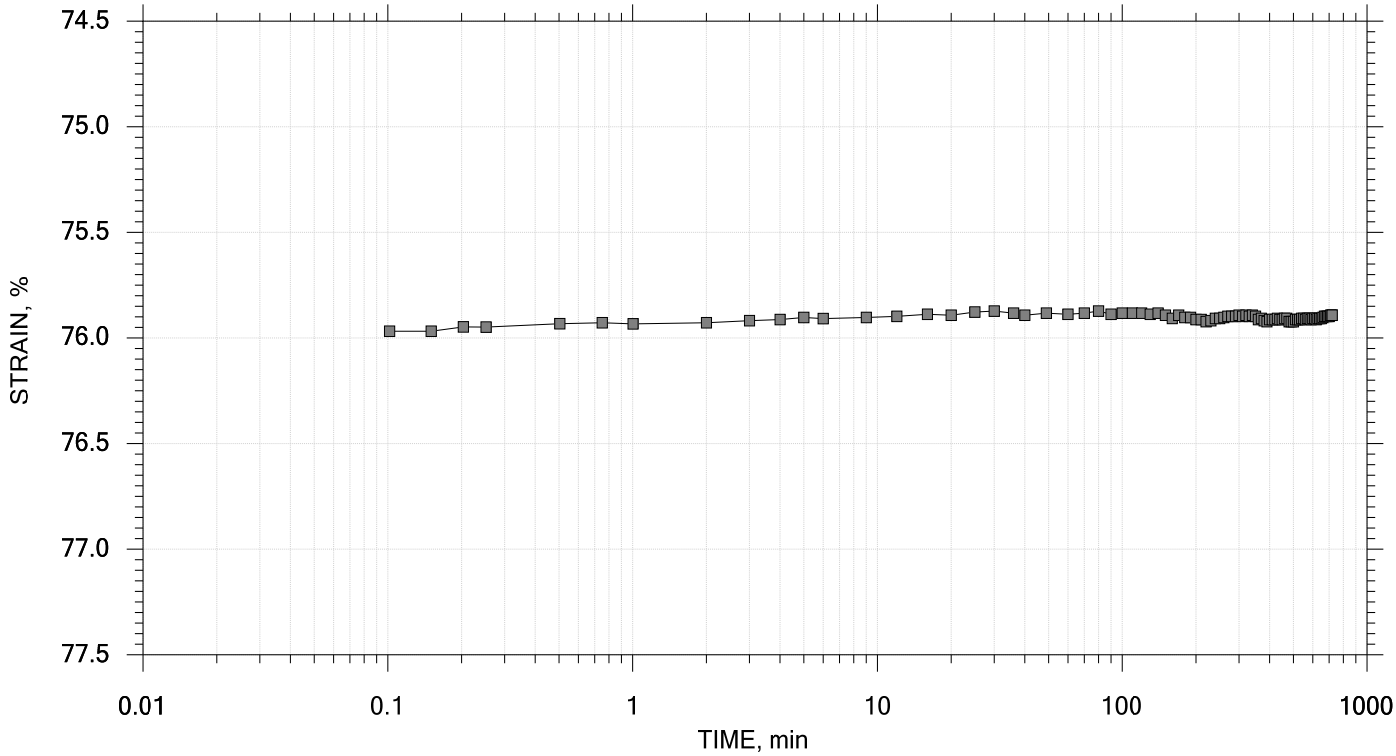
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-6	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/21/17	Test No.: IP-4
	Depth: 20-20.5	Sample Type: intact	Elevation: ---
	Description: Wet, very dark gray silt		
	Remarks: System O, Swell Pressure = 0.0656 tsf		

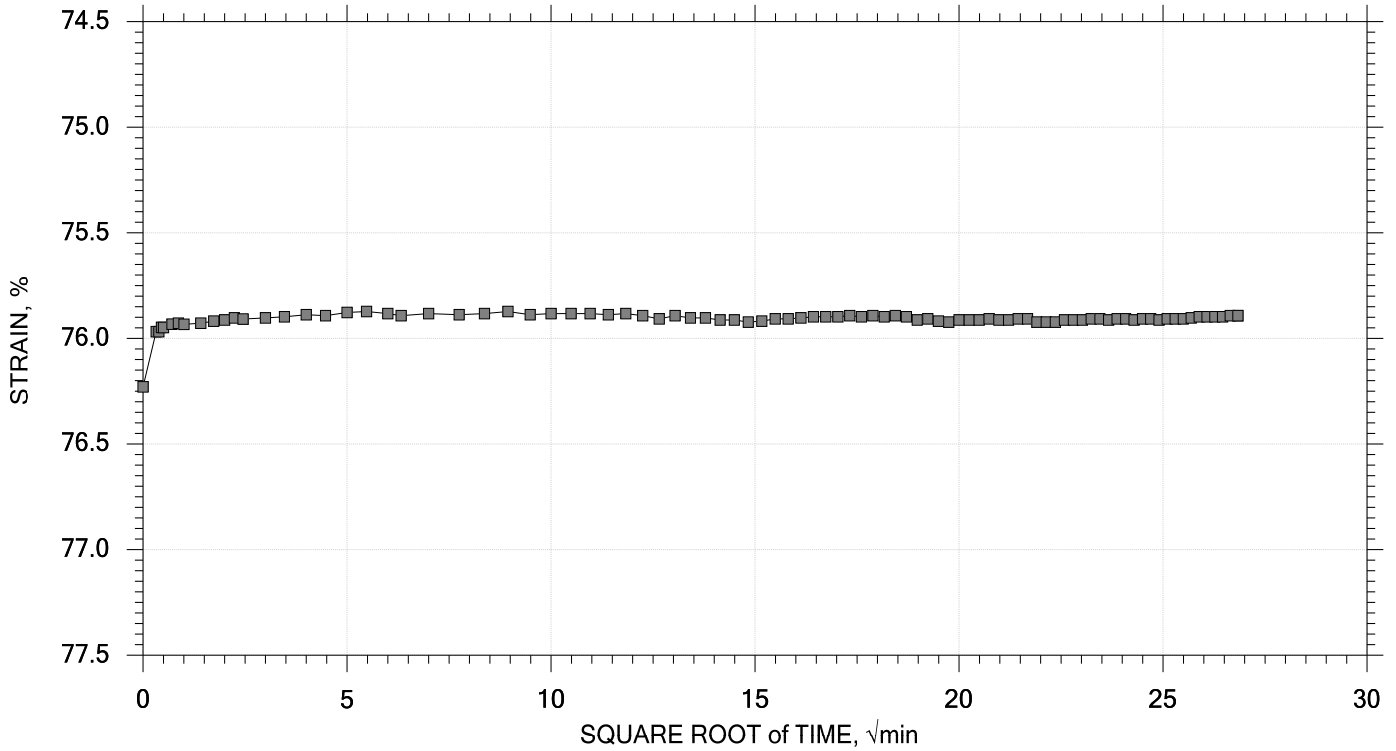
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 11 of 15

Stress: 8 tsf





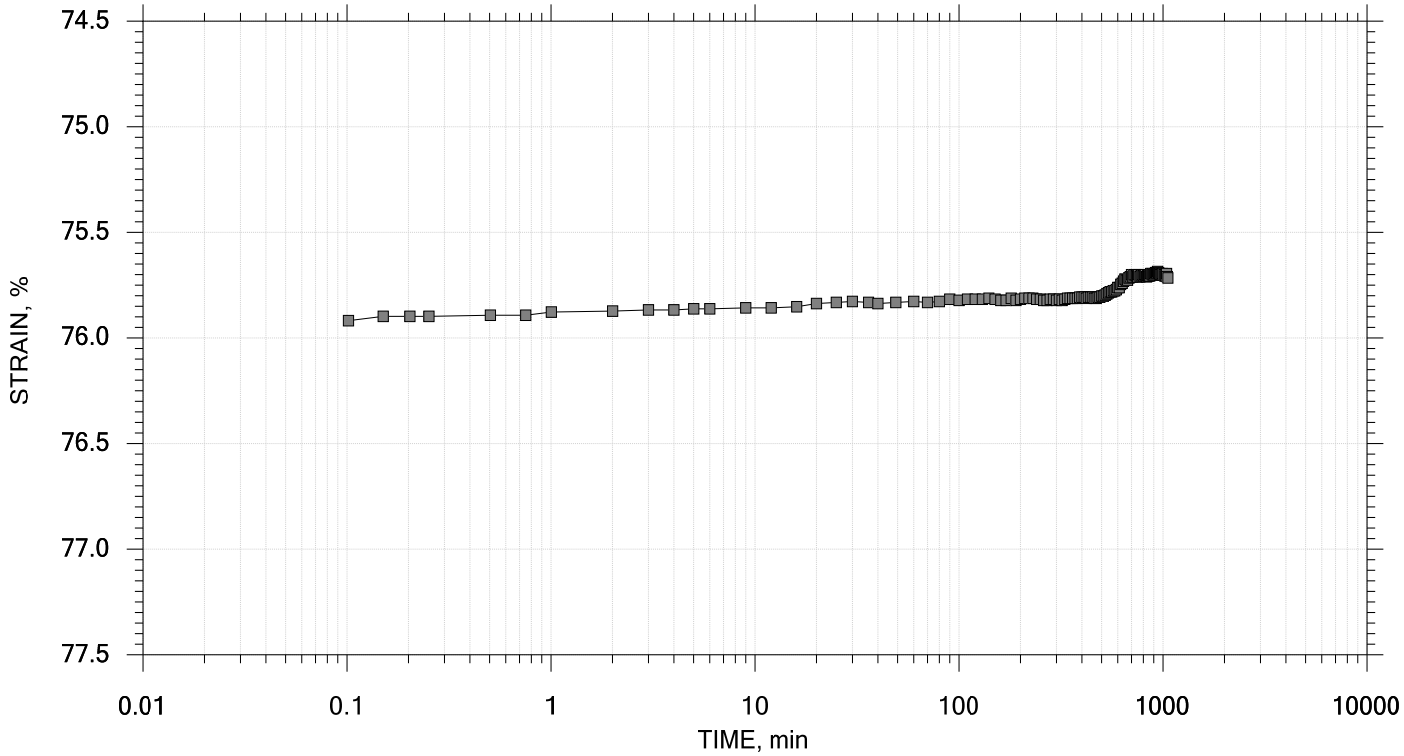
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-6	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/21/17	Test No.: IP-4
	Depth: 20-20.5	Sample Type: intact	Elevation: ---
	Description: Wet, very dark gray silt		
	Remarks: System O, Swell Pressure = 0.0656 tsf		

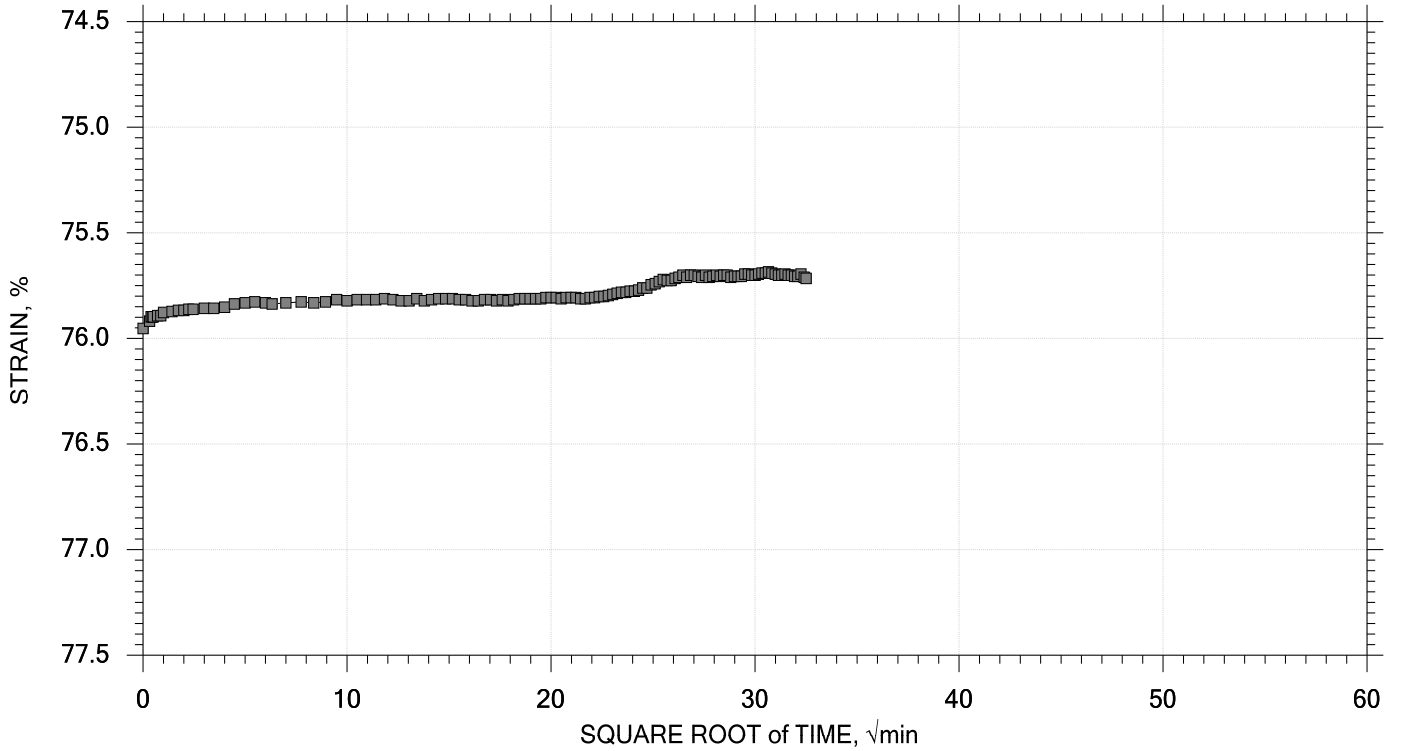
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 12 of 15

Stress: 2 tsf





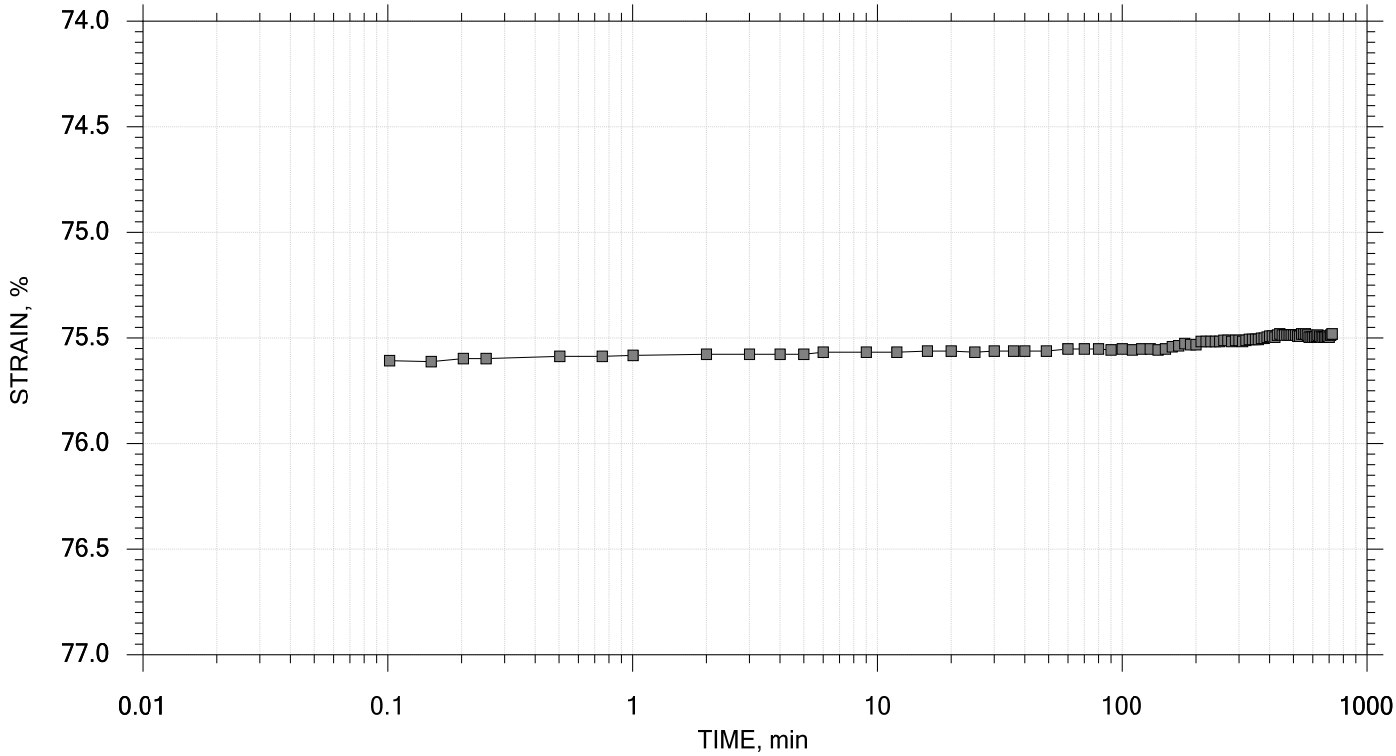
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-6	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/21/17	Test No.: IP-4
	Depth: 20-20.5	Sample Type: intact	Elevation: ---
	Description: Wet, very dark gray silt		
	Remarks: System O, Swell Pressure = 0.0656 tsf		

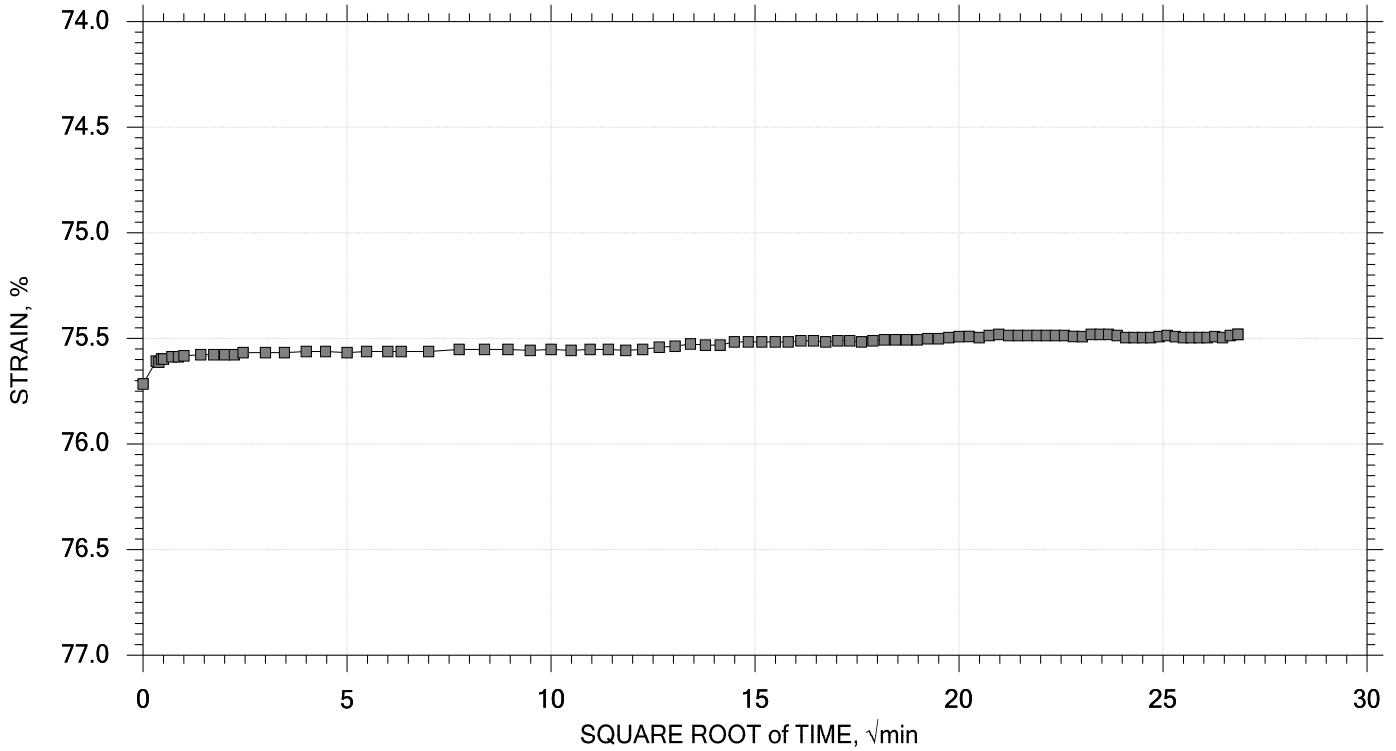
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 13 of 15

Stress: 0.5 tsf





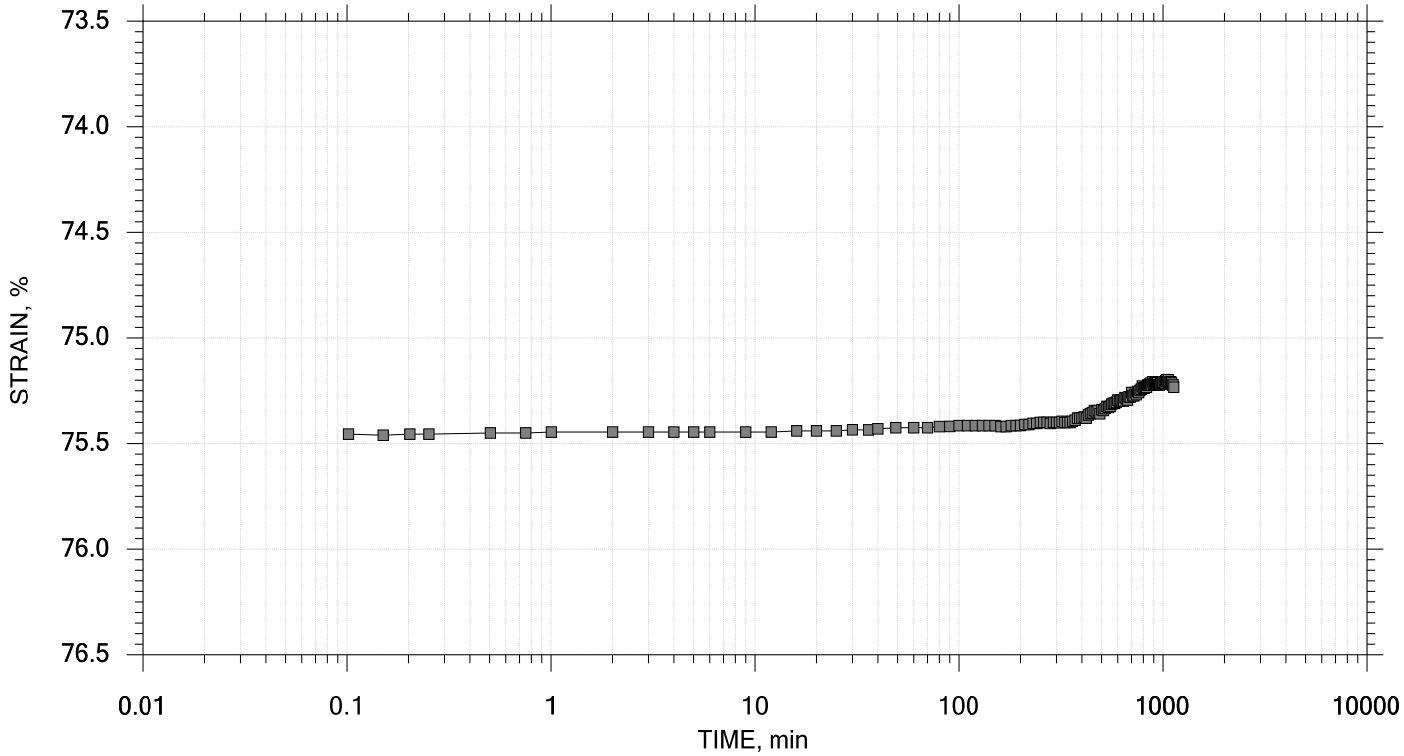
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-6	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/21/17	Test No.: IP-4
	Depth: 20-20.5	Sample Type: intact	Elevation: ---
	Description: Wet, very dark gray silt		
	Remarks: System O, Swell Pressure = 0.0656 tsf		

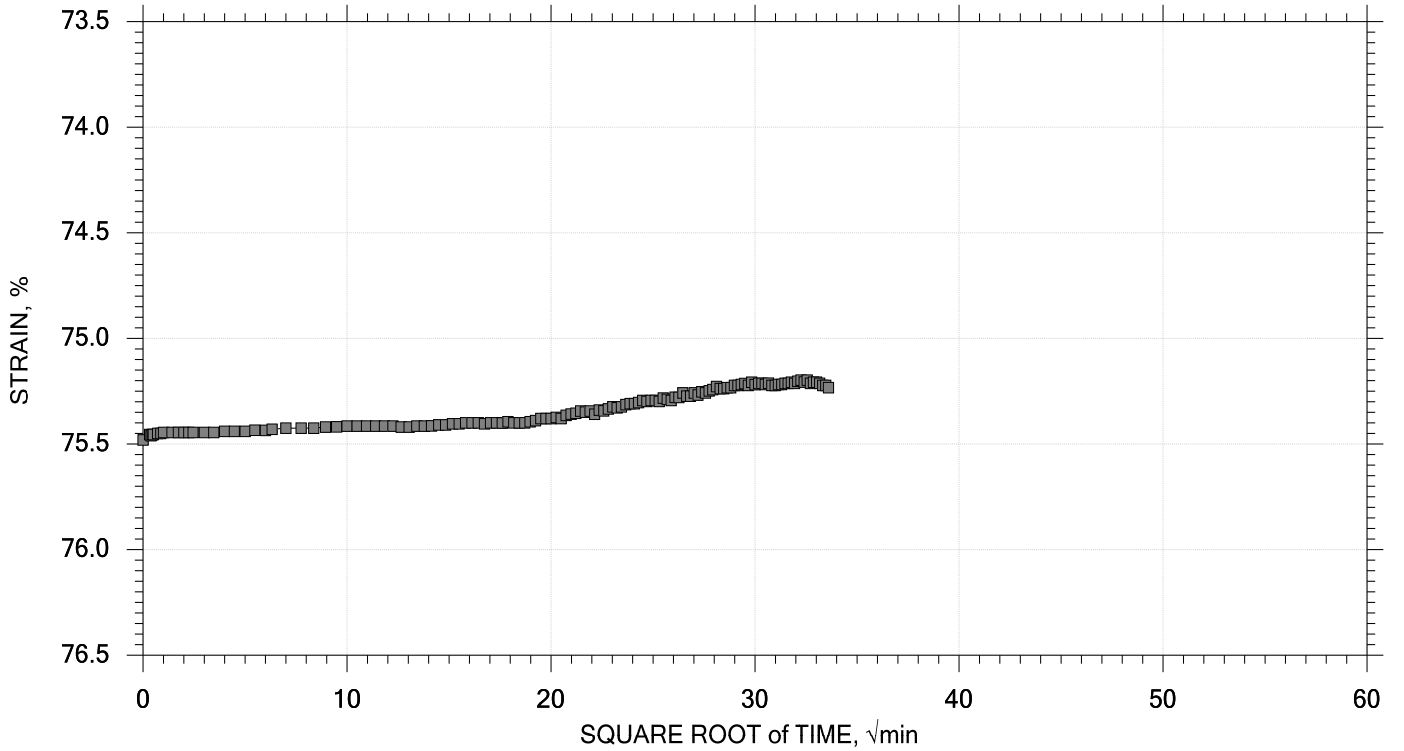
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 14 of 15

Stress: 0.125 tsf





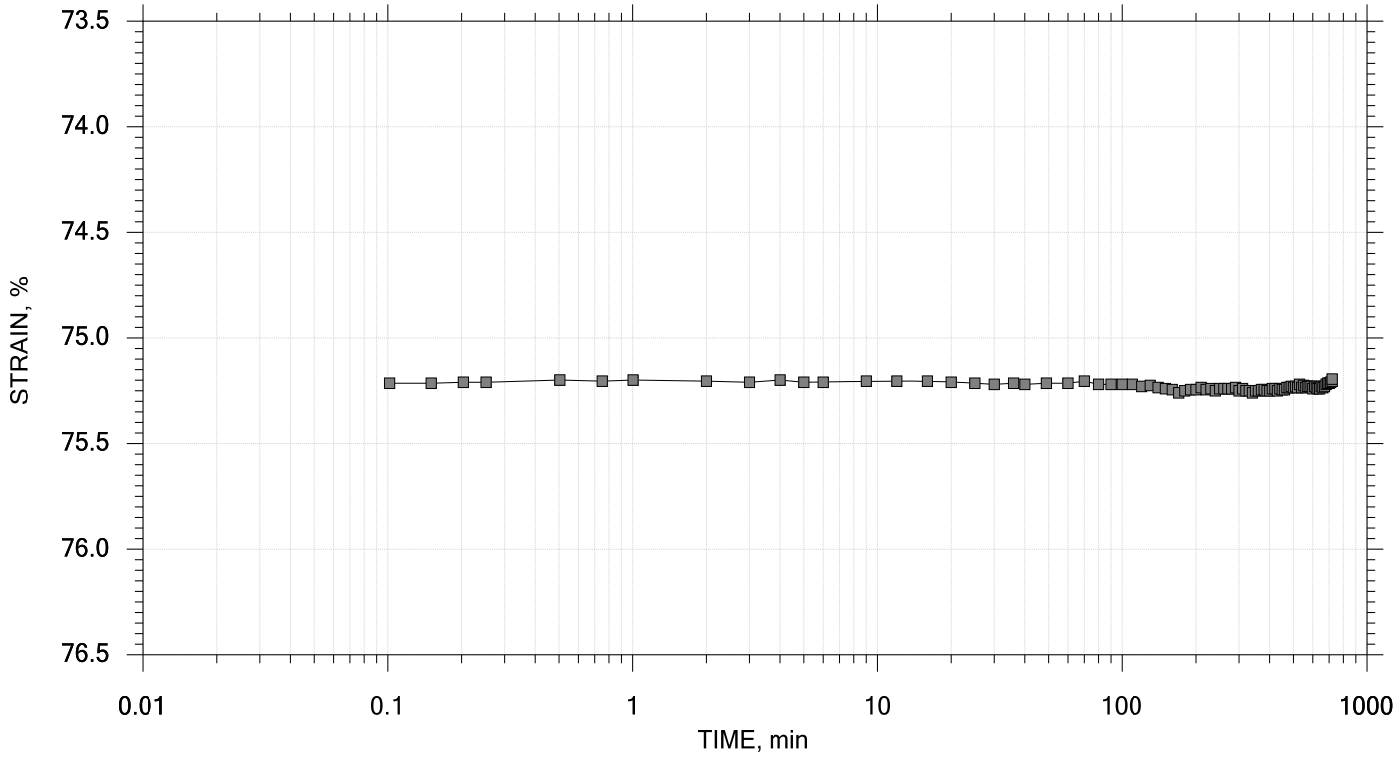
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-6	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/21/17	Test No.: IP-4
	Depth: 20-20.5	Sample Type: intact	Elevation: ---
	Description: Wet, very dark gray silt		
	Remarks: System O, Swell Pressure = 0.0656 tsf		

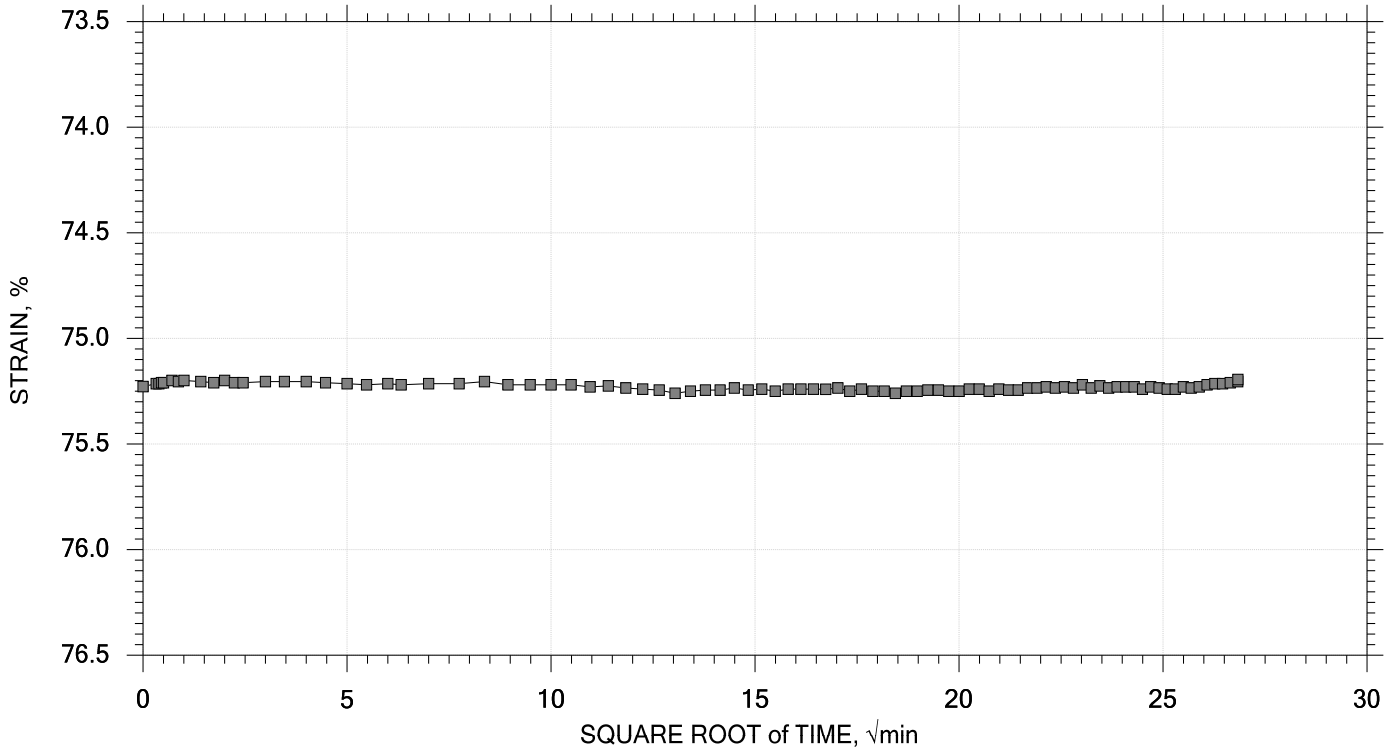
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 15 of 15

Stress: 0.0625 tsf

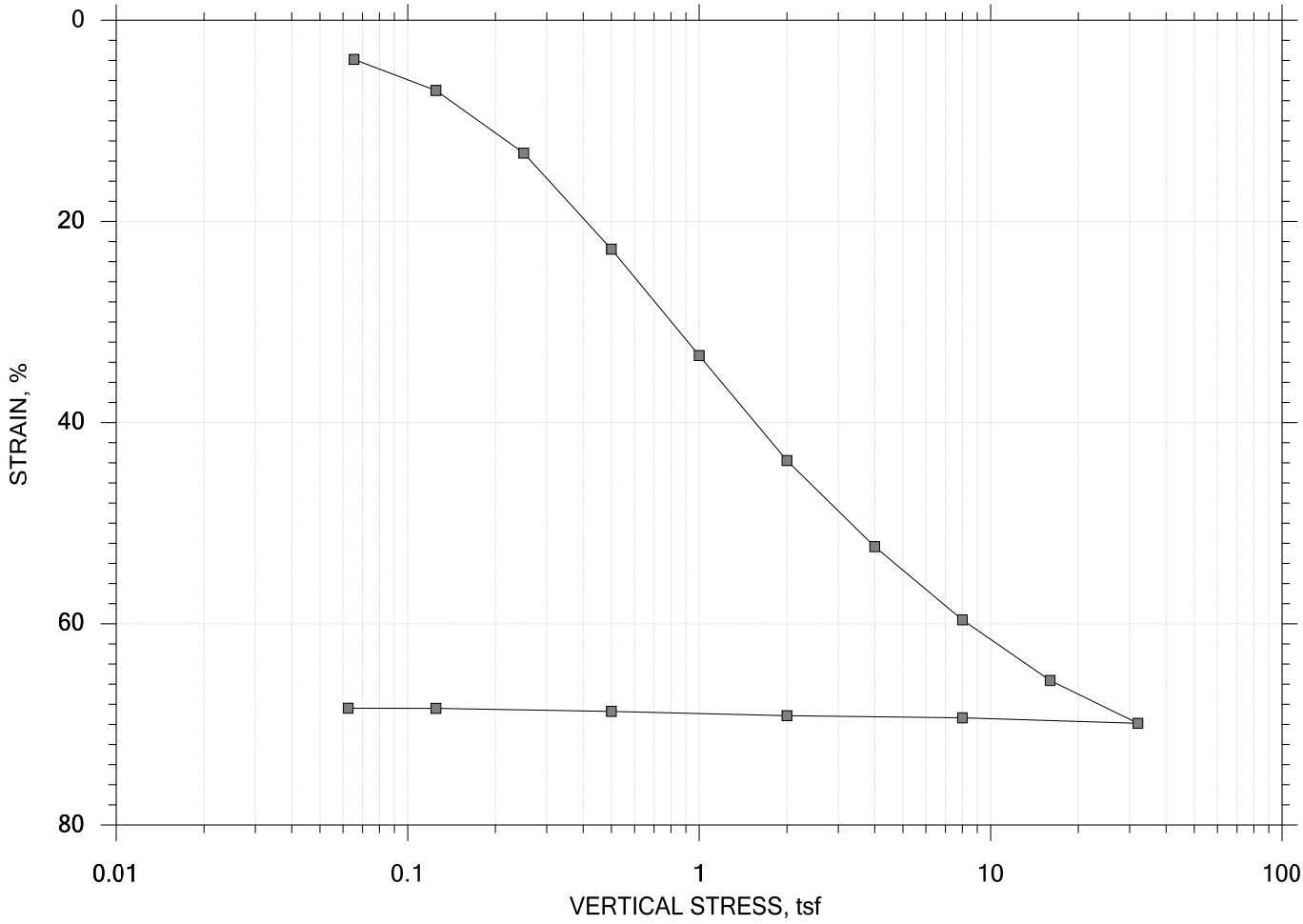


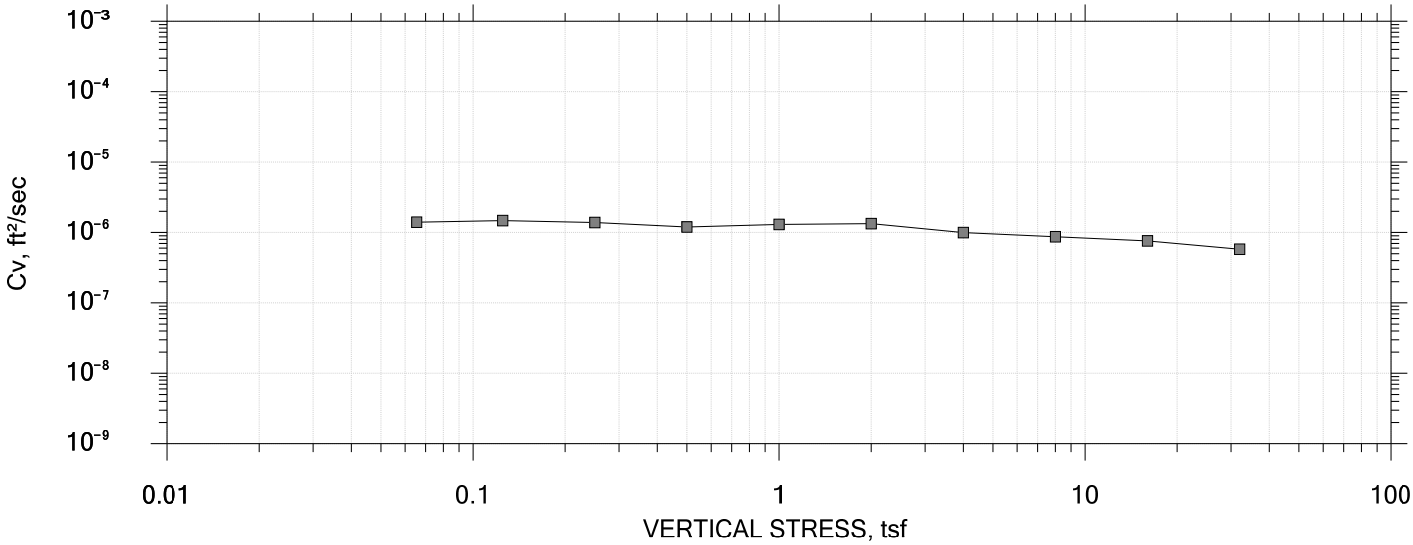


GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-6	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/21/17	Test No.: IP-4
	Depth: 20-20.5	Sample Type: intact	Elevation: ---
	Description: Wet, very dark gray silt		
	Remarks: System O, Swell Pressure = 0.0656 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT

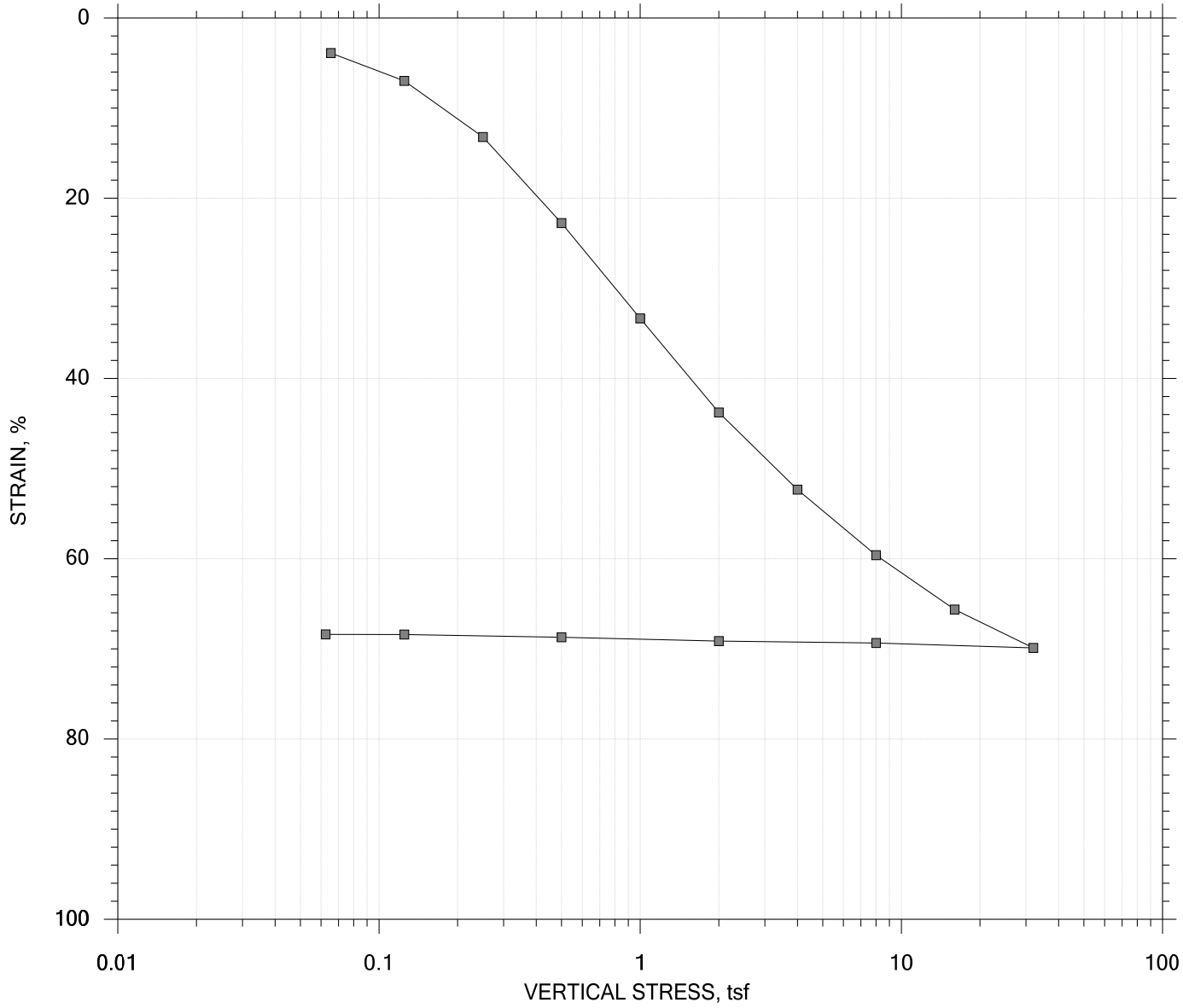




GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-12	Tested By: md	Checked By: njh
	Sample No.: S2	Test Date: 04/12/17	Test No.: IP-1
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System K, Swell Pressure = 0.0654 tsf		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT



					Before Test	After Test
Current Vertical Effective Stress: ---				Water Content, %	293.96	62.45
Preconsolidation Stress: ---				Dry Unit Weight, pcf	18.551	59.841
Compression Ratio: ---				Saturation, %	99.76	99.95
Diameter: 2.5 in		Height: 1 in		Void Ratio	7.04	1.49
LL: 227	PL: 108	PI: 119	GS: 2.39			

GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-12	Tested By: md	Checked By: njh
	Sample No.: S2	Test Date: 04/12/17	Test No.: IP-1
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System K, Swell Pressure = 0.0654 tsf		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
Boring No.: GZ-12	Tested By: md	Checked By: njh
Sample No.: S2	Test Date: 04/12/17	Depth: 18.5-19 ft
Test No.: IP-1	Sample Type: intact	Elevation: ---

Soil Description: Wet, dark gray silt
Remarks: System K, Swell Pressure = 0.0654 tsf

Measured Specific Gravity: 2.39	Liquid Limit: 227	Specimen Diameter: 2.50 in
Initial Void Ratio: 7.04	Plastic Limit: 108	Initial Height: 1.00 in
Final Void Ratio: 1.49	Plasticity Index: 119	Final Height: 0.31 in

	Before Consolidation		After Consolidation	
	Trimmings	Specimen+Ring	Specimen+Ring	Trimmings
Container ID	C-143	RING		C-817
Wt. Container + Wet Soil, gm	67.640	204.84	149.50	46.550
Wt. Container + Dry Soil, gm	23.230	134.57	134.57	31.850
Wt. Container, gm	8.3100	110.67	110.67	8.3100
Wt. Dry Soil, gm	14.920	23.903	23.903	23.540
Water Content, %	297.65	293.96	62.45	62.45
Void Ratio	---	7.04	1.49	---
Degree of Saturation, %	---	99.76	99.95	---
Dry Unit Weight, pcf	---	18.551	59.841	---

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Wynn Everett | Location: Everett, MA | Project No.: GTX-306274
Boring No.: GZ-12 | Tested By: md | Checked By: njh
Sample No.: S2 | Test Date: 04/12/17 | Depth: 18.5-19 ft
Test No.: IP-1 | Sample Type: intact | Elevation: ---

Soil Description: Wet, dark gray silt
Remarks: System K, Swell Pressure = 0.0654 tsf

Displacement at End of Increment

	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt T90 min	Cv ft²/sec	Mv 1/tsf	k ft/day
1	0.0654	0.03893	6.73	3.89	77.246	3.05e-007	5.95e-001	4.90e-004
2	0.125	0.06973	6.48	6.97	22.557	9.73e-007	5.17e-001	1.36e-003
3	0.250	0.1320	5.98	13.2	21.384	9.28e-007	4.98e-001	1.25e-003
4	0.500	0.2275	5.21	22.8	22.014	7.50e-007	3.82e-001	7.73e-004
5	1.00	0.3333	4.36	33.3	19.972	6.36e-007	2.12e-001	3.63e-004
6	2.00	0.4377	3.52	43.8	18.319	5.06e-007	1.04e-001	1.42e-004
7	4.00	0.5233	2.83	52.3	17.795	3.72e-007	4.28e-002	4.30e-005
8	8.00	0.5960	2.25	59.6	17.406	2.73e-007	1.82e-002	1.34e-005
9	16.0	0.6562	1.76	65.6	17.163	2.00e-007	7.53e-003	4.06e-006
10	32.0	0.6989	1.42	69.9	17.385	1.47e-007	2.67e-003	1.06e-006
11	8.00	0.6934	1.47	69.3	780.862	2.90e-009	2.29e-004	1.79e-009
12	2.00	0.6912	1.48	69.1	21.884	1.06e-007	3.71e-004	1.06e-007
13	0.500	0.6870	1.52	68.7	146.364	1.62e-008	2.82e-003	1.23e-007
14	0.125	0.6840	1.54	68.4	17.077	1.42e-007	7.92e-003	3.04e-006
15	0.0625	0.6839	1.54	68.4	0.000	0.00e+000	1.68e-003	0.00e+000

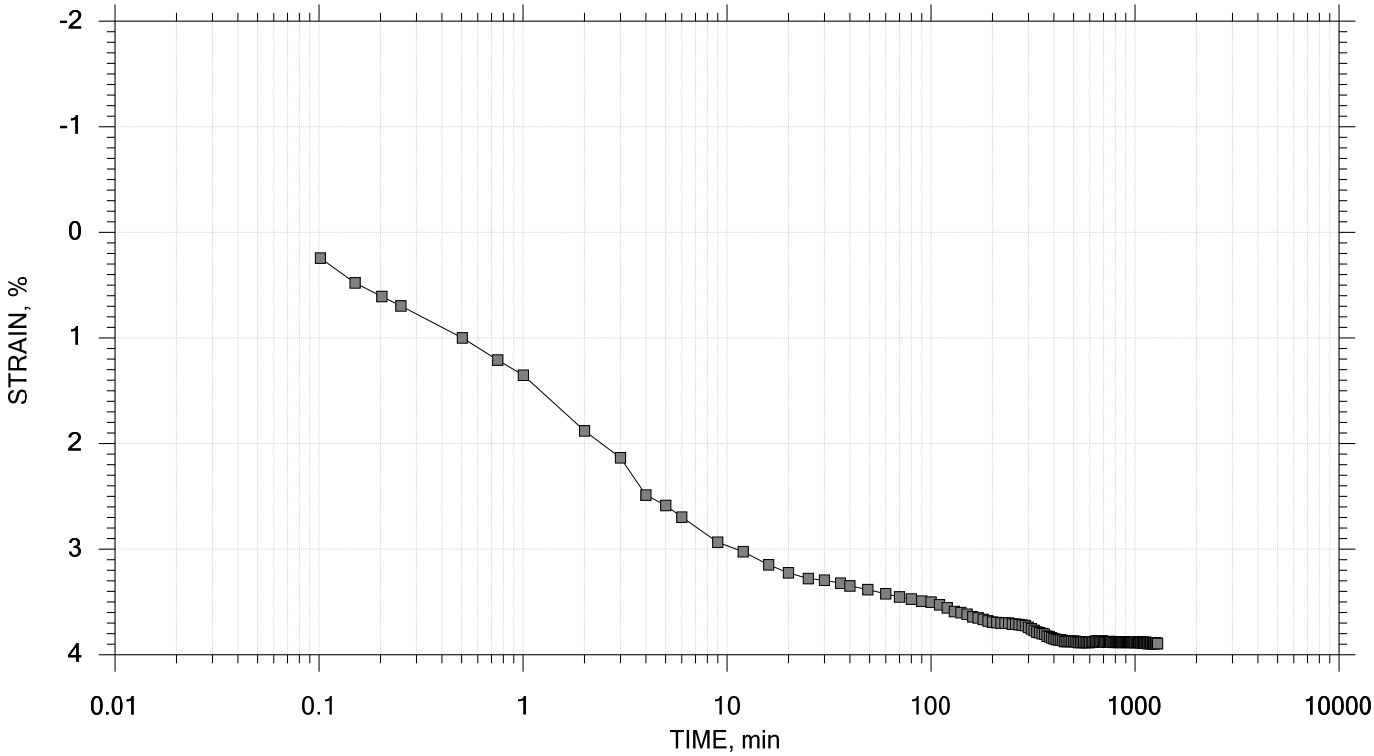
	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Log T50 min	Cv ft²/sec	Mv 1/tsf	k ft/day	Ca %
1	0.0654	0.03893	6.73	3.89	0.000	0.00e+000	5.95e-001	0.00e+000	0.00e+000
2	0.125	0.06973	6.48	6.97	3.782	1.35e-006	5.17e-001	1.88e-003	0.00e+000
3	0.250	0.1320	5.98	13.2	3.516	1.31e-006	4.98e-001	1.76e-003	0.00e+000
4	0.500	0.2275	5.21	22.8	0.000	0.00e+000	3.82e-001	0.00e+000	0.00e+000
5	1.00	0.3333	4.36	33.3	2.032	1.45e-006	2.12e-001	8.29e-004	0.00e+000
6	2.00	0.4377	3.52	43.8	1.427	1.51e-006	1.04e-001	4.24e-004	0.00e+000
7	4.00	0.5233	2.83	52.3	0.000	0.00e+000	4.28e-002	0.00e+000	0.00e+000
8	8.00	0.5960	2.25	59.6	0.000	0.00e+000	1.82e-002	0.00e+000	0.00e+000
9	16.0	0.6562	1.76	65.6	0.000	0.00e+000	7.53e-003	0.00e+000	0.00e+000
10	32.0	0.6989	1.42	69.9	0.000	0.00e+000	2.67e-003	0.00e+000	0.00e+000
11	8.00	0.6934	1.47	69.3	0.000	0.00e+000	2.29e-004	0.00e+000	0.00e+000
12	2.00	0.6912	1.48	69.1	0.000	0.00e+000	3.71e-004	0.00e+000	0.00e+000
13	0.500	0.6870	1.52	68.7	0.000	0.00e+000	2.82e-003	0.00e+000	0.00e+000
14	0.125	0.6840	1.54	68.4	0.000	0.00e+000	7.92e-003	0.00e+000	0.00e+000
15	0.0625	0.6839	1.54	68.4	0.000	0.00e+000	1.68e-003	0.00e+000	0.00e+000

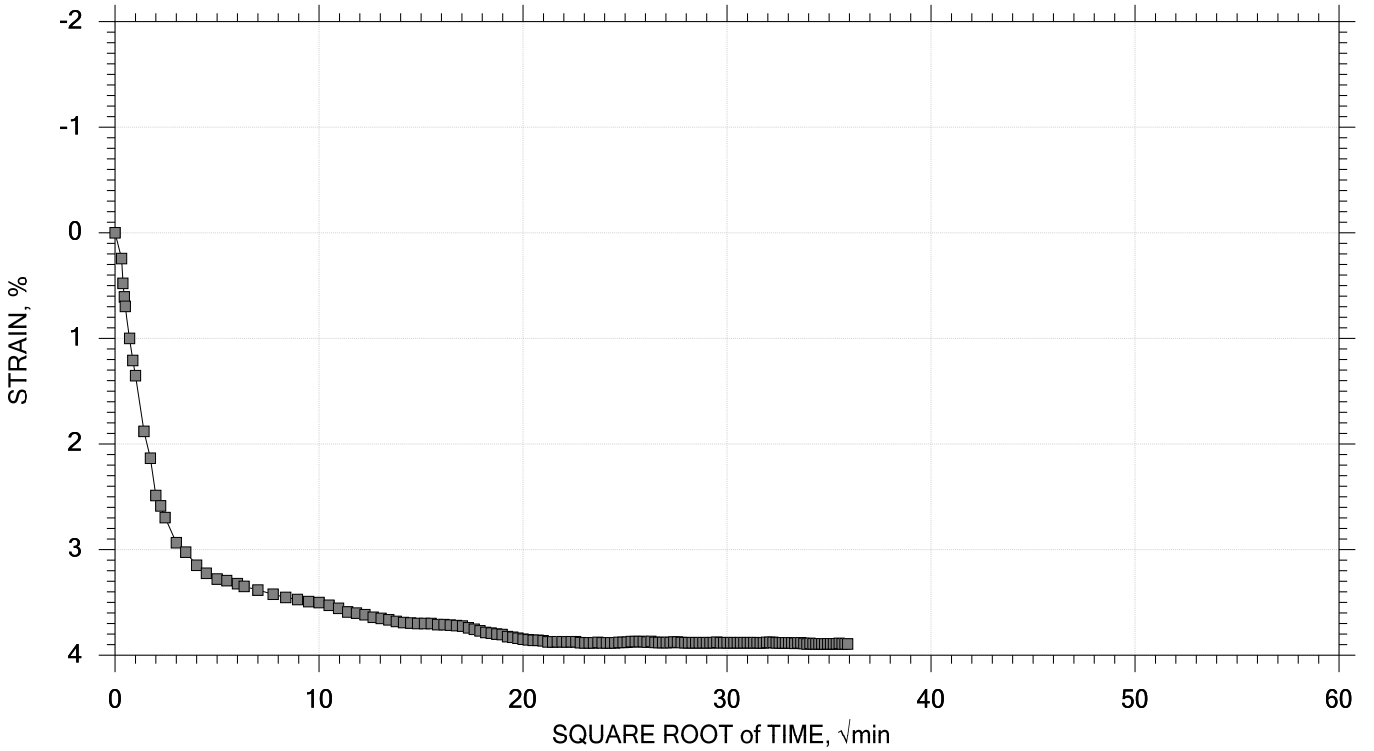
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Volume Step 1 of 15

Stress: 0.065434 tsf





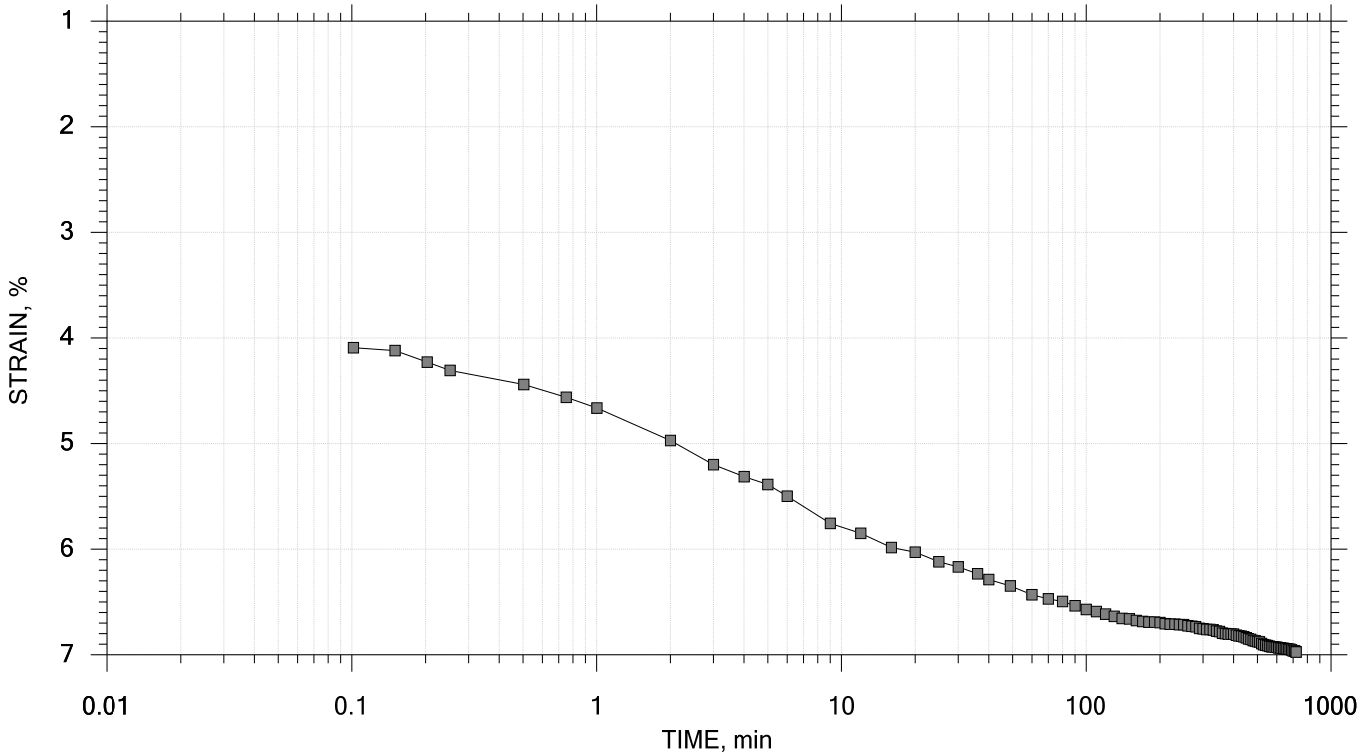
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-12	Tested By: md	Checked By: njh
	Sample No.: S2	Test Date: 04/12/17	Test No.: IP-1
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

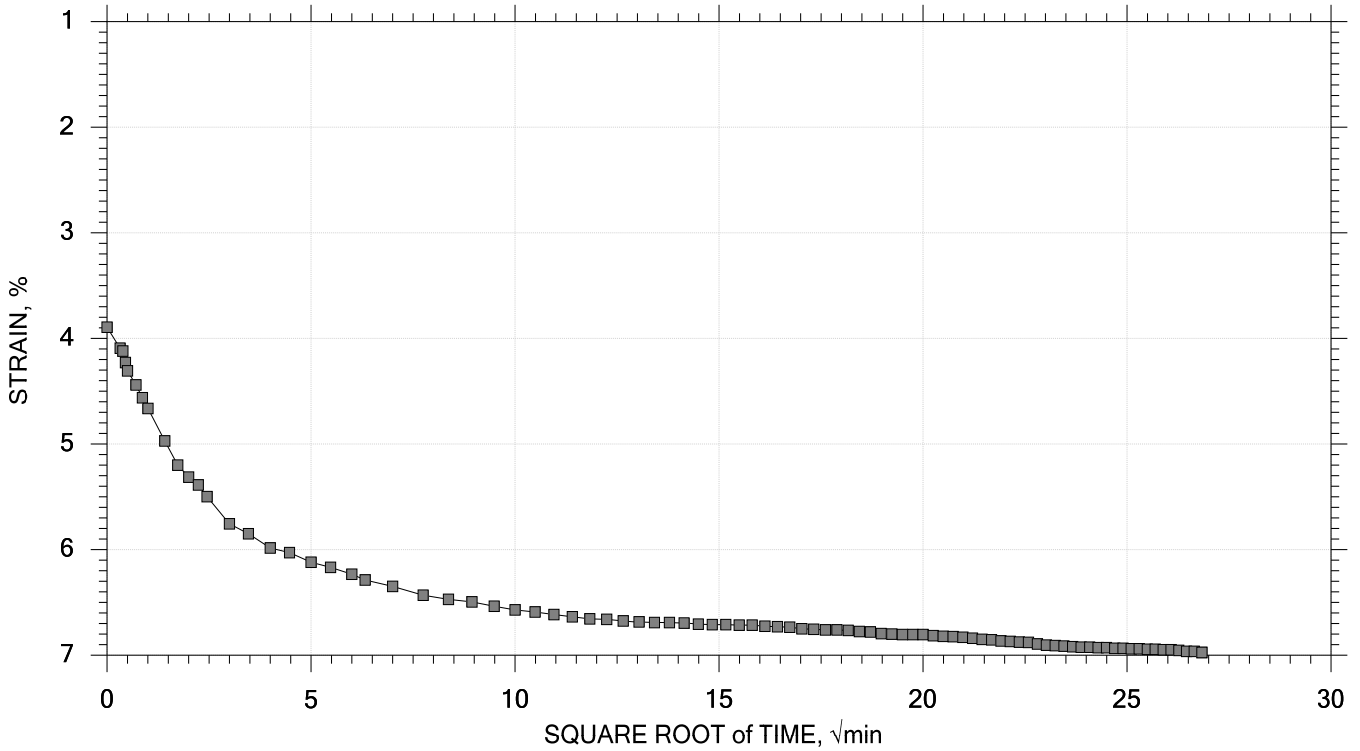
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 2 of 15

Stress: 0.125 tsf





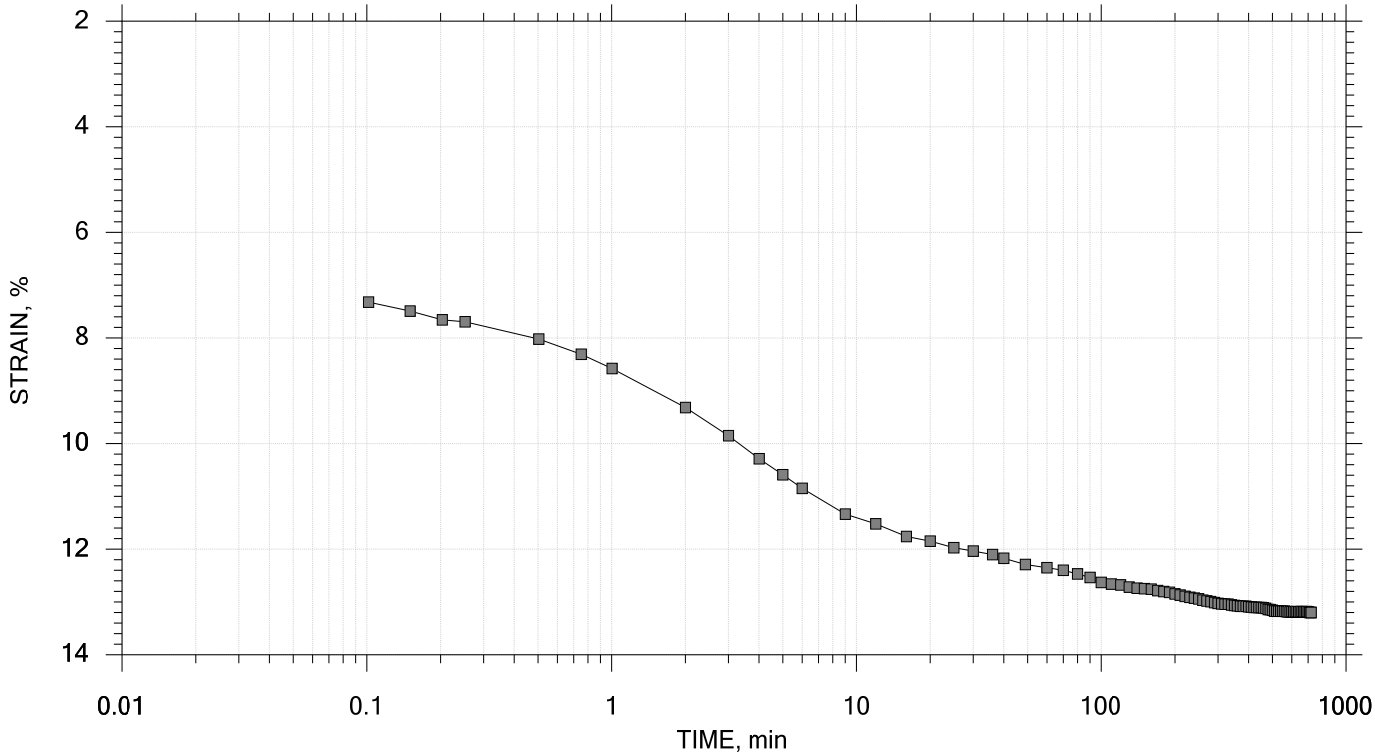
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-12	Tested By: md	Checked By: njh
	Sample No.: S2	Test Date: 04/12/17	Test No.: IP-1
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

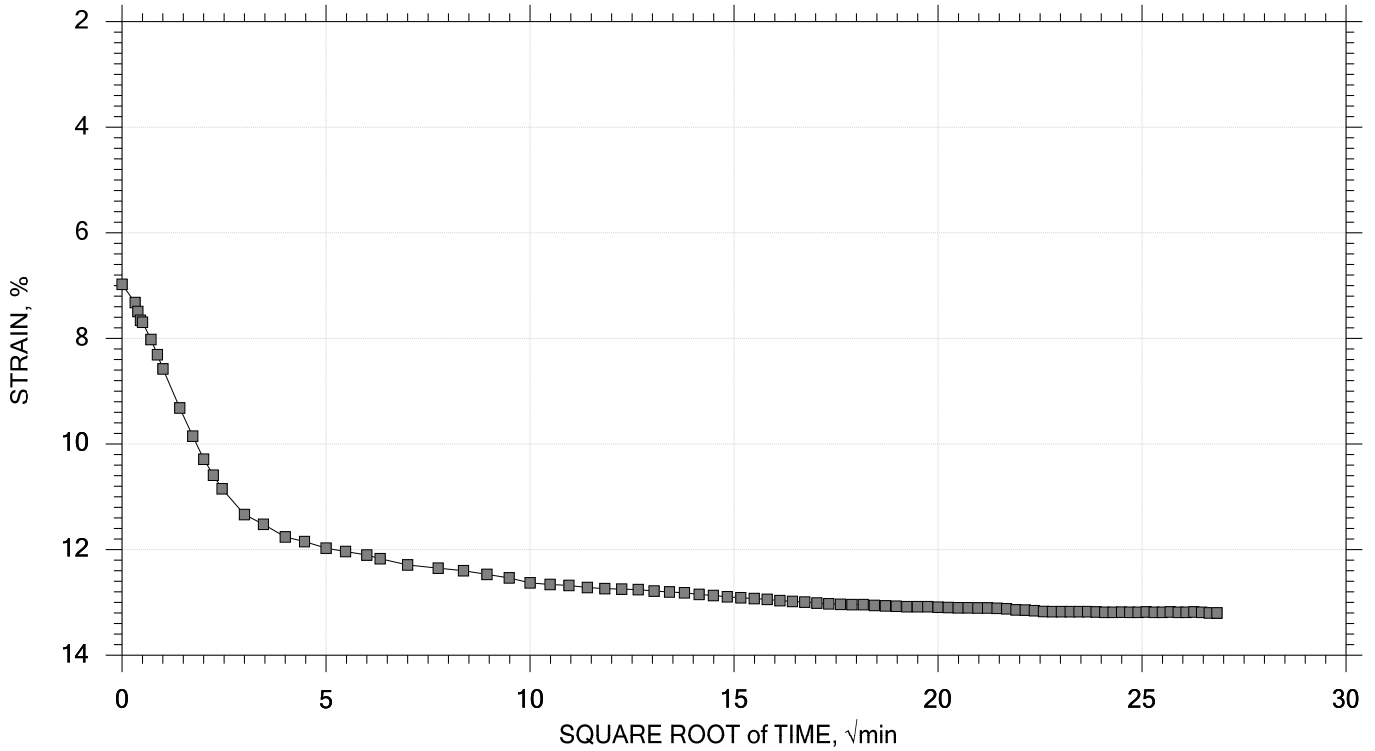
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 3 of 15

Stress: 0.25 tsf





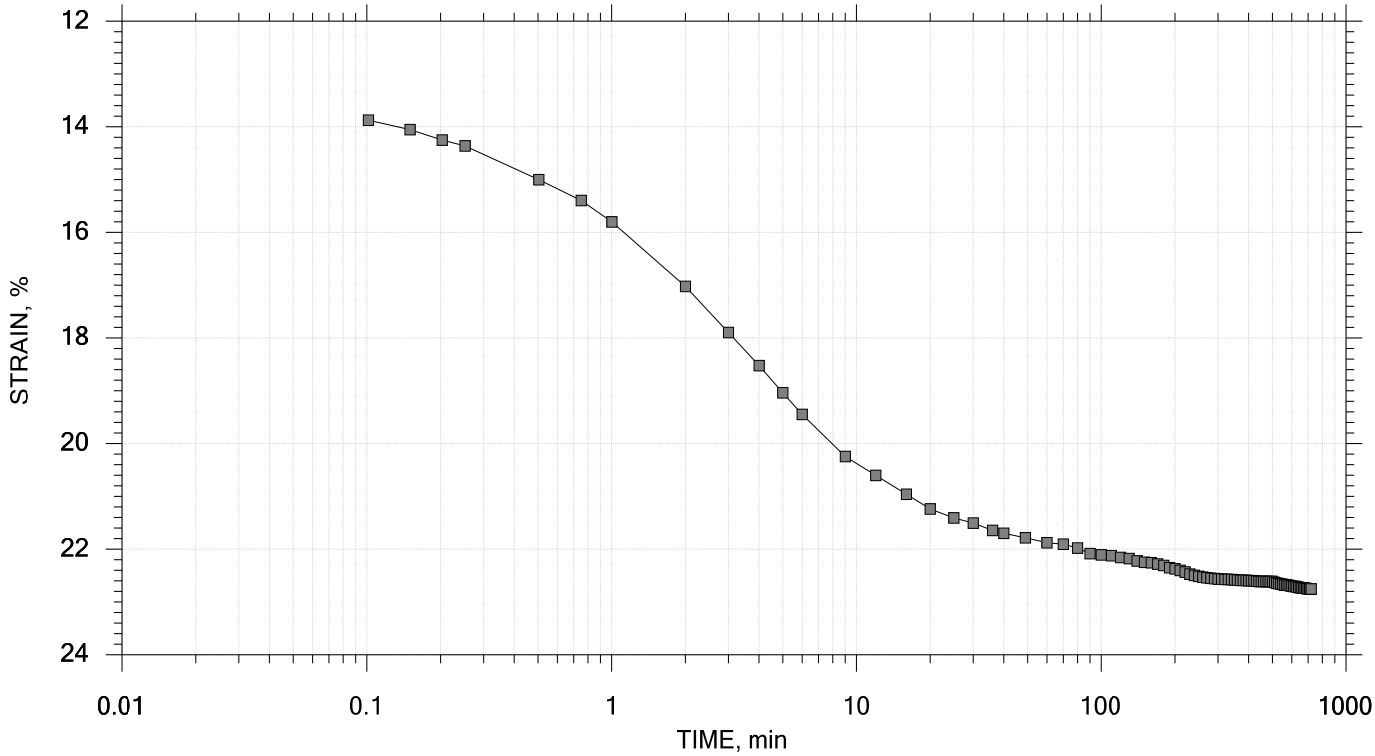
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-12	Tested By: md	Checked By: njh
	Sample No.: S2	Test Date: 04/12/17	Test No.: IP-1
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

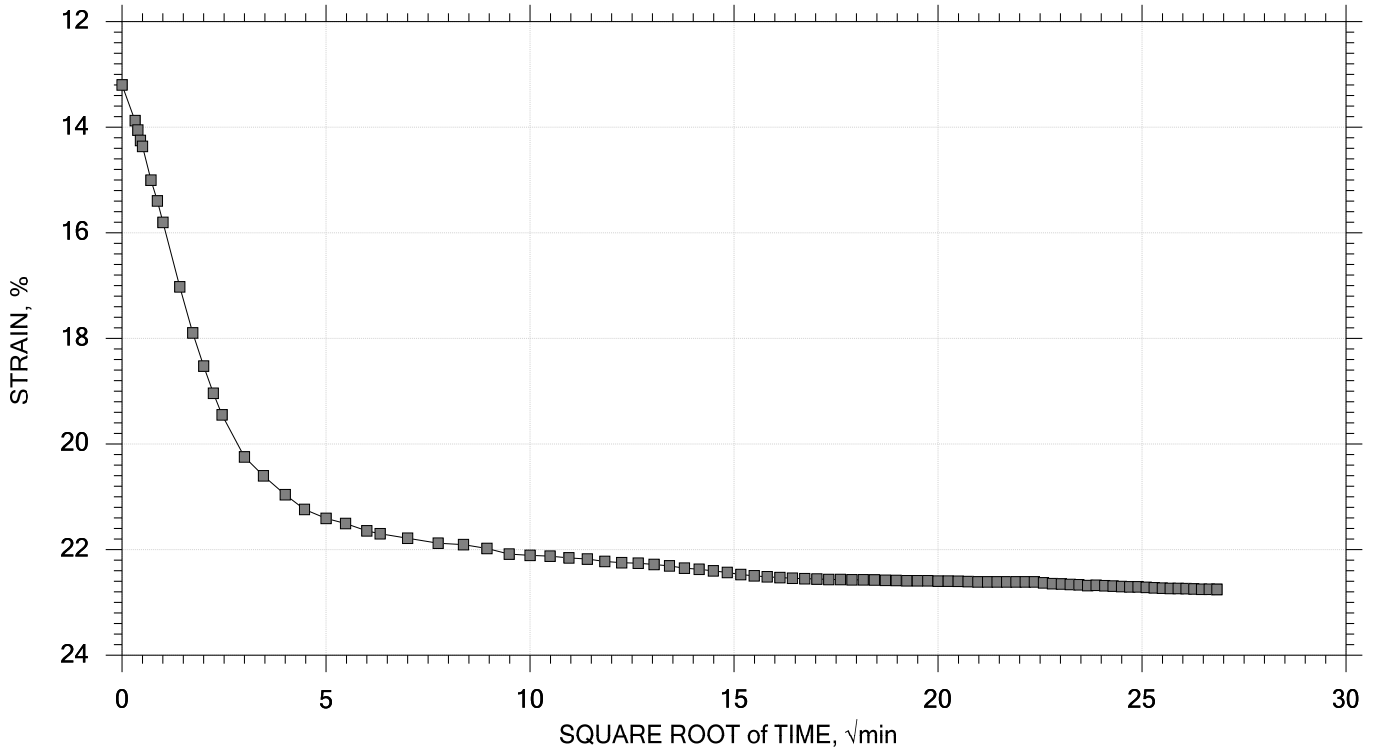
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 4 of 15

Stress: 0.5 tsf





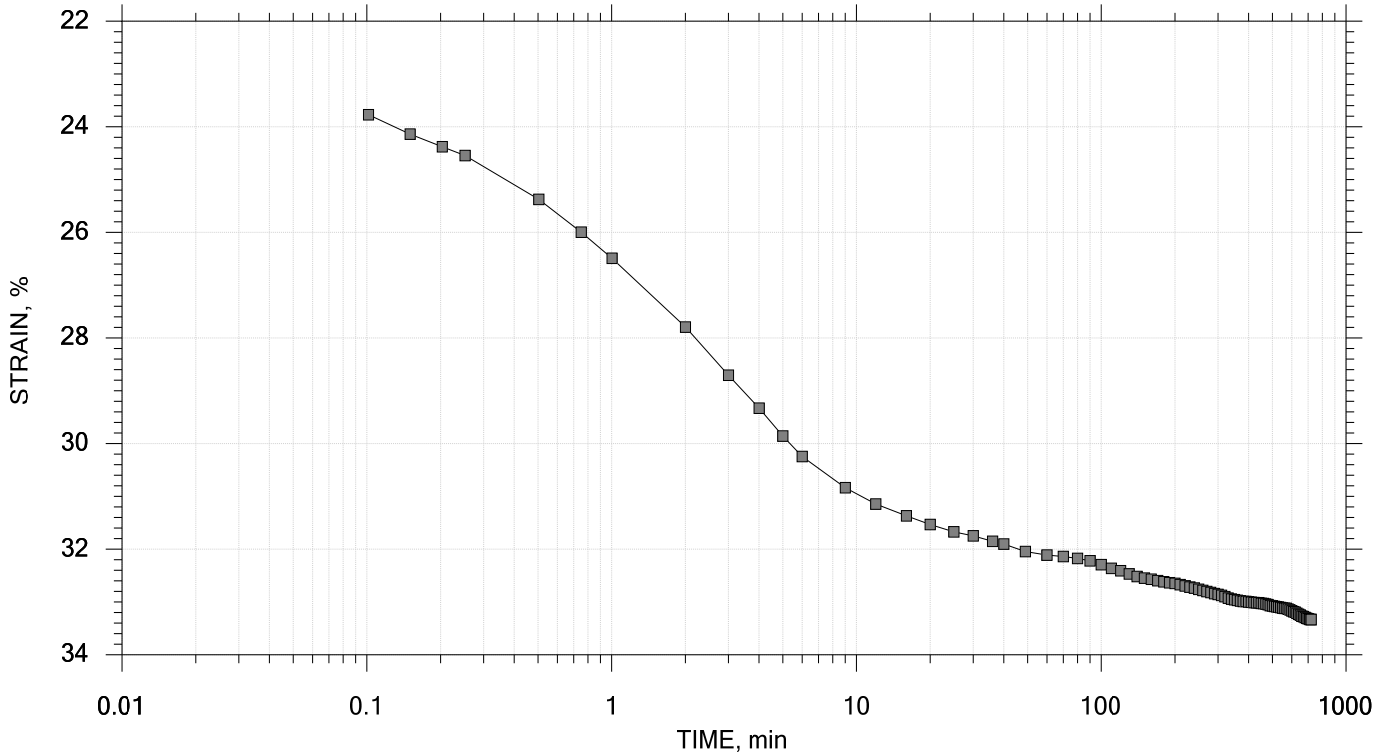
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-12	Tested By: md	Checked By: njh
	Sample No.: S2	Test Date: 04/12/17	Test No.: IP-1
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

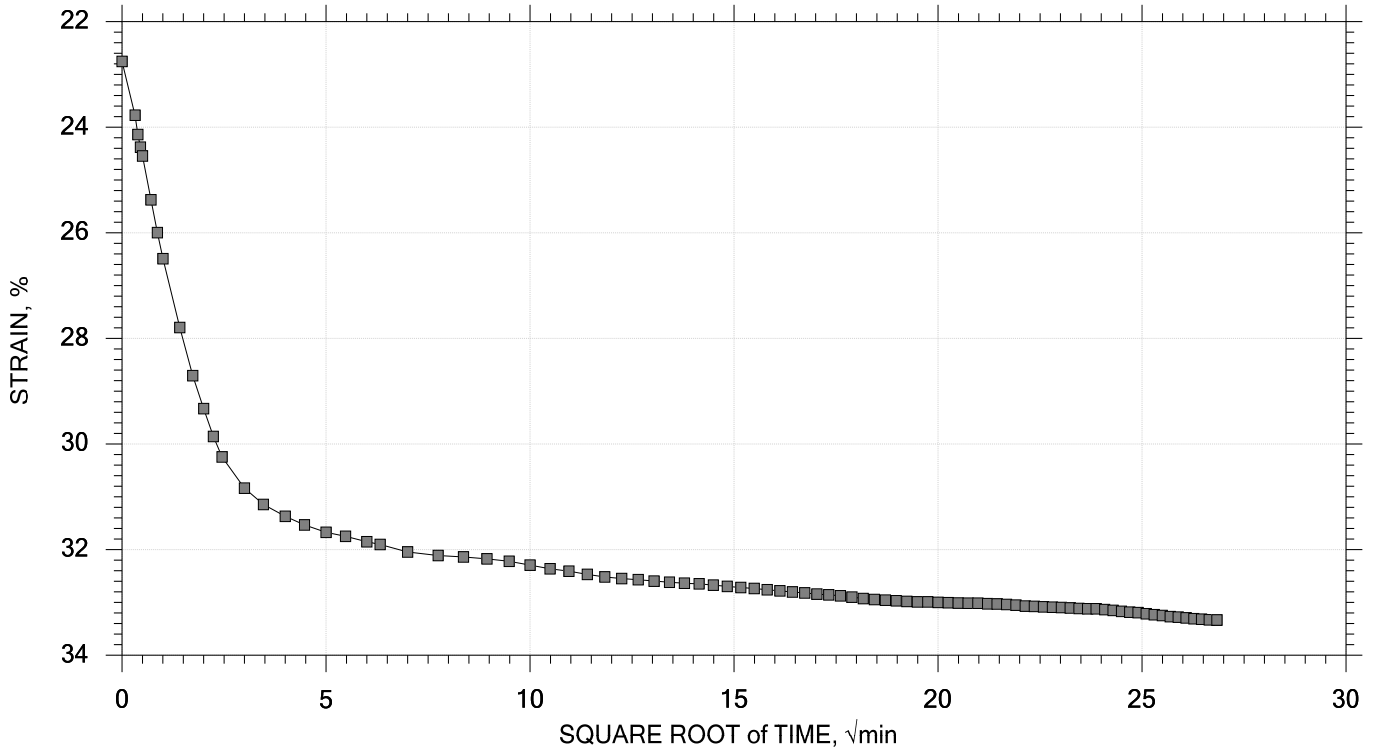
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 5 of 15

Stress: 1 tsf





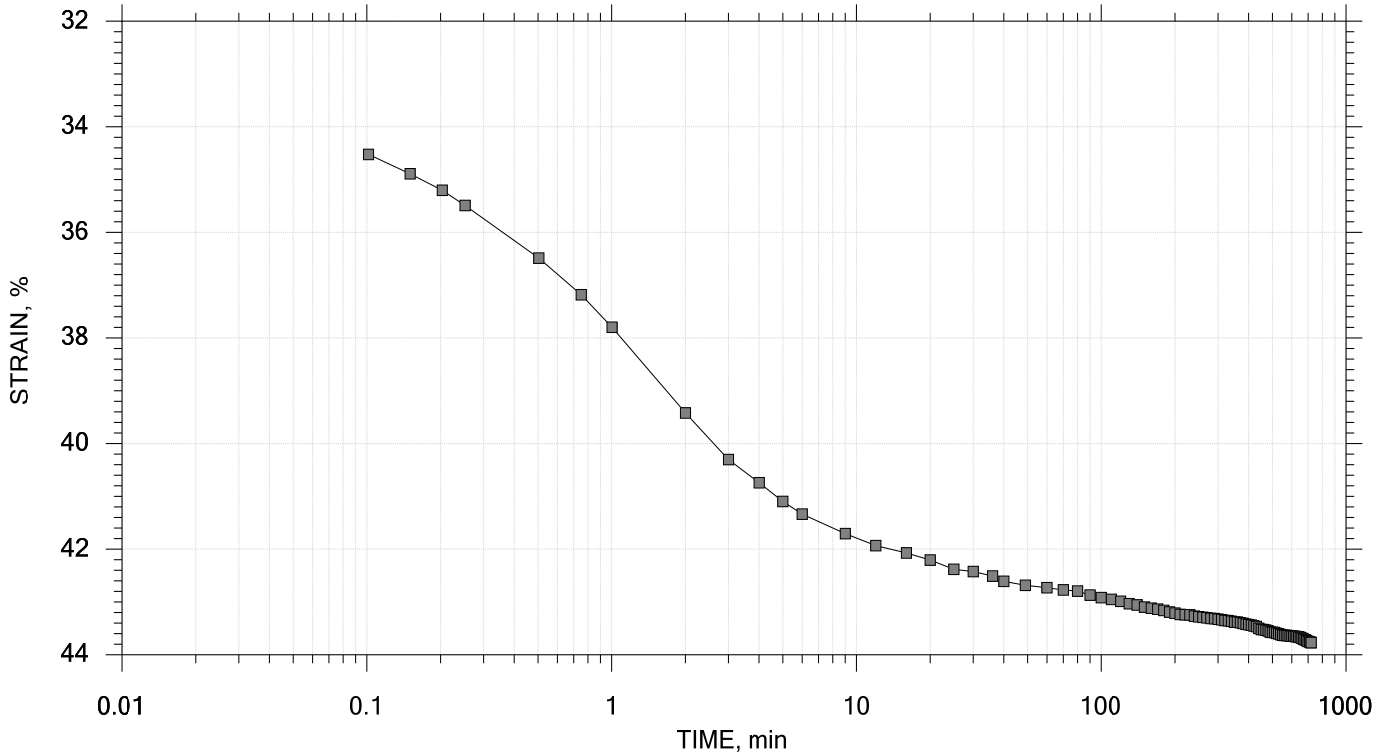
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-12	Tested By: md	Checked By: njh
	Sample No.: S2	Test Date: 04/12/17	Test No.: IP-1
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

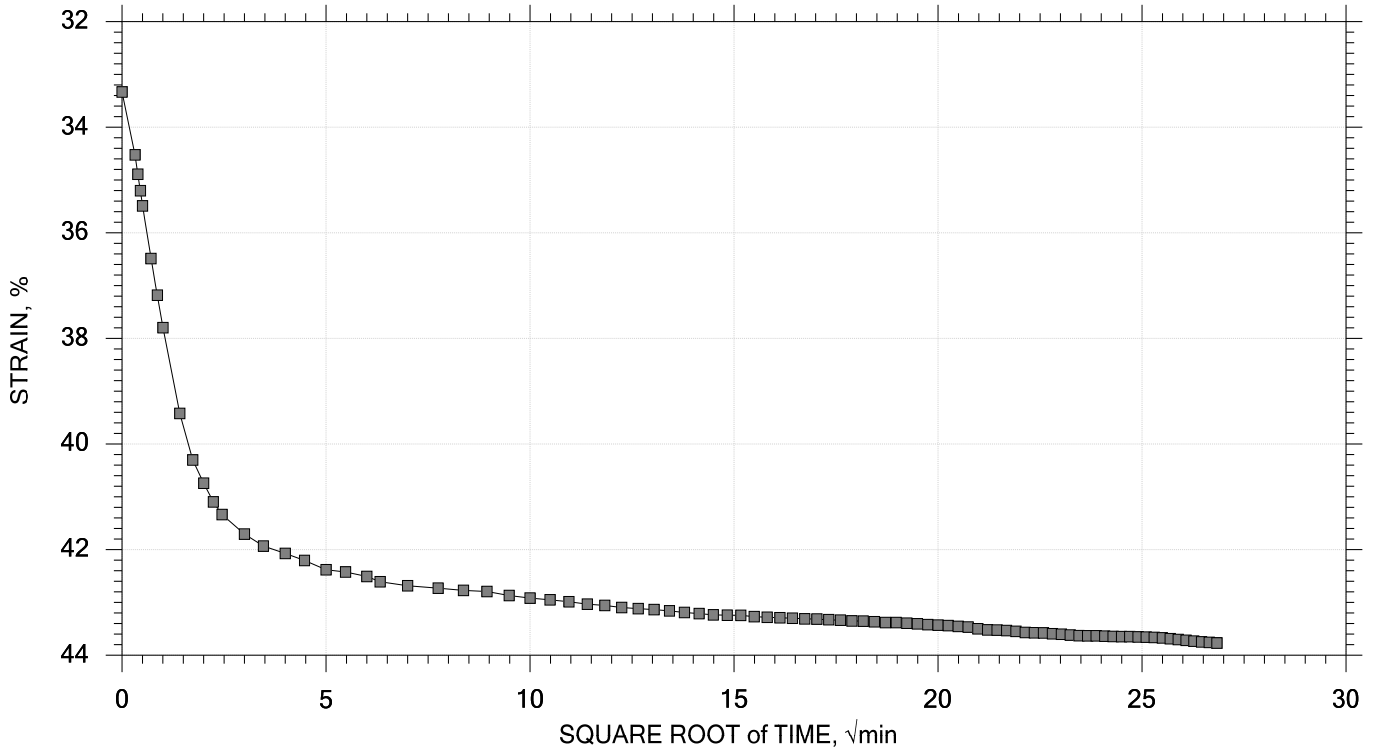
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 6 of 15

Stress: 2 tsf





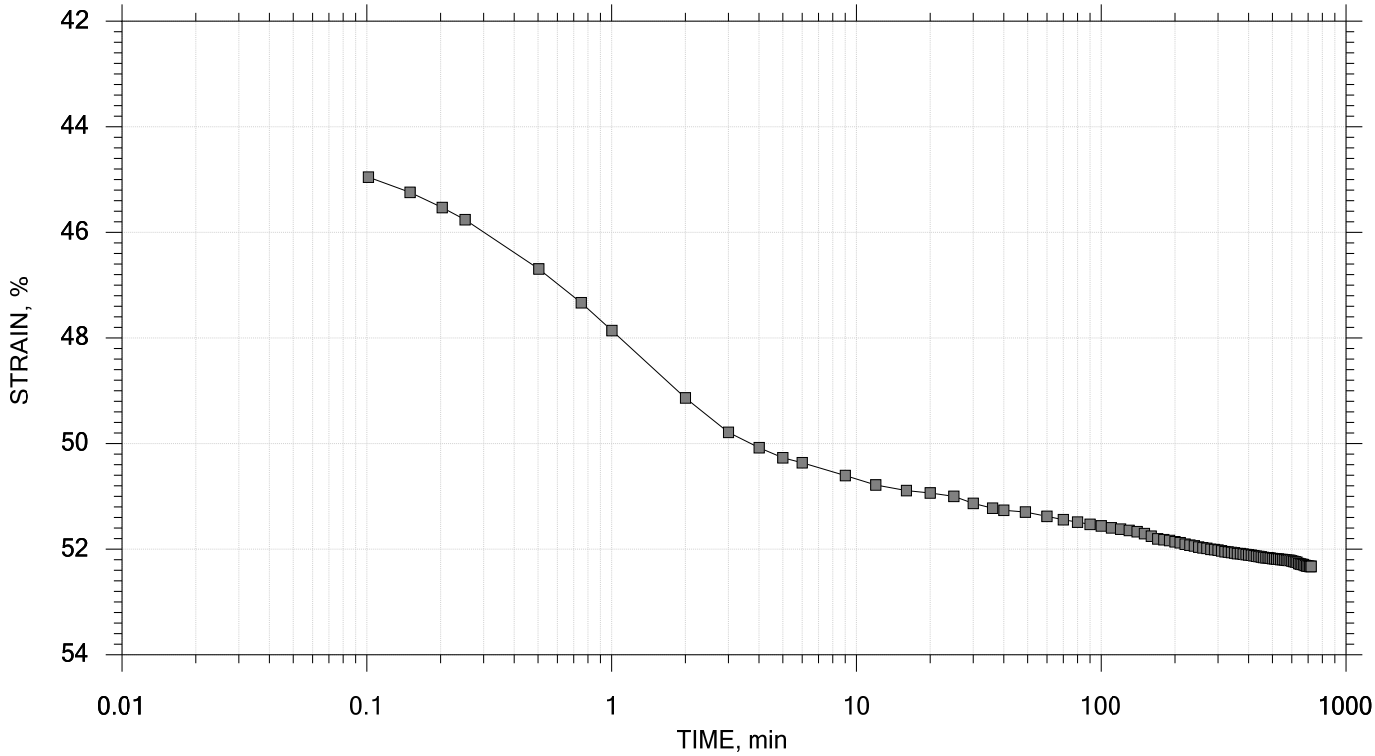
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-12	Tested By: md	Checked By: njh
	Sample No.: S2	Test Date: 04/12/17	Test No.: IP-1
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

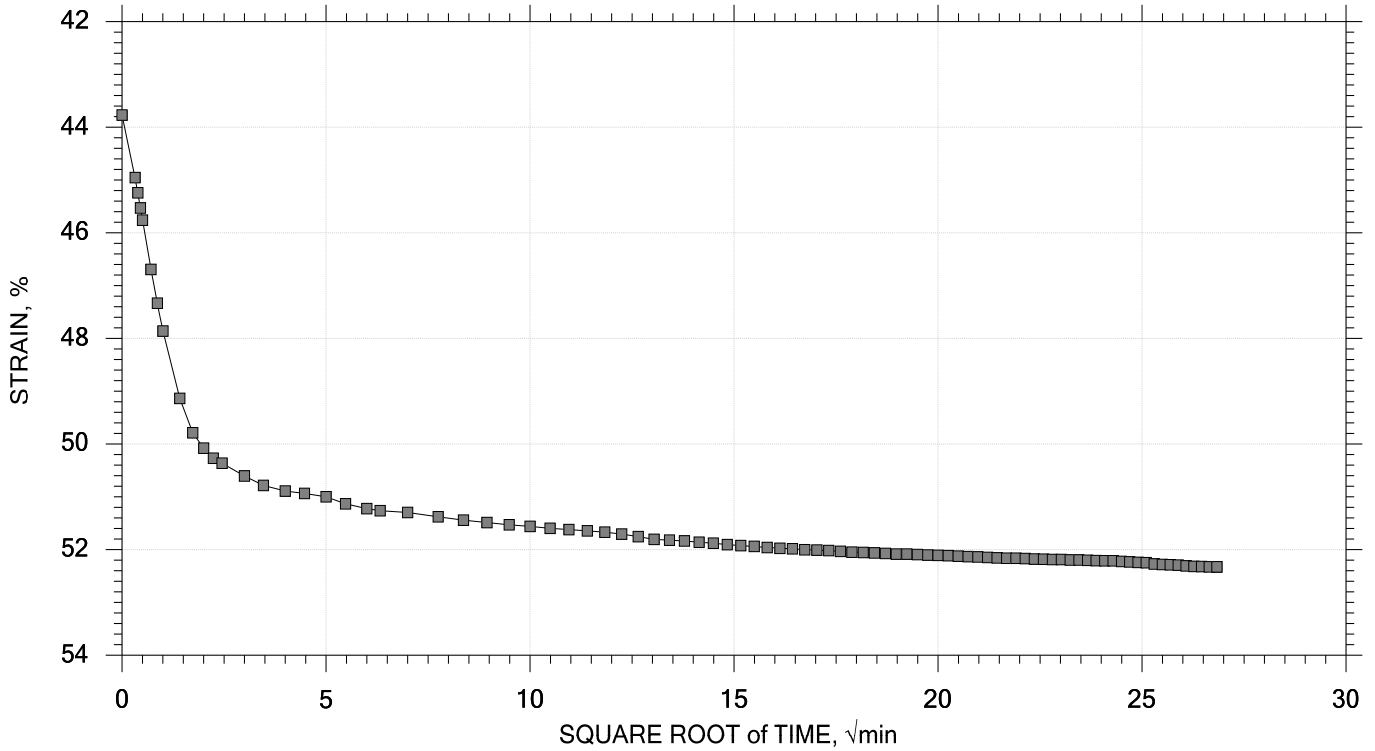
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 7 of 15

Stress: 4 tsf





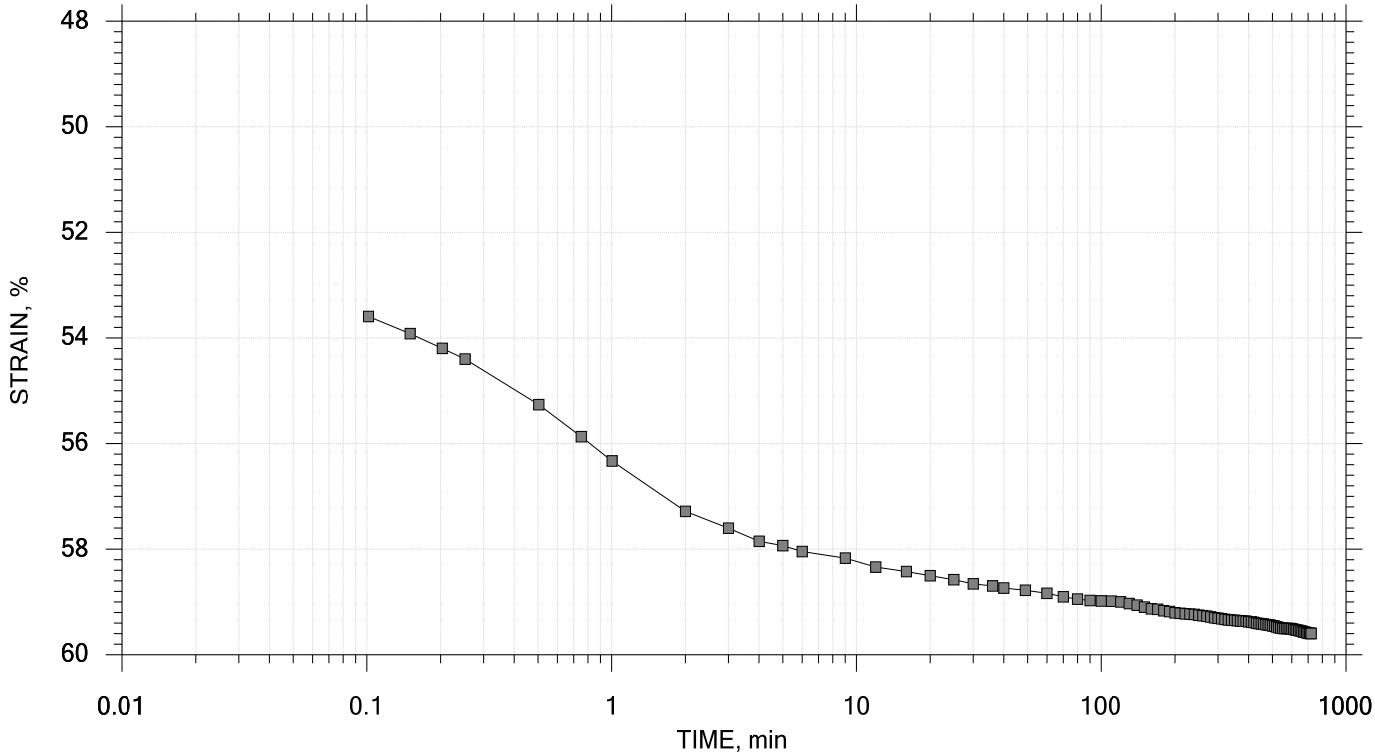
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-12	Tested By: md	Checked By: njh
	Sample No.: S2	Test Date: 04/12/17	Test No.: IP-1
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

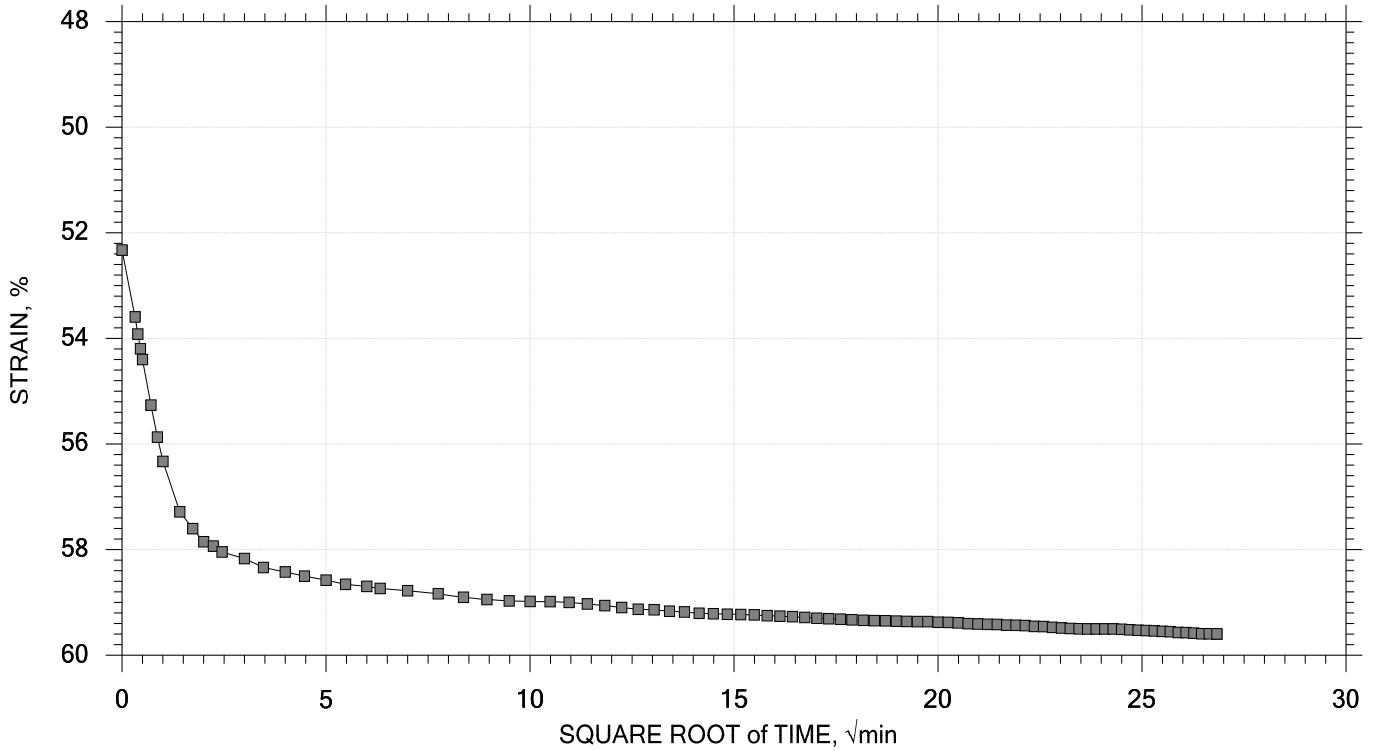
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 8 of 15

Stress: 8 tsf





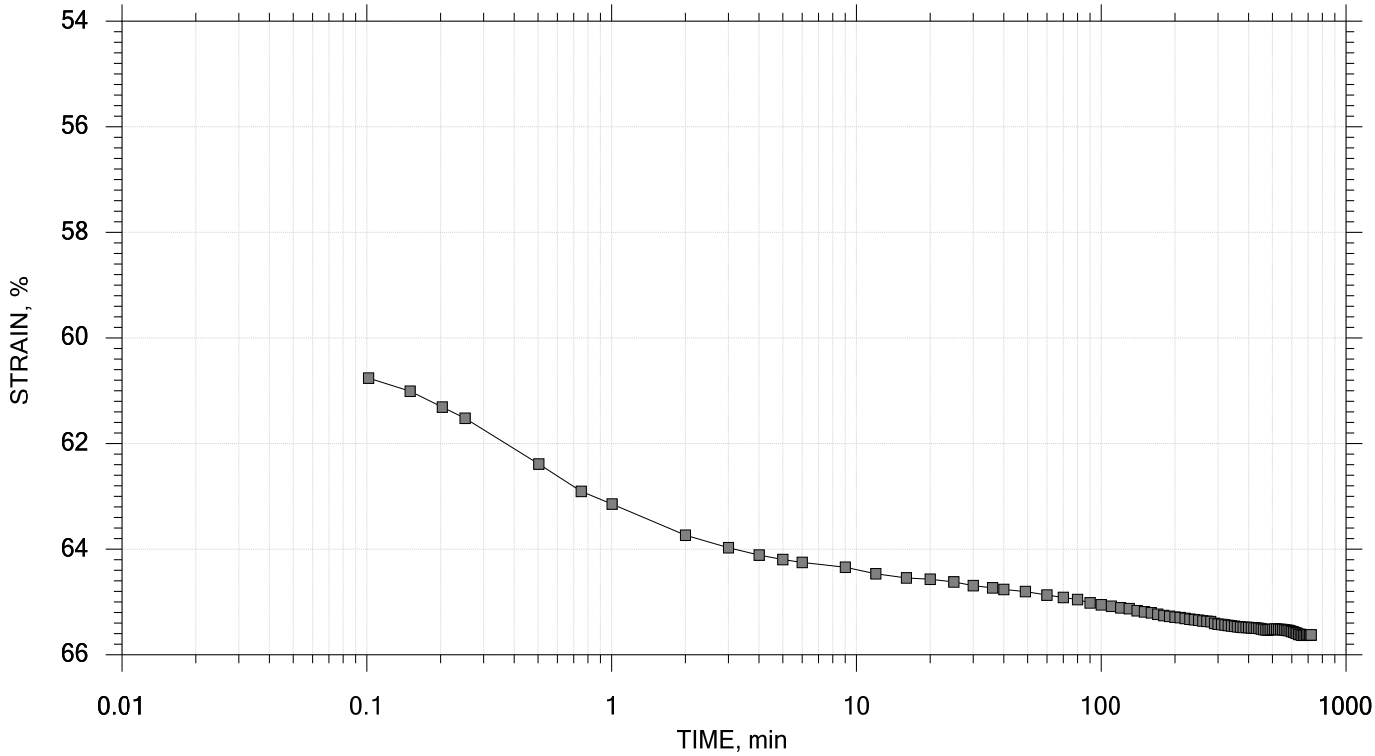
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-12	Tested By: md	Checked By: njh
	Sample No.: S2	Test Date: 04/12/17	Test No.: IP-1
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

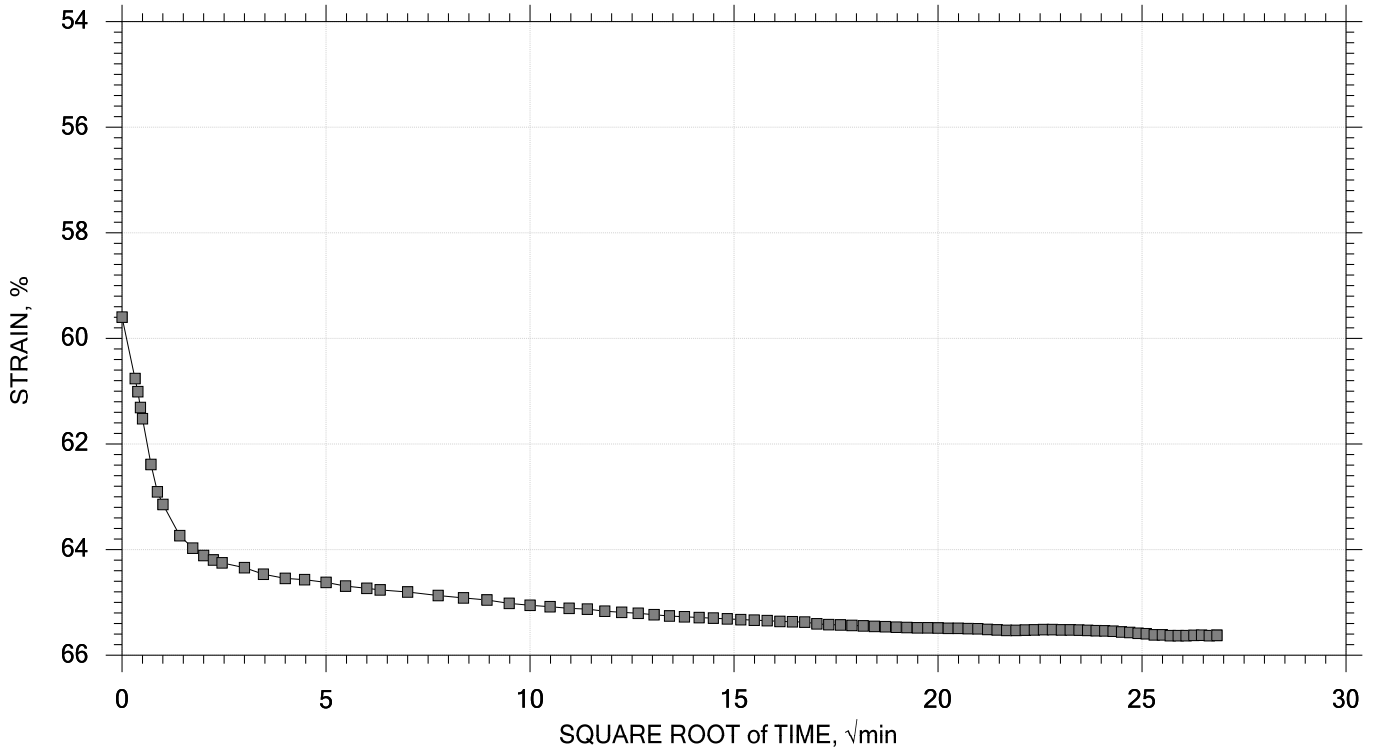
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 9 of 15

Stress: 16 tsf





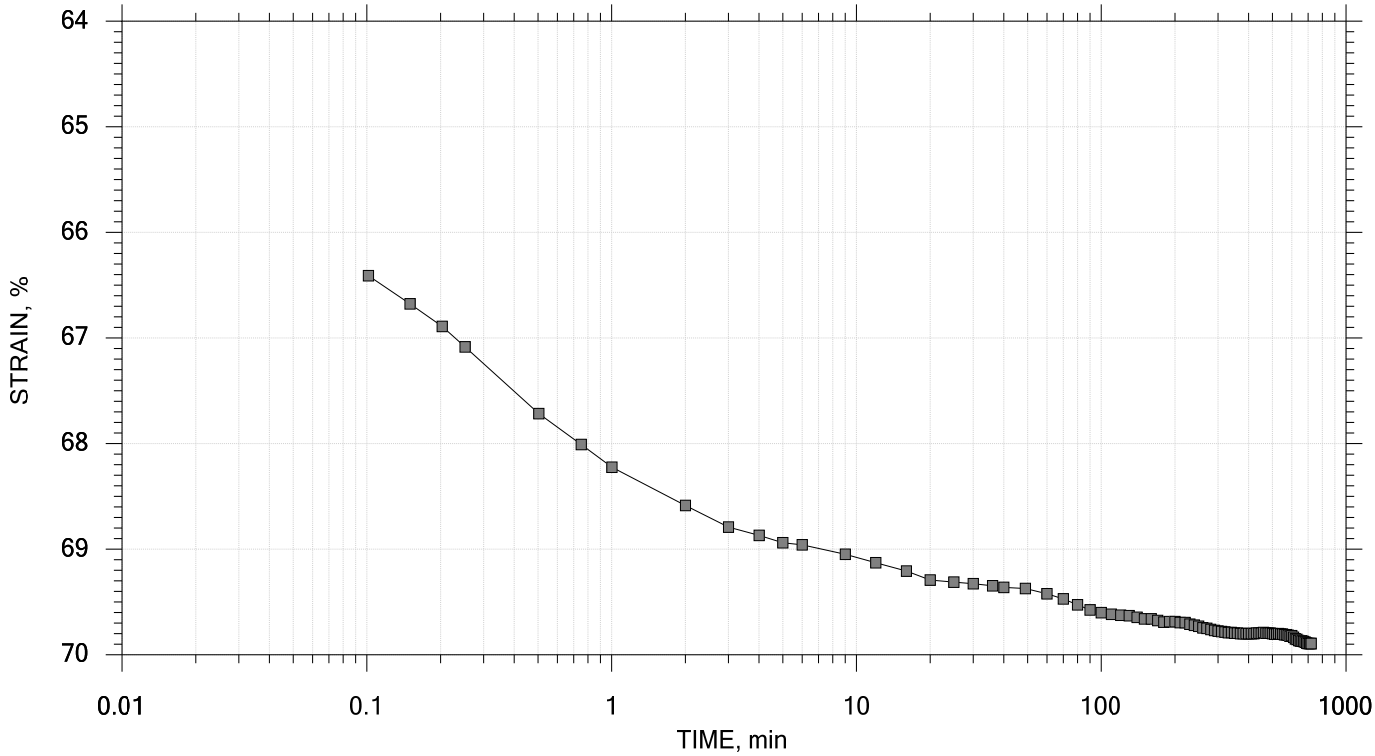
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-12	Tested By: md	Checked By: njh
	Sample No.: S2	Test Date: 04/12/17	Test No.: IP-1
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

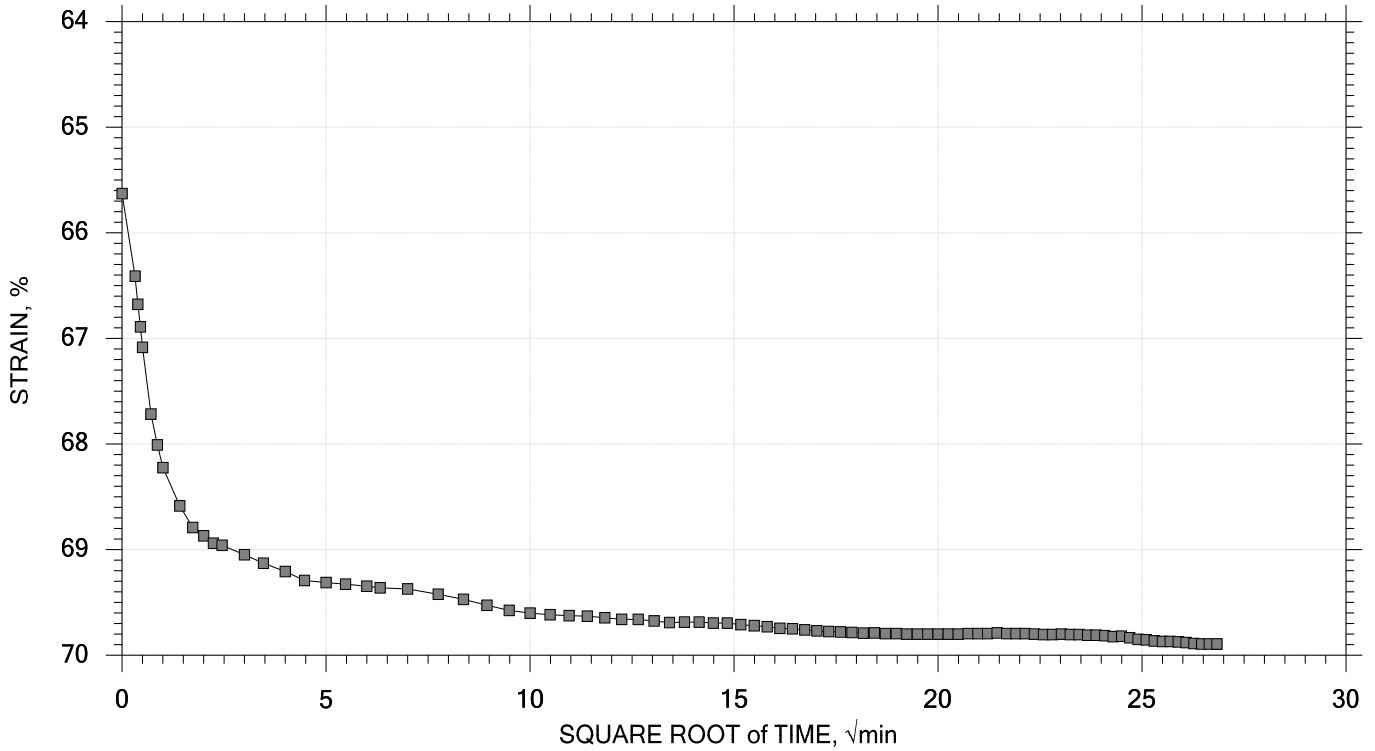
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 10 of 15

Stress: 32 tsf





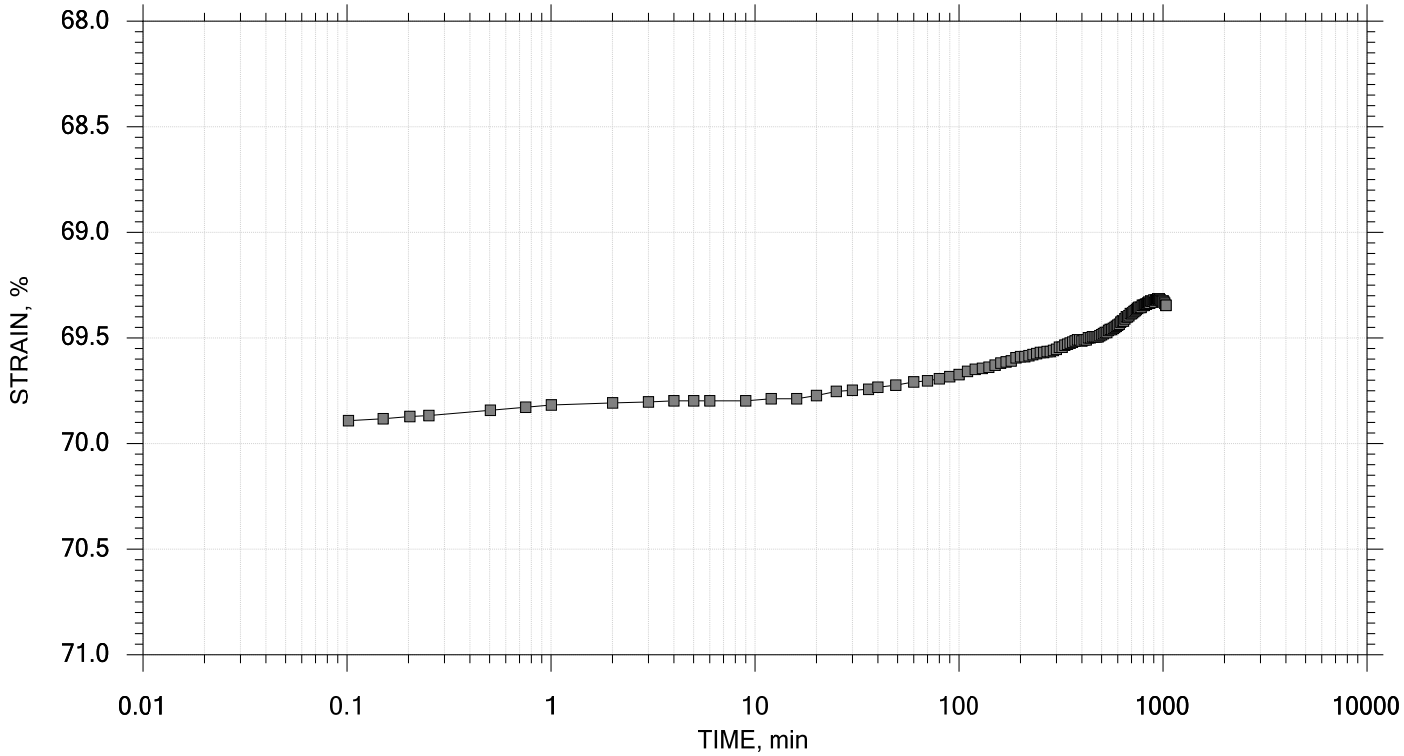
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-12	Tested By: md	Checked By: njh
	Sample No.: S2	Test Date: 04/12/17	Test No.: IP-1
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

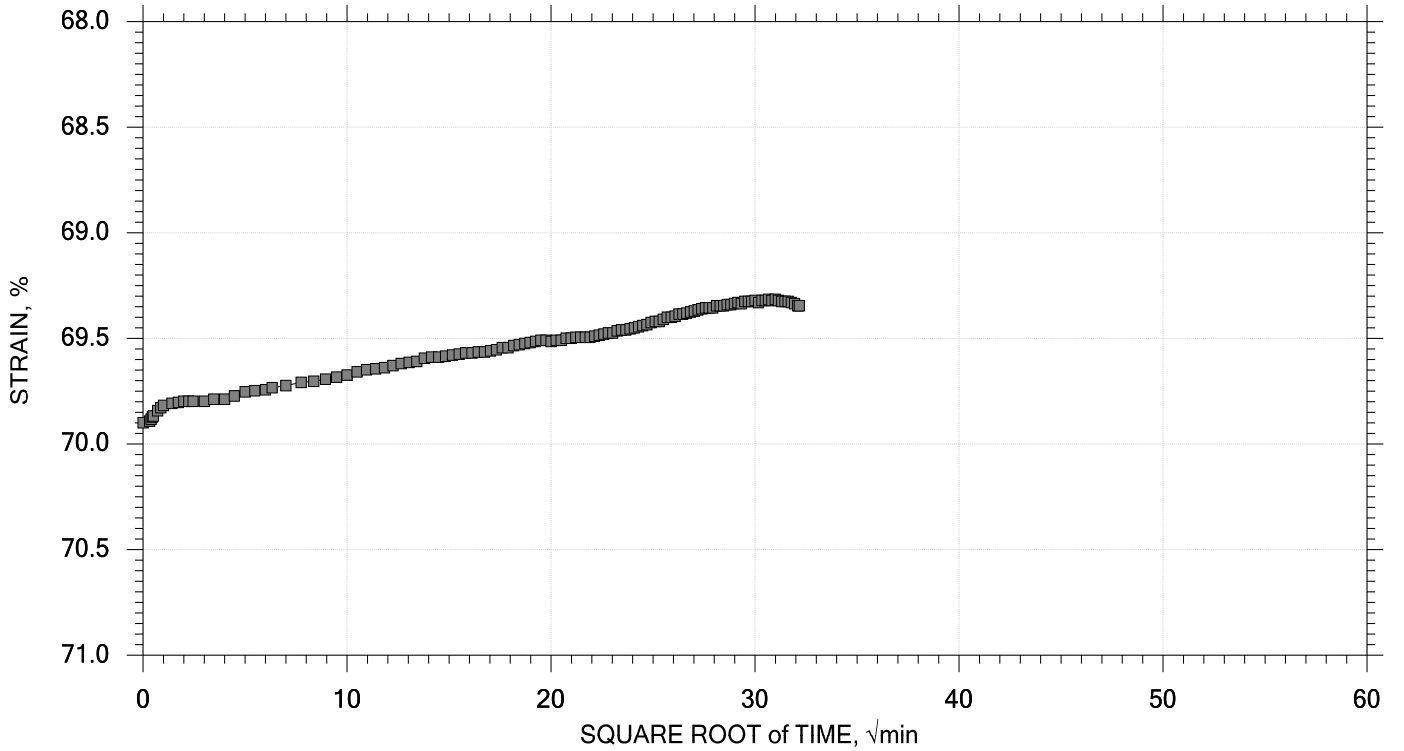
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 11 of 15

Stress: 8 tsf





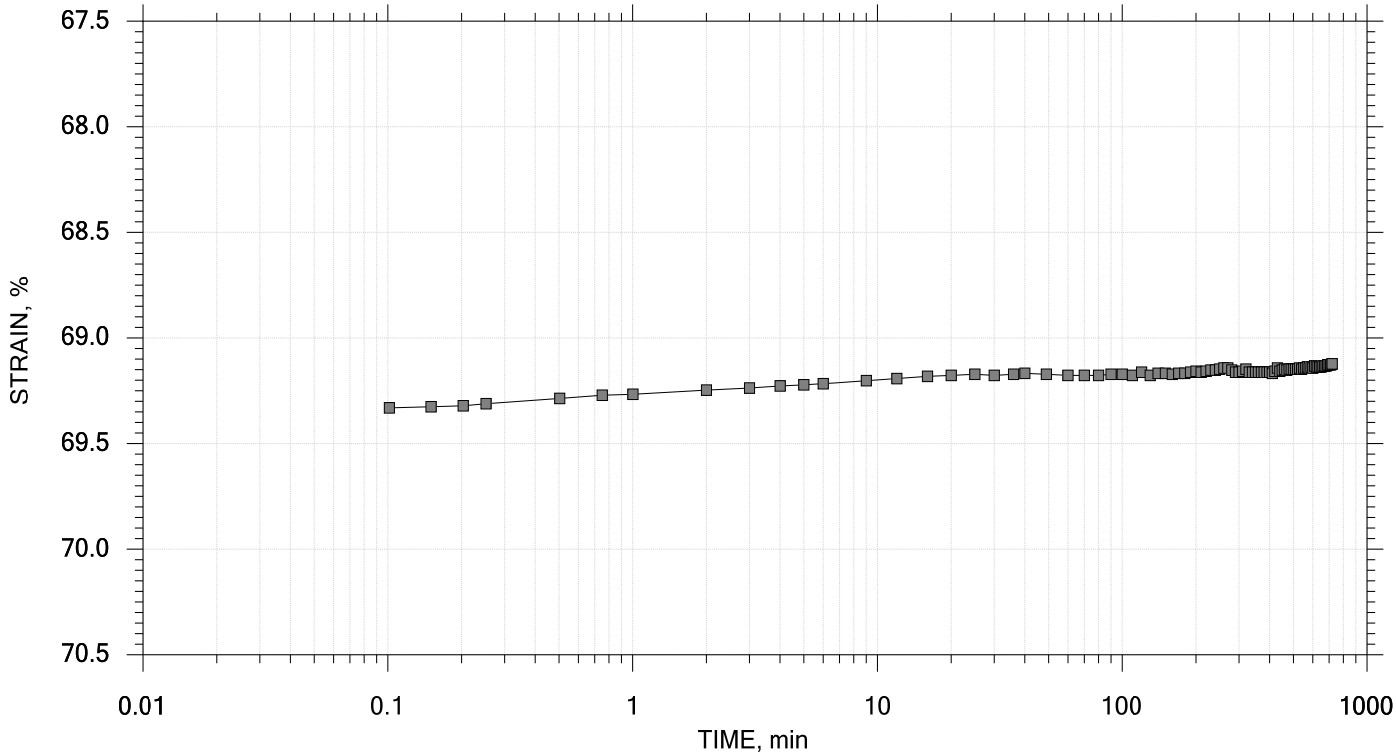
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-12	Tested By: md	Checked By: njh
	Sample No.: S2	Test Date: 04/12/17	Test No.: IP-1
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

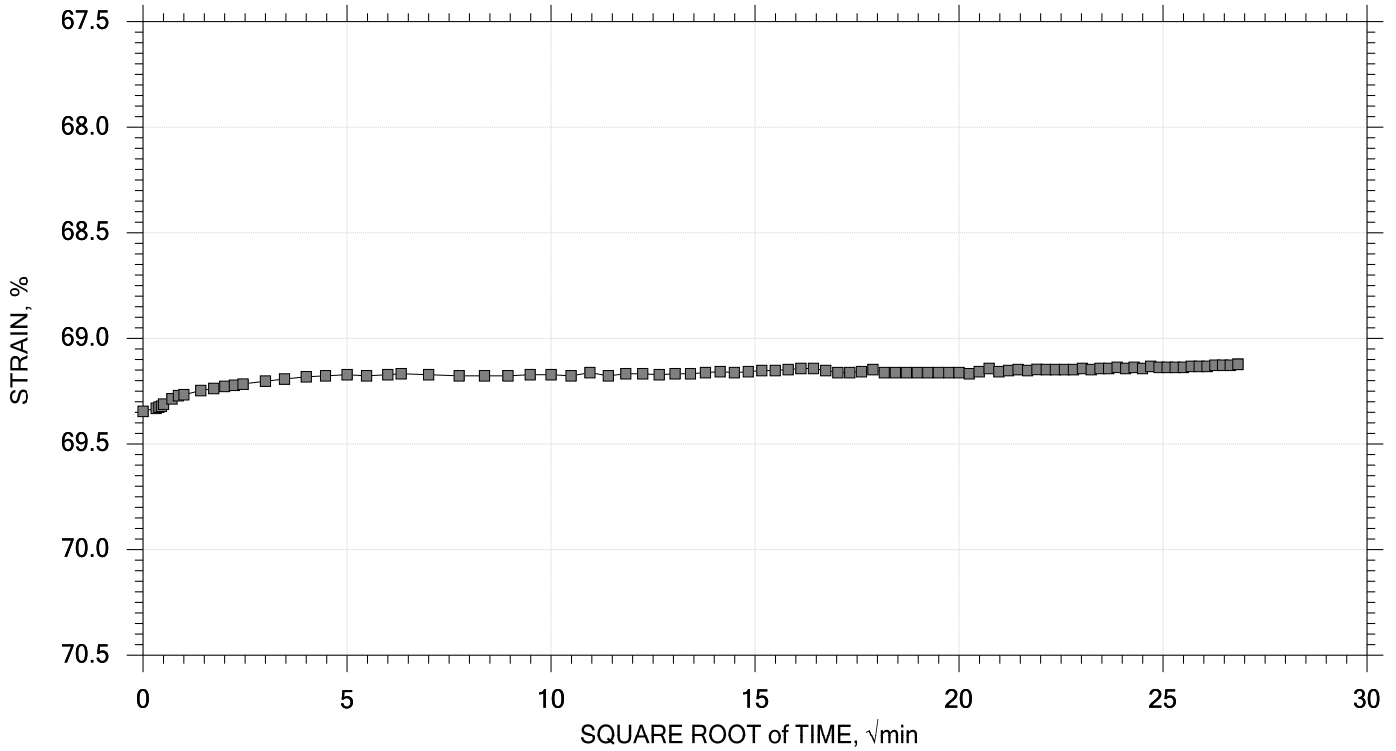
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 12 of 15

Stress: 2 tsf





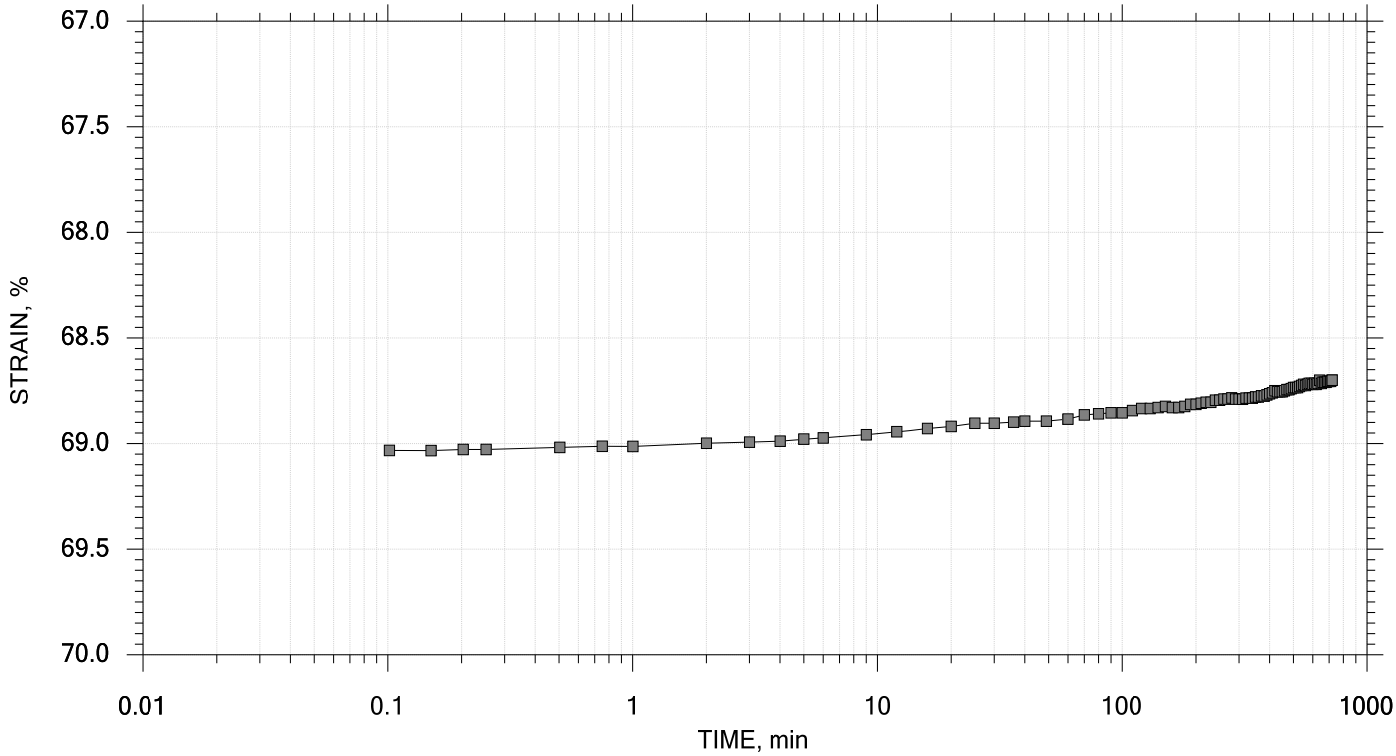
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-12	Tested By: md	Checked By: njh
	Sample No.: S2	Test Date: 04/12/17	Test No.: IP-1
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

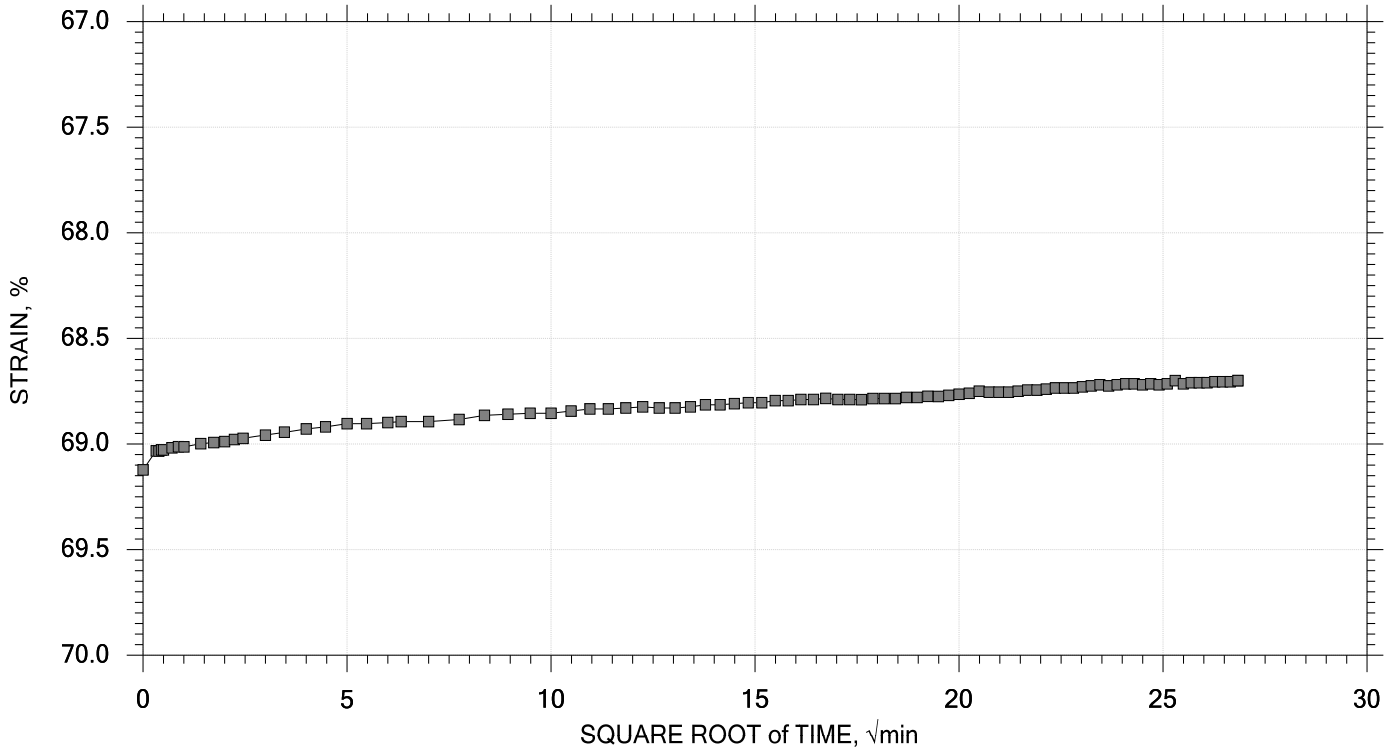
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 13 of 15

Stress: 0.5 tsf





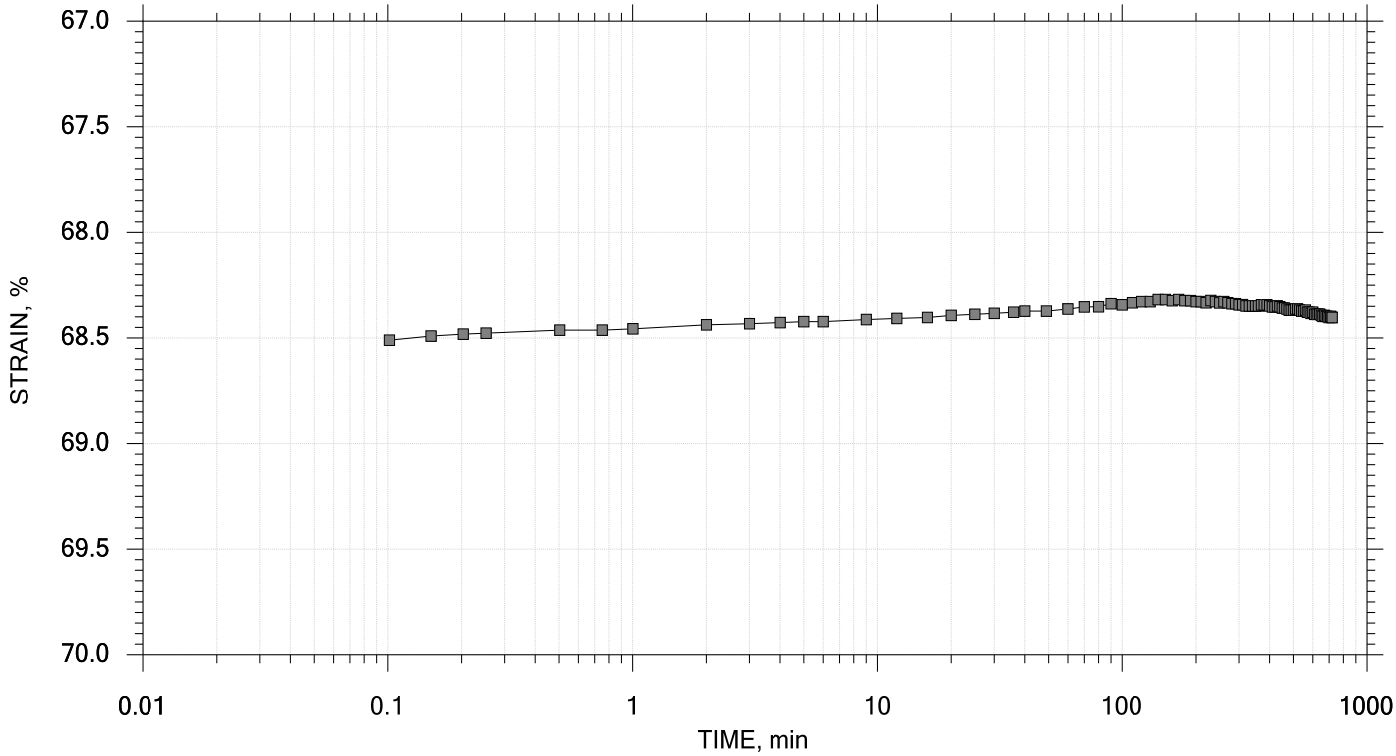
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-12	Tested By: md	Checked By: njh
	Sample No.: S2	Test Date: 04/12/17	Test No.: IP-1
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

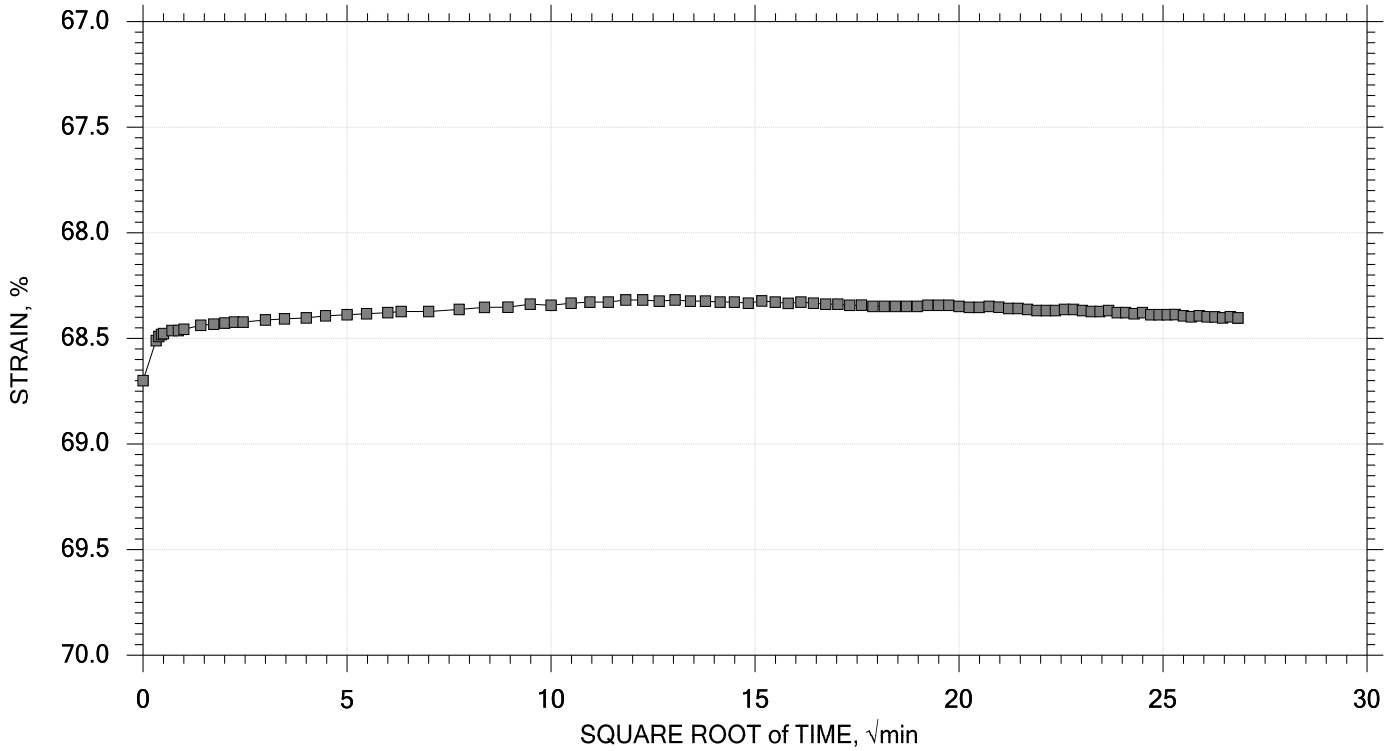
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 14 of 15

Stress: 0.125 tsf





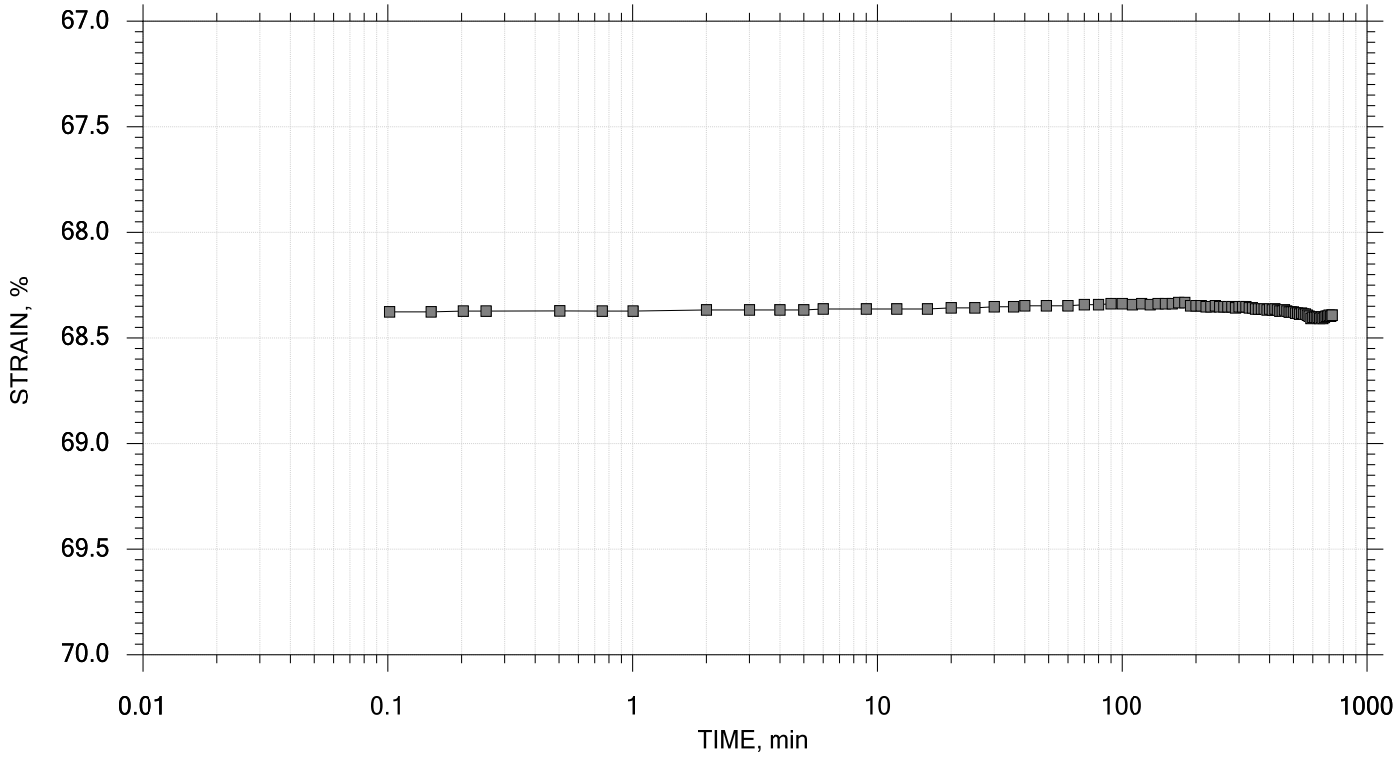
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-12	Tested By: md	Checked By: njh
	Sample No.: S2	Test Date: 04/12/17	Test No.: IP-1
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

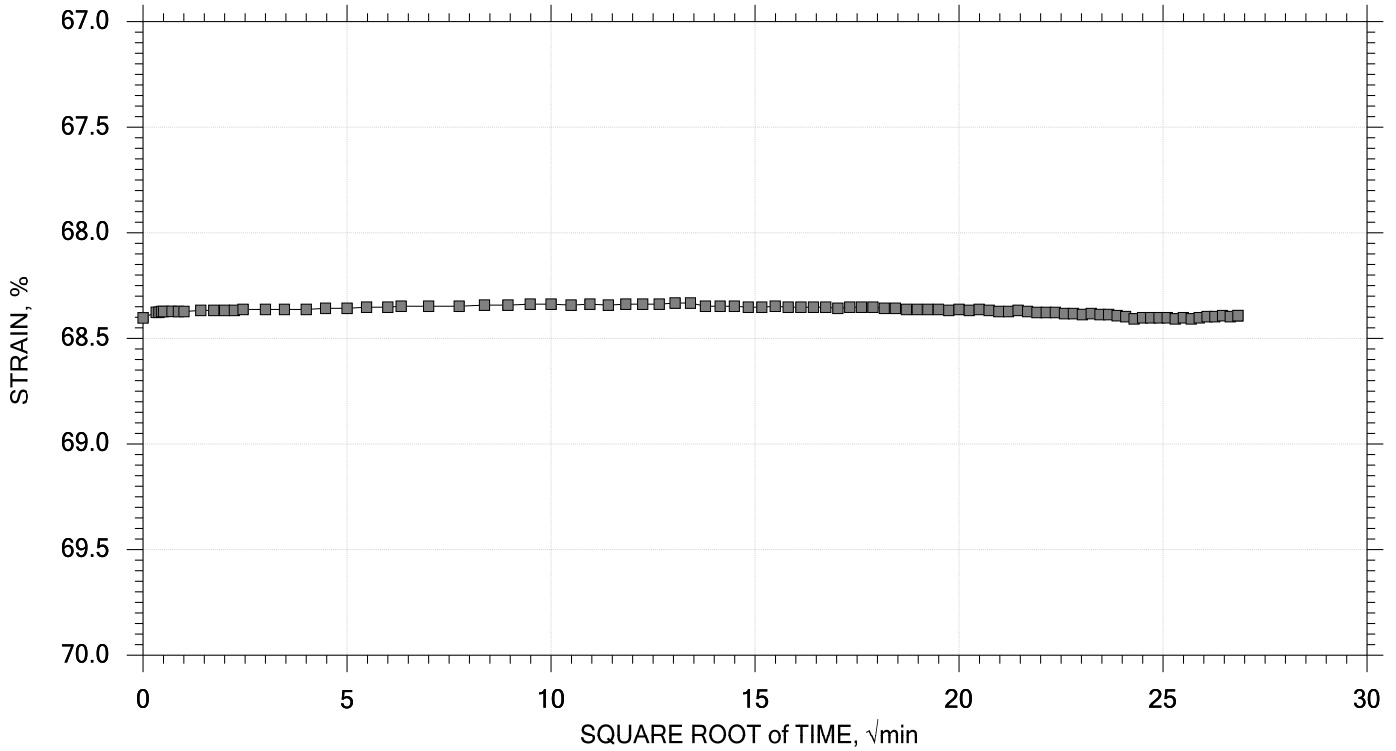
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 15 of 15

Stress: 0.0625 tsf

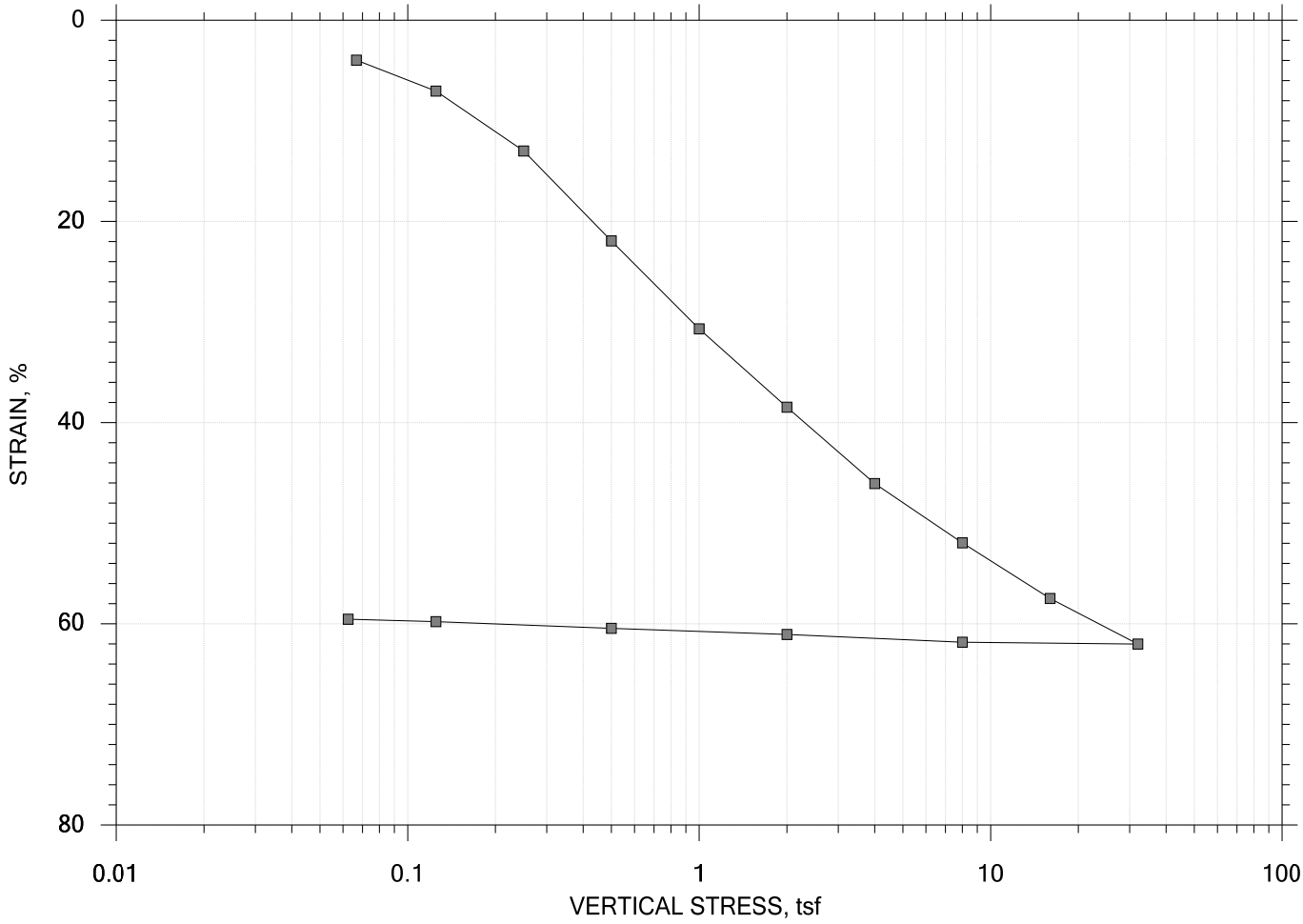


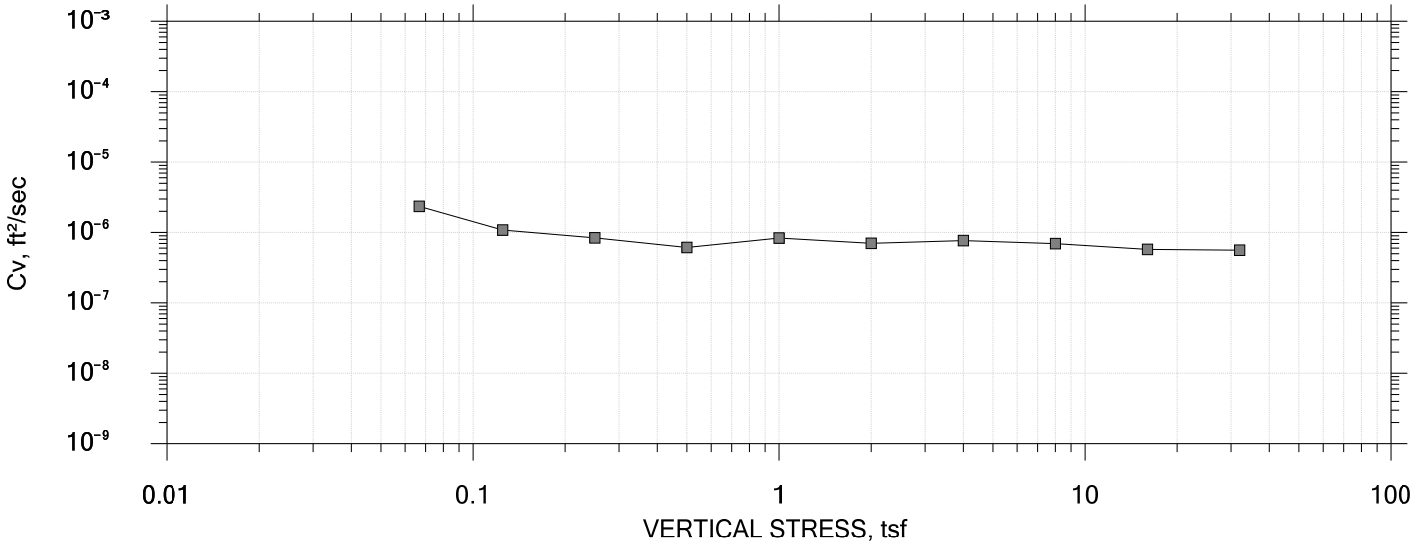


GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-12	Tested By: md	Checked By: njh
	Sample No.: S2	Test Date: 04/12/17	Test No.: IP-1
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt		
	Remarks: System K, Swell Pressure = 0.0654 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT

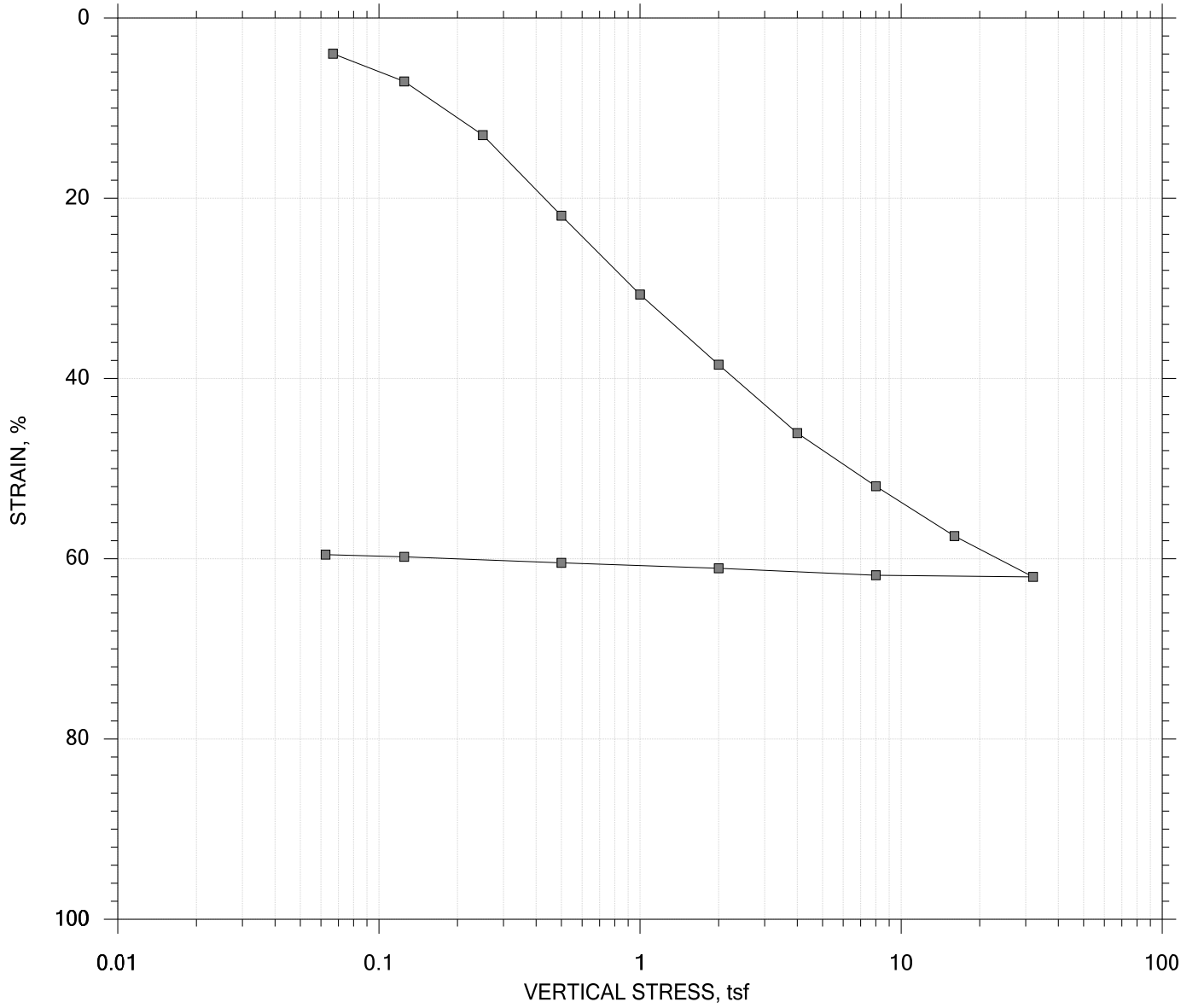




GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-17	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/20/17	Test No.: IP-3
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt with sand		
	Remarks: System X, Swell Pressure = 0.0667 tsf		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT



				Before Test	After Test
Current Vertical Effective Stress: ---				Water Content, %	158.50	39.76
Preconsolidation Stress: ---				Dry Unit Weight, pcf	30.086	77.143
Compression Ratio: ---				Saturation, %	95.28	99.97
Diameter: 2.5 in		Height: 1 in		Void Ratio	4.04	0.97
LL: 119	PL: 55	PI: 64	GS: 2.43			

GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-17	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/20/17	Test No.: IP-3
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt with sand		
	Remarks: System X, Swell Pressure = 0.0667 tsf		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
Boring No.: GZ-17	Tested By: md	Checked By: njh
Sample No.: S1	Test Date: 04/20/17	Depth: 18.5-19 ft
Test No.: IP-3	Sample Type: intact	Elevation: ---

Soil Description: Wet, dark gray silt with sand
Remarks: System X, Swell Pressure = 0.0667 tsf

Measured Specific Gravity: 2.43	Liquid Limit: 119	Specimen Diameter: 2.50 in
Initial Void Ratio: 4.04	Plastic Limit: 55	Initial Height: 1.00 in
Final Void Ratio: 0.966	Plasticity Index: 64	Final Height: 0.39 in

	Before Consolidation		After Consolidation	
	Trimmings	Specimen+Ring	Specimen+Ring	Trimmings
Container ID	C-1270	RING		C-1535
Wt. Container + Wet Soil, gm	105.21	211.72	165.69	62.270
Wt. Container + Dry Soil, gm	45.470	150.28	150.28	46.910
Wt. Container, gm	8.5200	111.51	111.51	8.2800
Wt. Dry Soil, gm	36.950	38.766	38.766	38.630
Water Content, %	161.68	158.50	39.76	39.76
Void Ratio	---	4.04	0.966	---
Degree of Saturation, %	---	95.28	99.97	---
Dry Unit Weight, pcf	---	30.086	77.143	---

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Wynn Everett | Location: Everett, MA | Project No.: GTX-306274
Boring No.: GZ-17 | Tested By: md | Checked By: njh
Sample No.: S1 | Test Date: 04/20/17 | Depth: 18.5-19 ft
Test No.: IP-3 | Sample Type: intact | Elevation: ---

Soil Description: Wet, dark gray silt with sand
Remarks: System X, Swell Pressure = 0.0667 tsf

Displacement at End of Increment

	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt T90 min	Cv ft²/sec	Mv 1/tsf	k ft/day
1	0.0667	0.03969	3.84	3.97	21.513	1.10e-006	5.95e-001	1.76e-003
2	0.125	0.07041	3.69	7.04	29.331	7.47e-007	5.27e-001	1.06e-003
3	0.250	0.1300	3.39	13.0	26.230	7.57e-007	4.77e-001	9.73e-004
4	0.500	0.2194	2.94	21.9	28.258	5.91e-007	3.58e-001	5.70e-004
5	1.00	0.3068	2.50	30.7	23.319	5.71e-007	1.75e-001	2.69e-004
6	2.00	0.3846	2.10	38.5	22.362	4.70e-007	7.78e-002	9.86e-005
7	4.00	0.4605	1.72	46.1	20.857	3.92e-007	3.80e-002	4.02e-005
8	8.00	0.5195	1.42	51.9	20.695	3.08e-007	1.47e-002	1.23e-005
9	16.0	0.5748	1.14	57.5	20.378	2.47e-007	6.92e-003	4.61e-006
10	32.0	0.6201	0.915	62.0	19.417	2.05e-007	2.83e-003	1.56e-006
11	8.00	0.6183	0.925	61.8	166.097	2.14e-008	7.53e-005	4.35e-009
12	2.00	0.6105	0.964	61.1	298.004	1.22e-008	1.30e-003	4.30e-008
13	0.500	0.6045	0.994	60.4	200.003	1.89e-008	4.03e-003	2.06e-007
14	0.125	0.5979	1.03	59.8	0.000	0.00e+000	1.76e-002	0.00e+000
15	0.0625	0.5953	1.04	59.5	0.000	0.00e+000	4.02e-002	0.00e+000

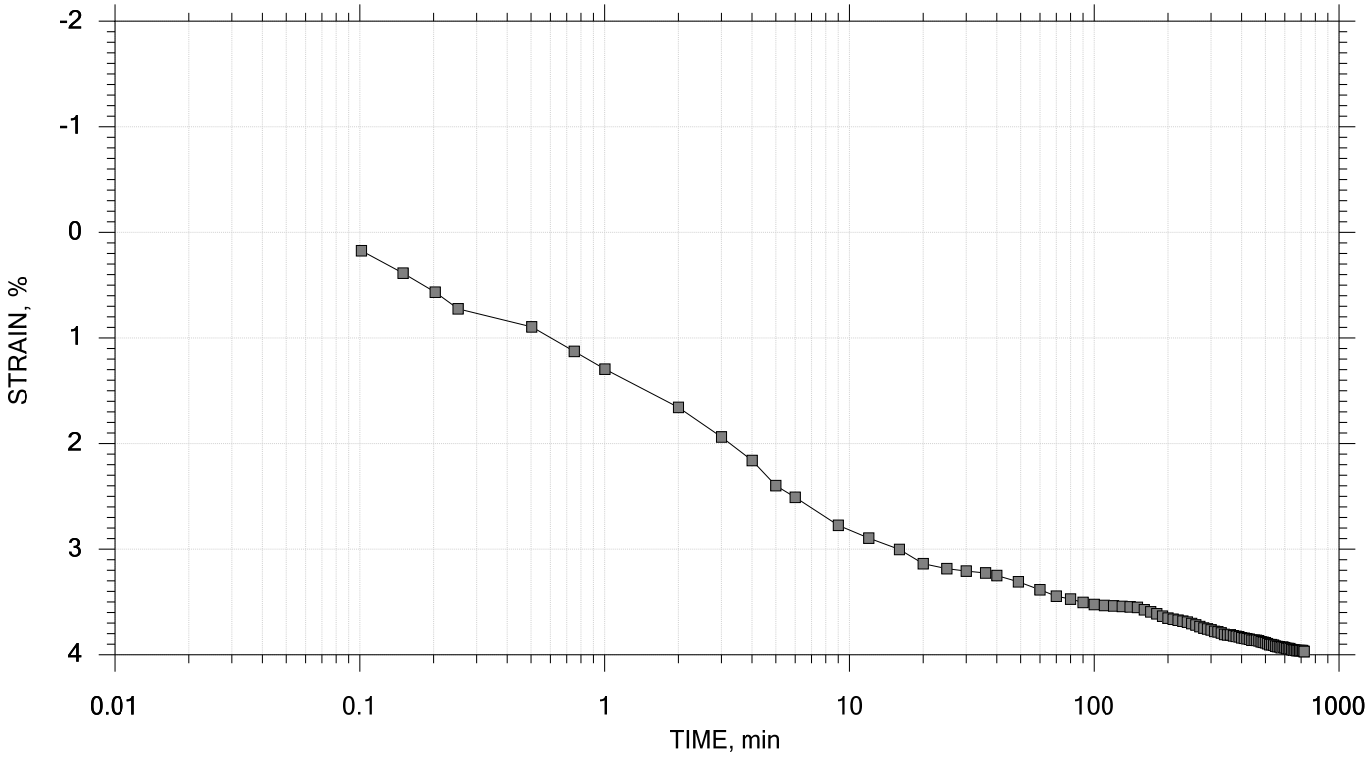
	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Log T50 min	Cv ft²/sec	Mv 1/tsf	k ft/day	Ca %
1	0.0667	0.03969	3.84	3.97	1.609	3.40e-006	5.95e-001	5.46e-003	0.00e+000
2	0.125	0.07041	3.69	7.04	0.000	0.00e+000	5.27e-001	0.00e+000	0.00e+000
3	0.250	0.1300	3.39	13.0	6.646	6.94e-007	4.77e-001	8.92e-004	0.00e+000
4	0.500	0.2194	2.94	21.9	7.430	5.23e-007	3.58e-001	5.04e-004	0.00e+000
5	1.00	0.3068	2.50	30.7	3.892	7.95e-007	1.75e-001	3.75e-004	0.00e+000
6	2.00	0.3846	2.10	38.5	3.711	6.58e-007	7.78e-002	1.38e-004	0.00e+000
7	4.00	0.4605	1.72	46.1	2.252	8.44e-007	3.80e-002	8.64e-005	0.00e+000
8	8.00	0.5195	1.42	51.9	1.757	8.44e-007	1.47e-002	3.36e-005	0.00e+000
9	16.0	0.5748	1.14	57.5	1.702	6.87e-007	6.92e-003	1.28e-005	0.00e+000
10	32.0	0.6201	0.915	62.0	1.371	6.74e-007	2.83e-003	5.15e-006	0.00e+000
11	8.00	0.6183	0.925	61.8	0.000	0.00e+000	7.53e-005	0.00e+000	0.00e+000
12	2.00	0.6105	0.964	61.1	0.000	0.00e+000	1.30e-003	0.00e+000	0.00e+000
13	0.500	0.6045	0.994	60.4	0.000	0.00e+000	4.03e-003	0.00e+000	0.00e+000
14	0.125	0.5979	1.03	59.8	0.000	0.00e+000	1.76e-002	0.00e+000	0.00e+000
15	0.0625	0.5953	1.04	59.5	417.842	2.22e-009	4.02e-002	2.41e-007	0.00e+000

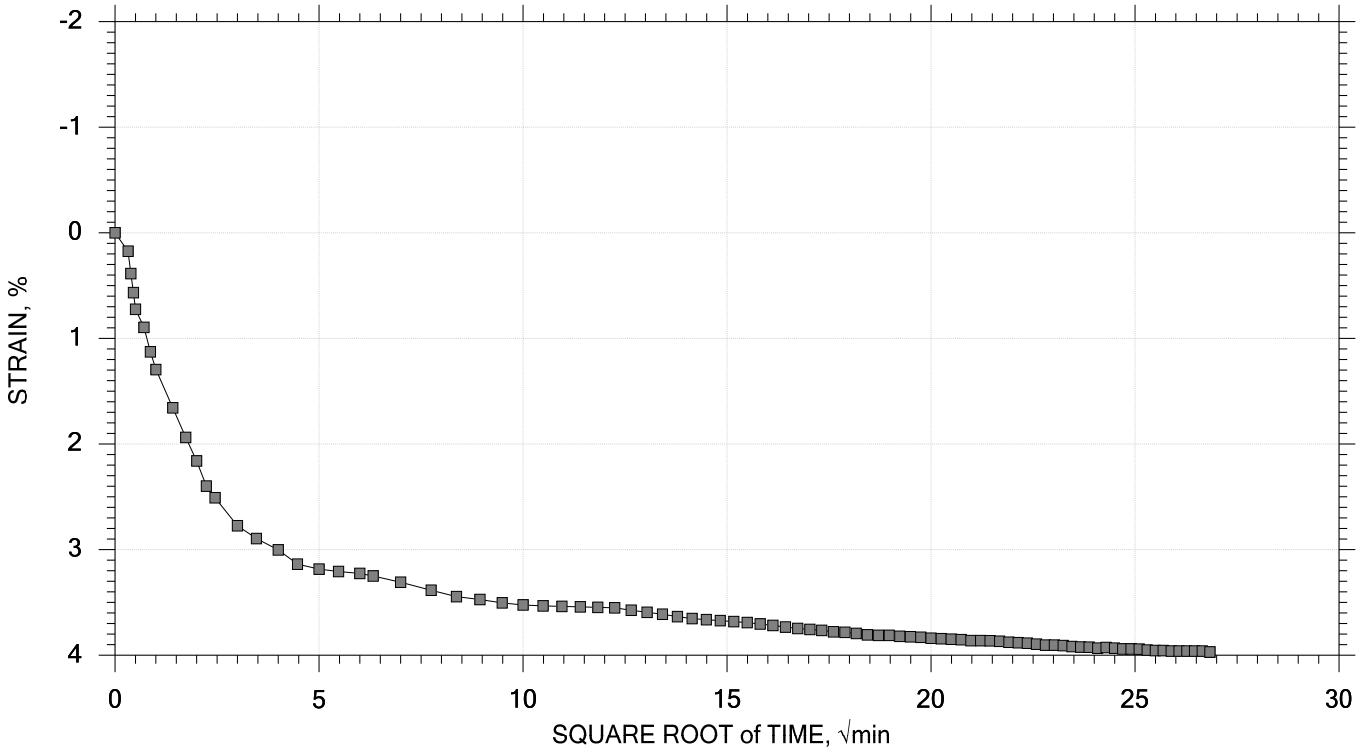
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Volume Step 1 of 15

Stress: 0.066687 tsf





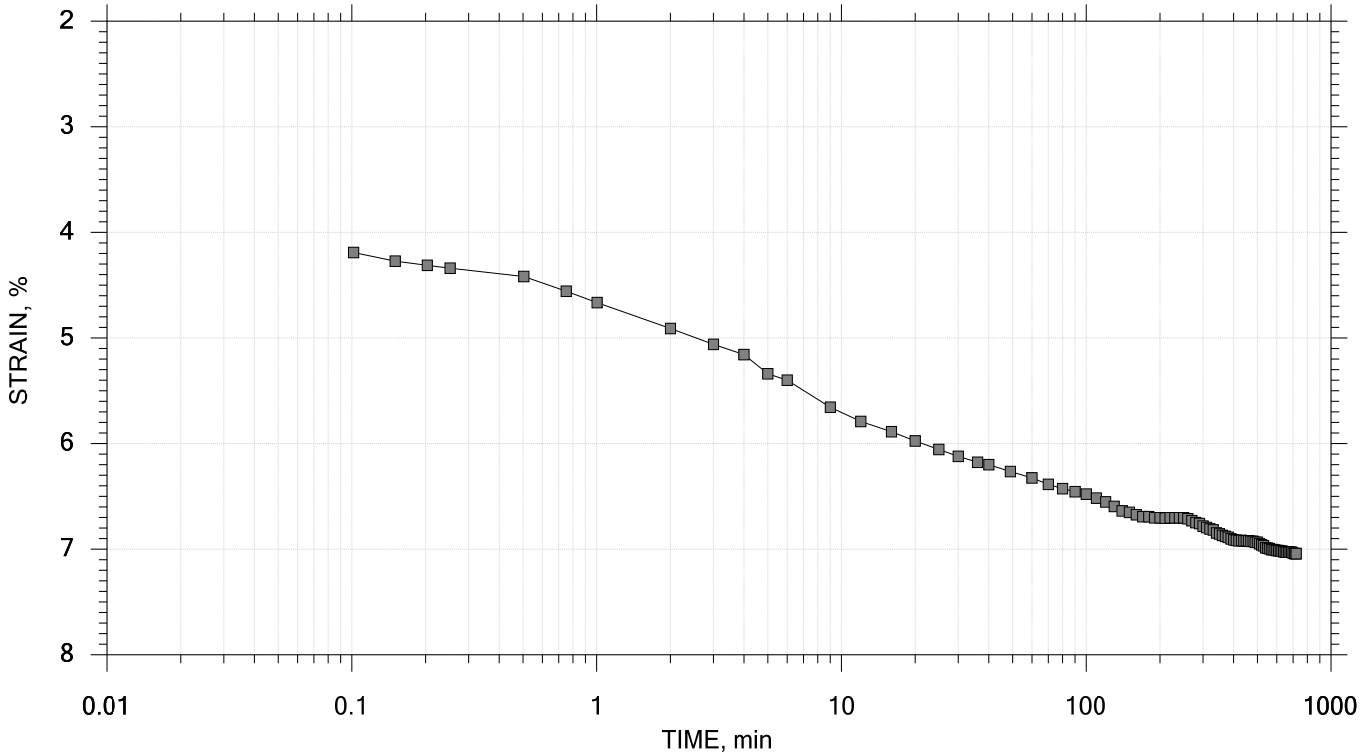
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-17	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/20/17	Test No.: IP-3
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt with sand		
	Remarks: System X, Swell Pressure = 0.0667 tsf		

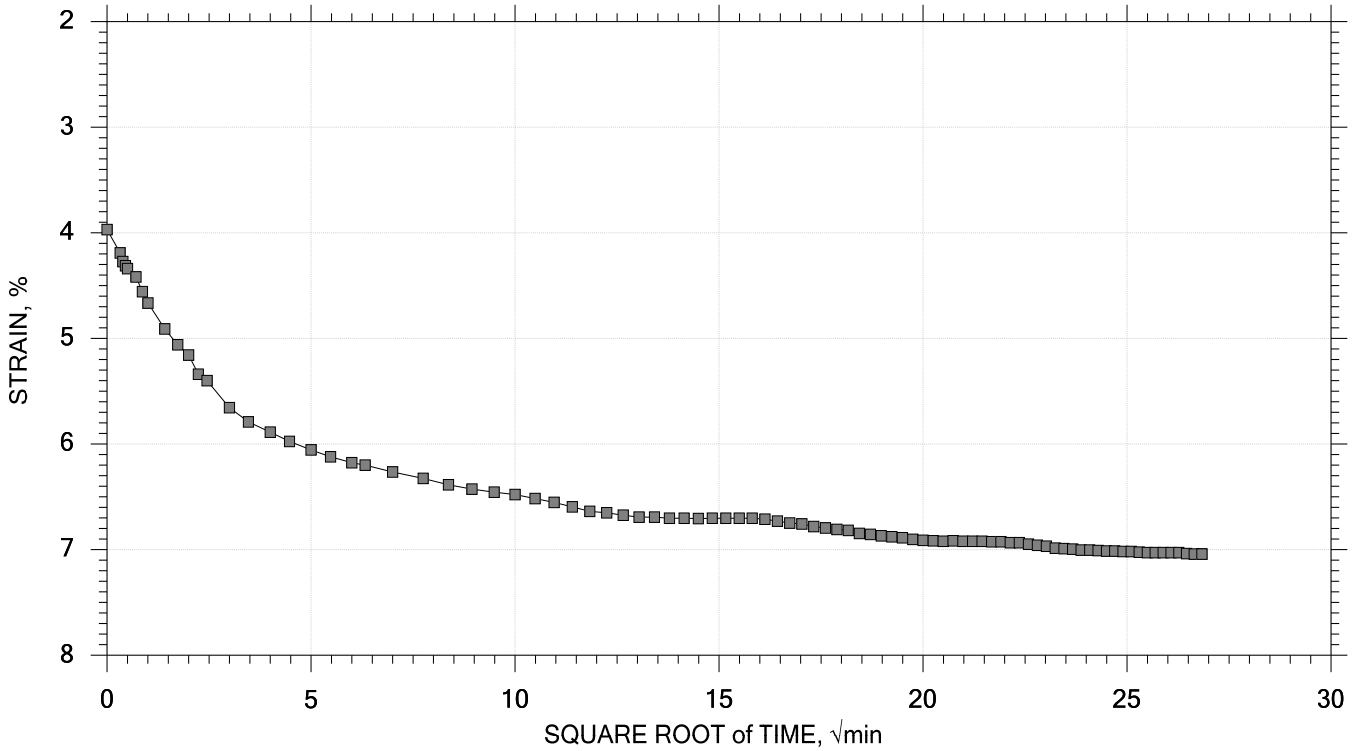
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 2 of 15

Stress: 0.125 tsf





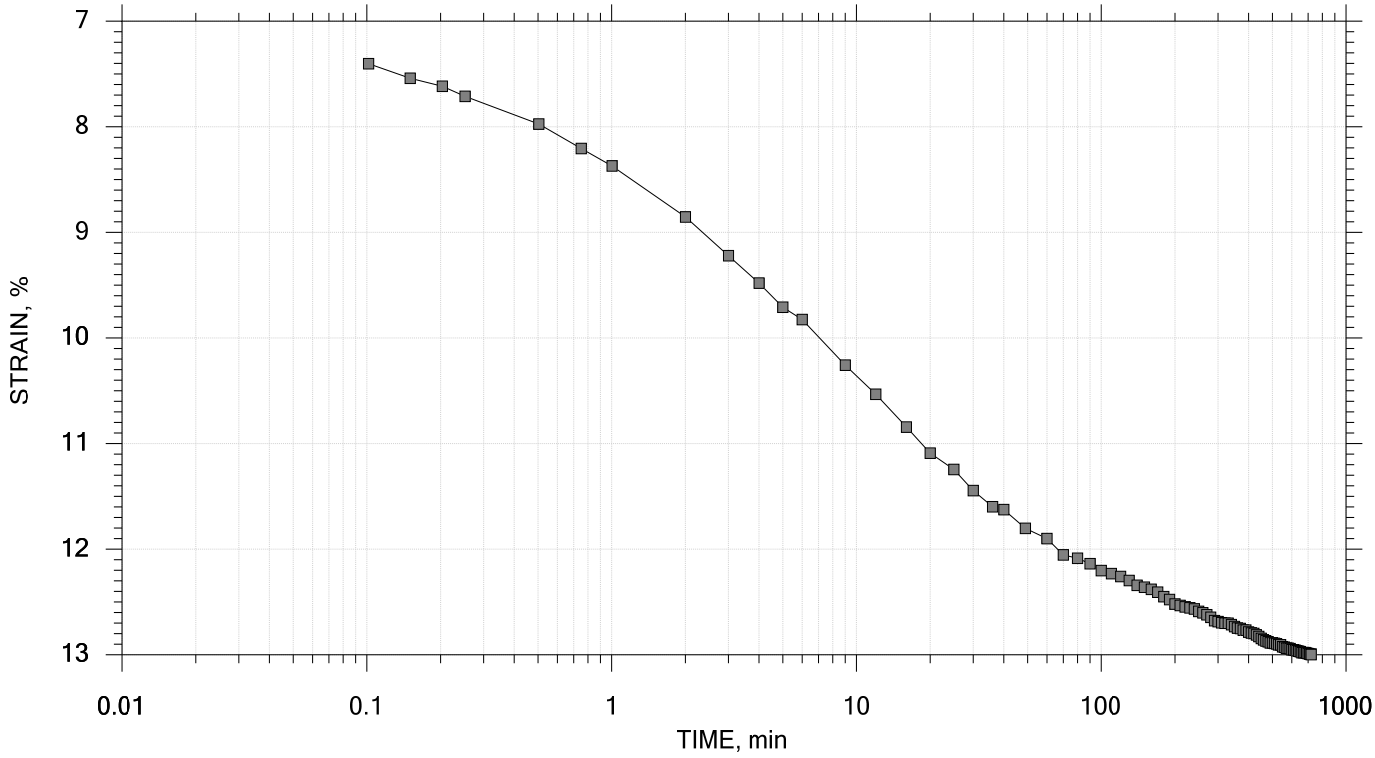
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-17	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/20/17	Test No.: IP-3
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt with sand		
	Remarks: System X, Swell Pressure = 0.0667 tsf		

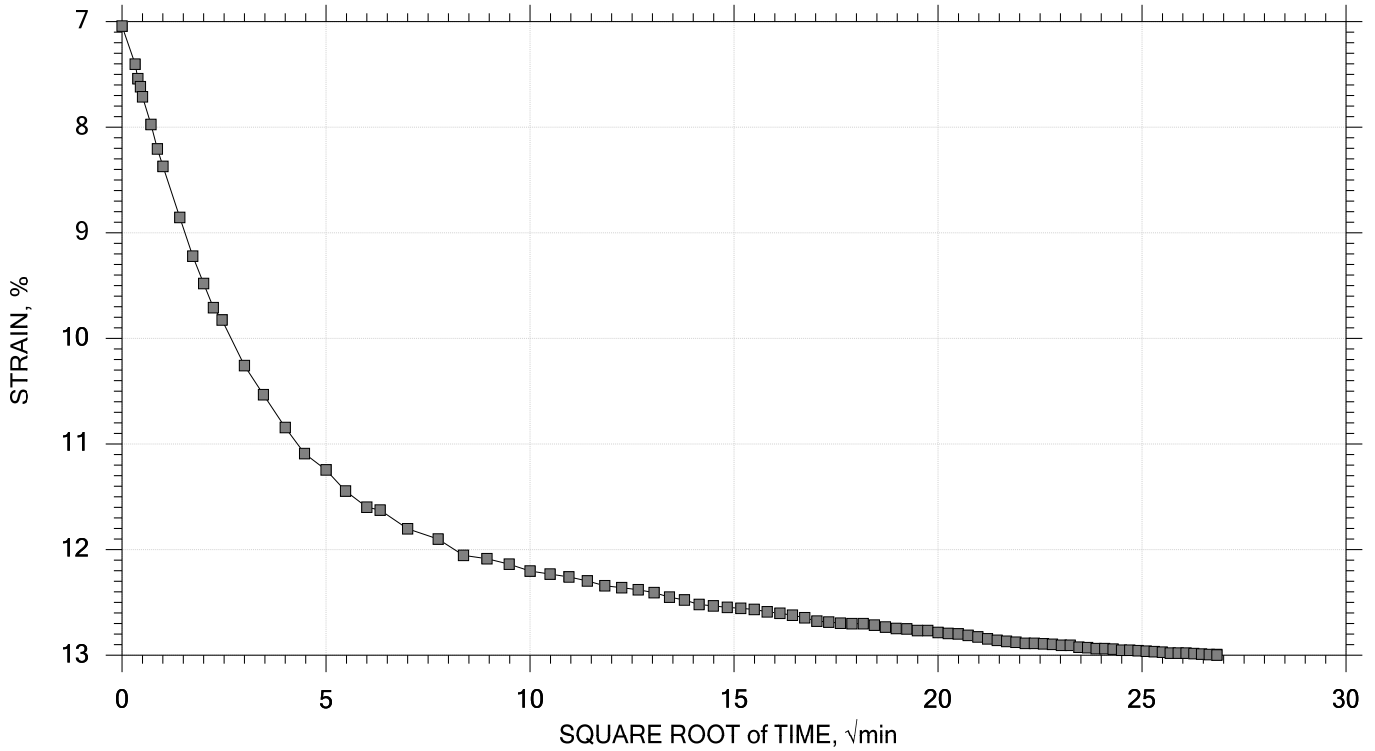
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 3 of 15

Stress: 0.25 tsf





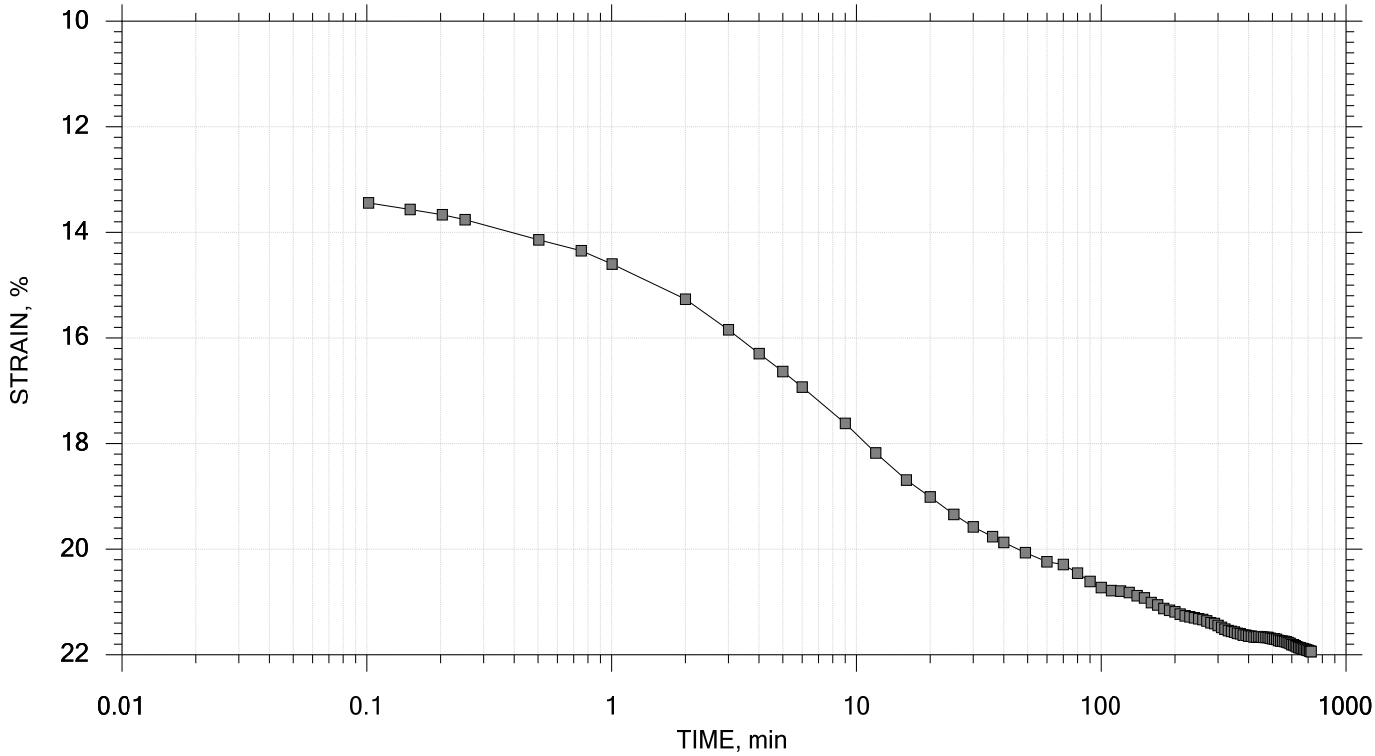
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-17	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/20/17	Test No.: IP-3
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt with sand		
	Remarks: System X, Swell Pressure = 0.0667 tsf		

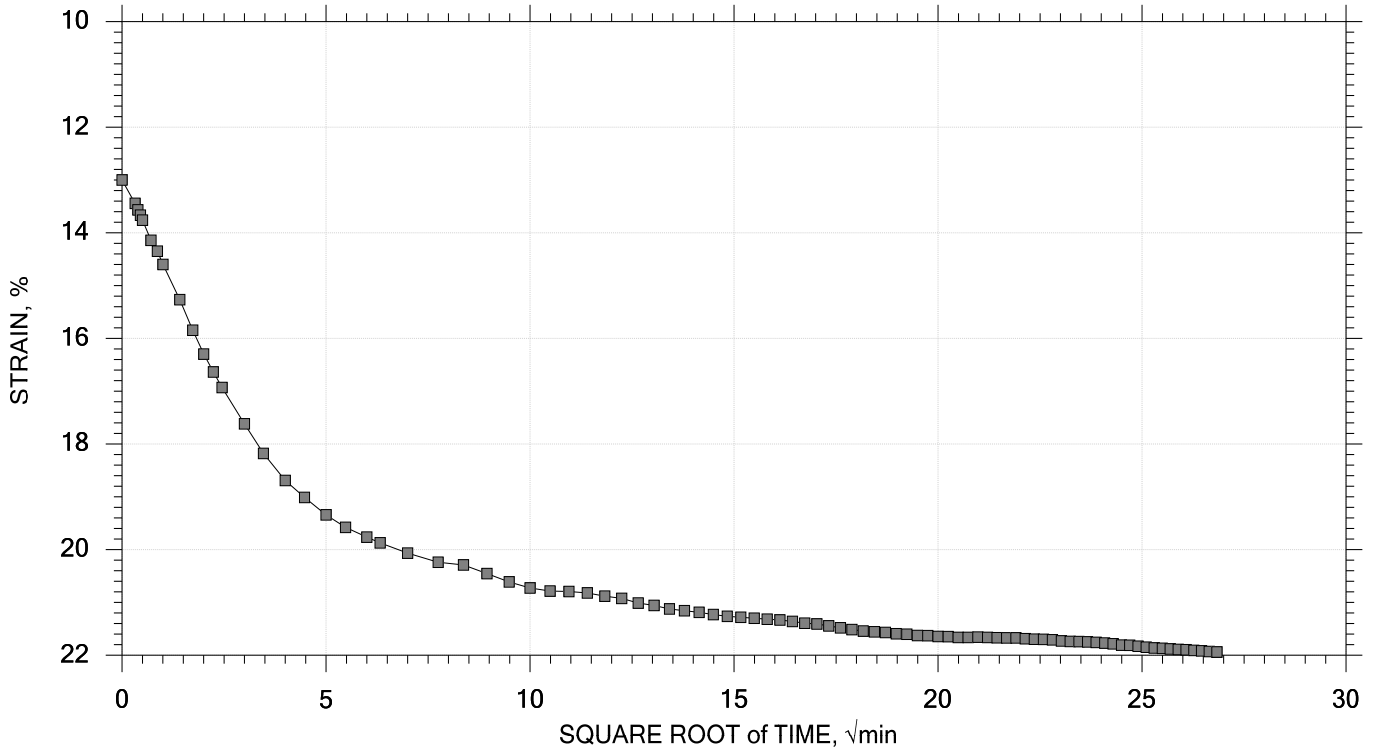
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 4 of 15

Stress: 0.5 tsf





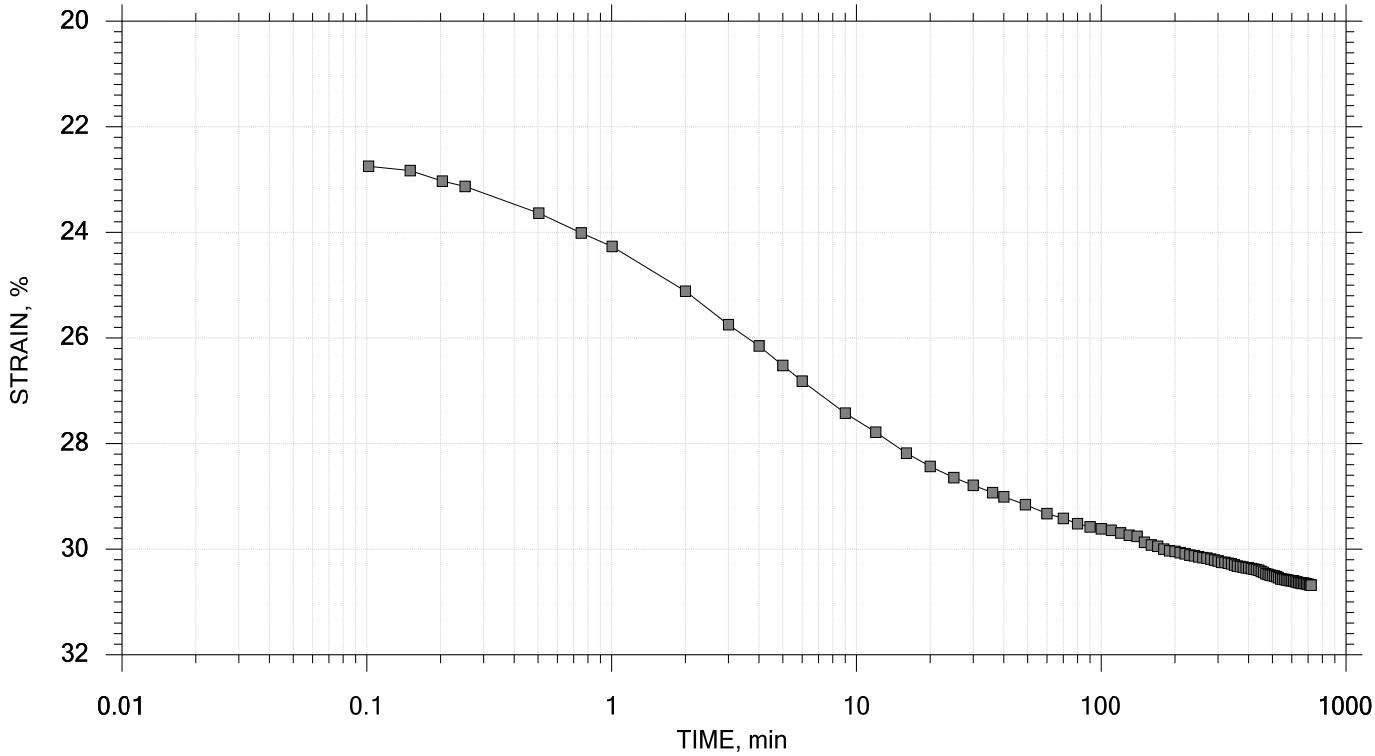
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-17	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/20/17	Test No.: IP-3
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt with sand		
	Remarks: System X, Swell Pressure = 0.0667 tsf		

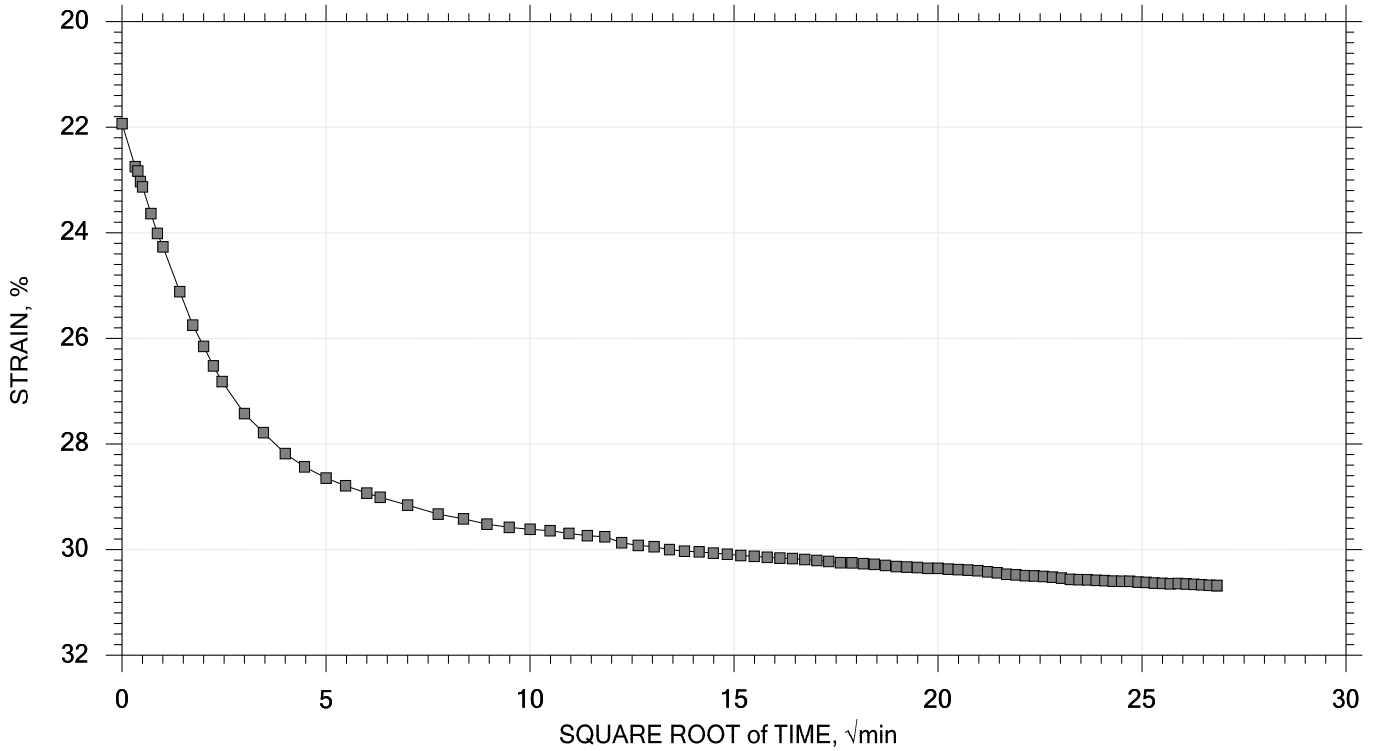
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 5 of 15

Stress: 1 tsf





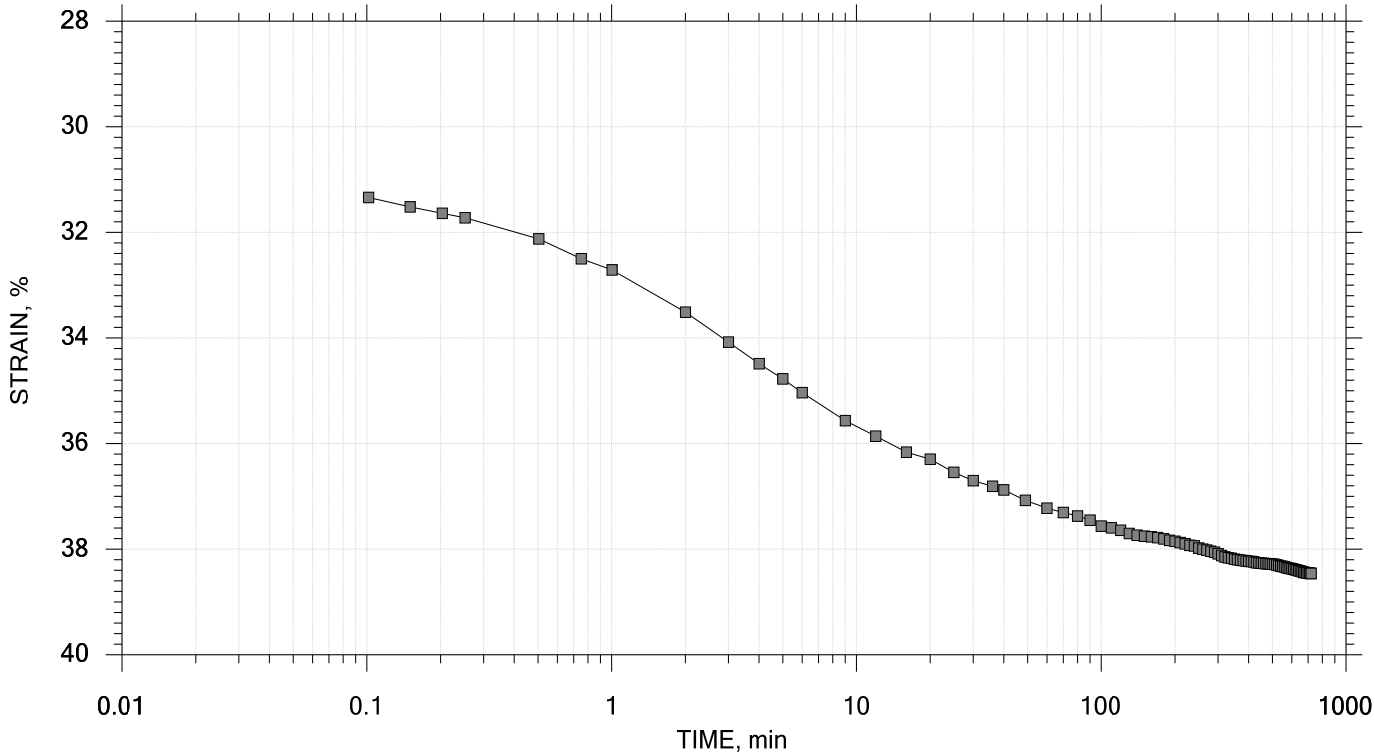
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-17	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/20/17	Test No.: IP-3
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt with sand		
	Remarks: System X, Swell Pressure = 0.0667 tsf		

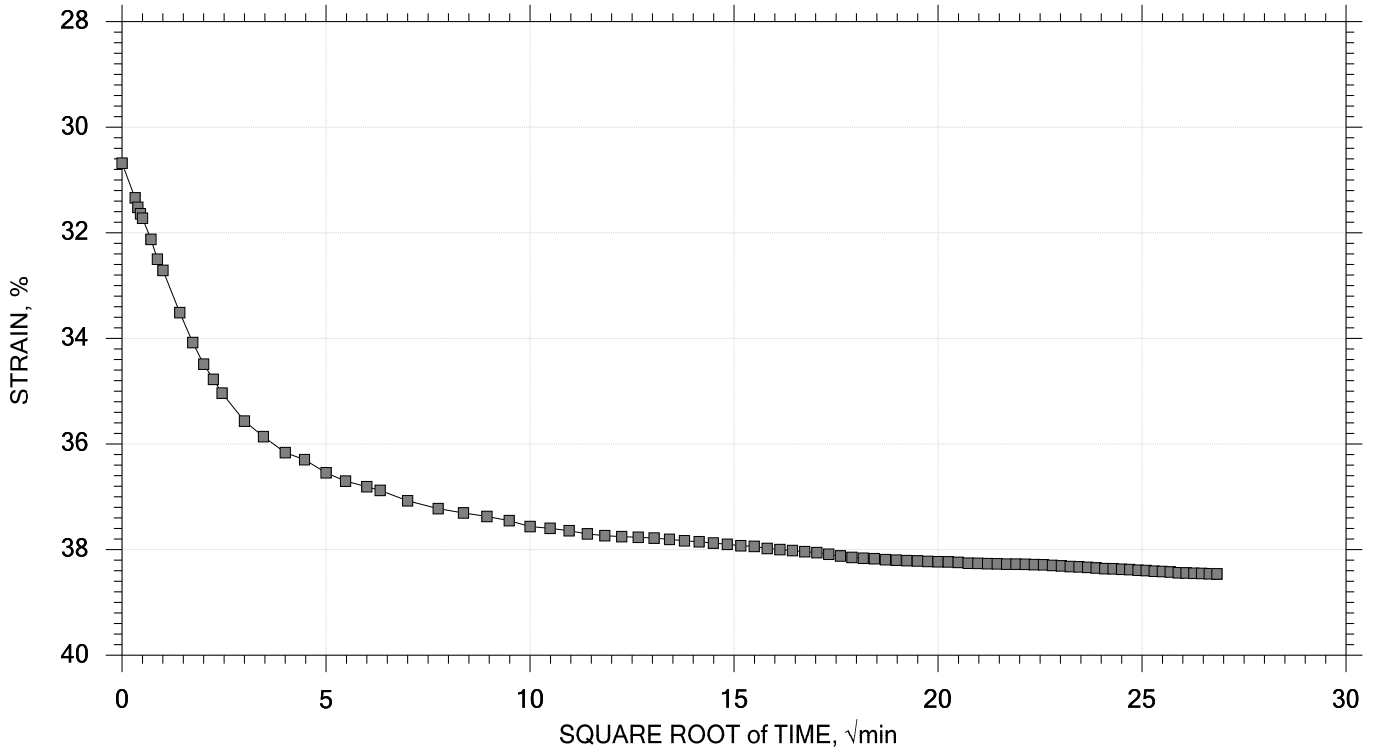
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 6 of 15

Stress: 2 tsf





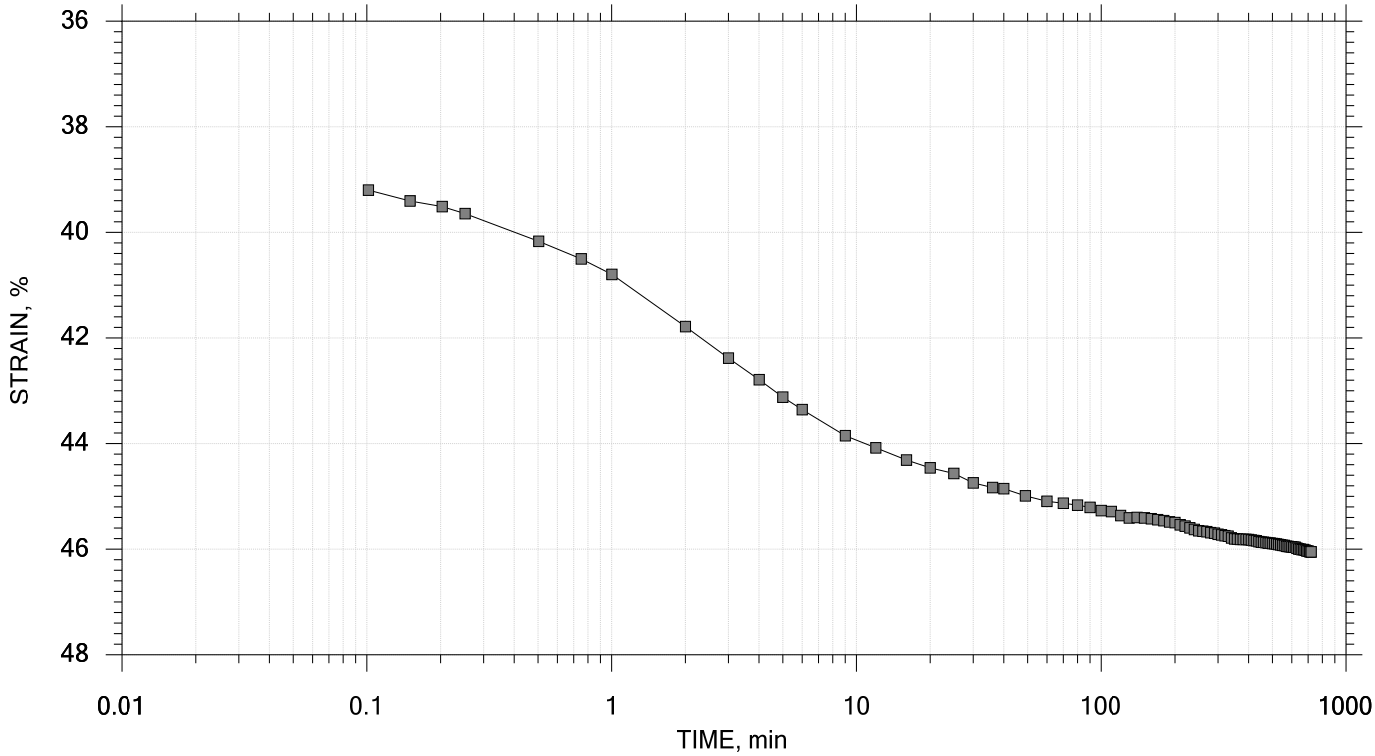
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-17	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/20/17	Test No.: IP-3
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt with sand		
	Remarks: System X, Swell Pressure = 0.0667 tsf		

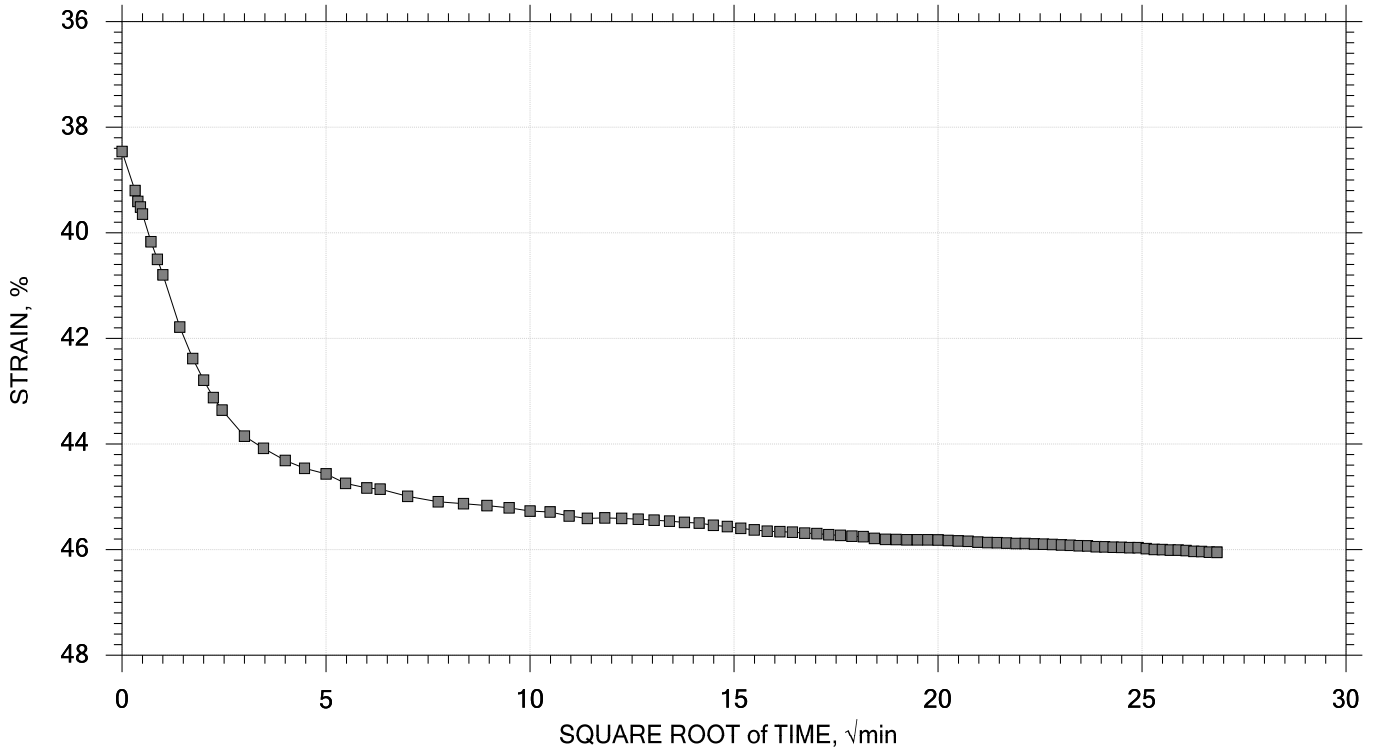
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 7 of 15

Stress: 4 tsf





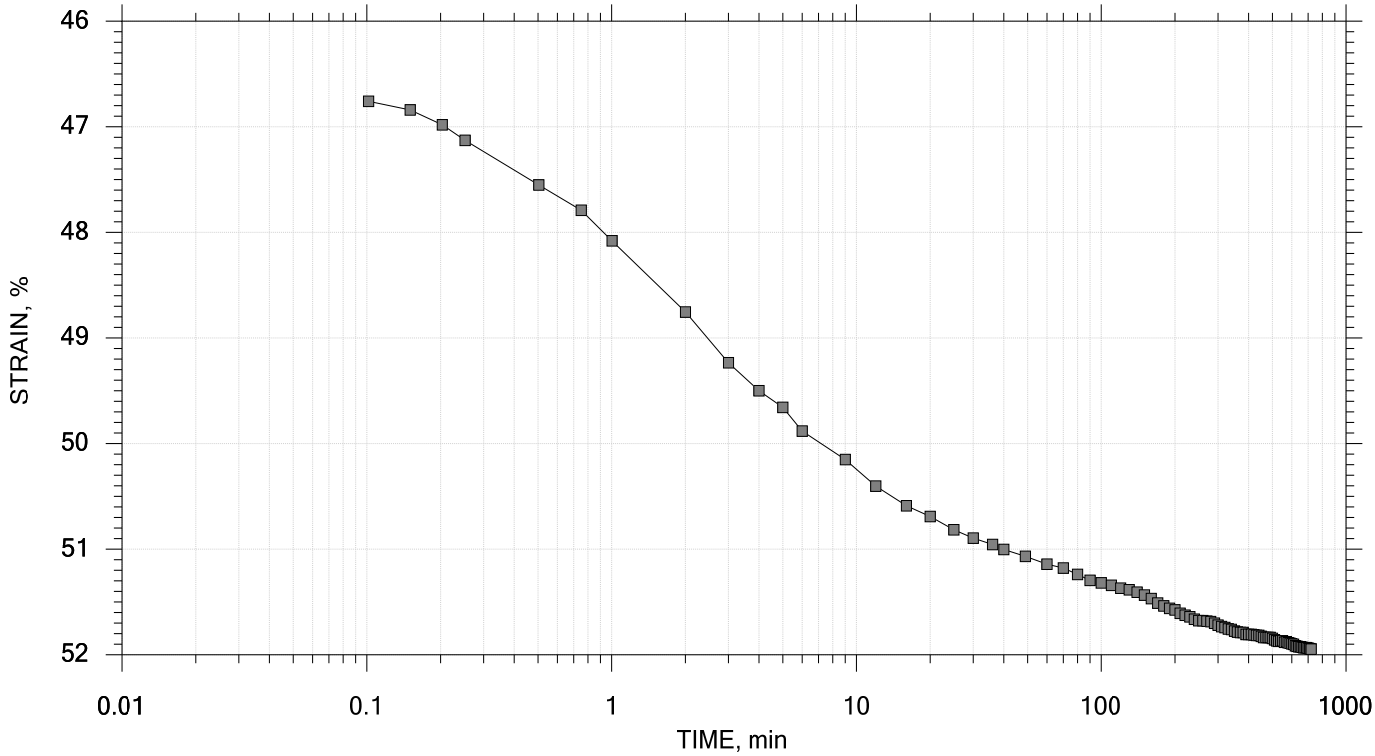
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-17	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/20/17	Test No.: IP-3
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt with sand		
	Remarks: System X, Swell Pressure = 0.0667 tsf		

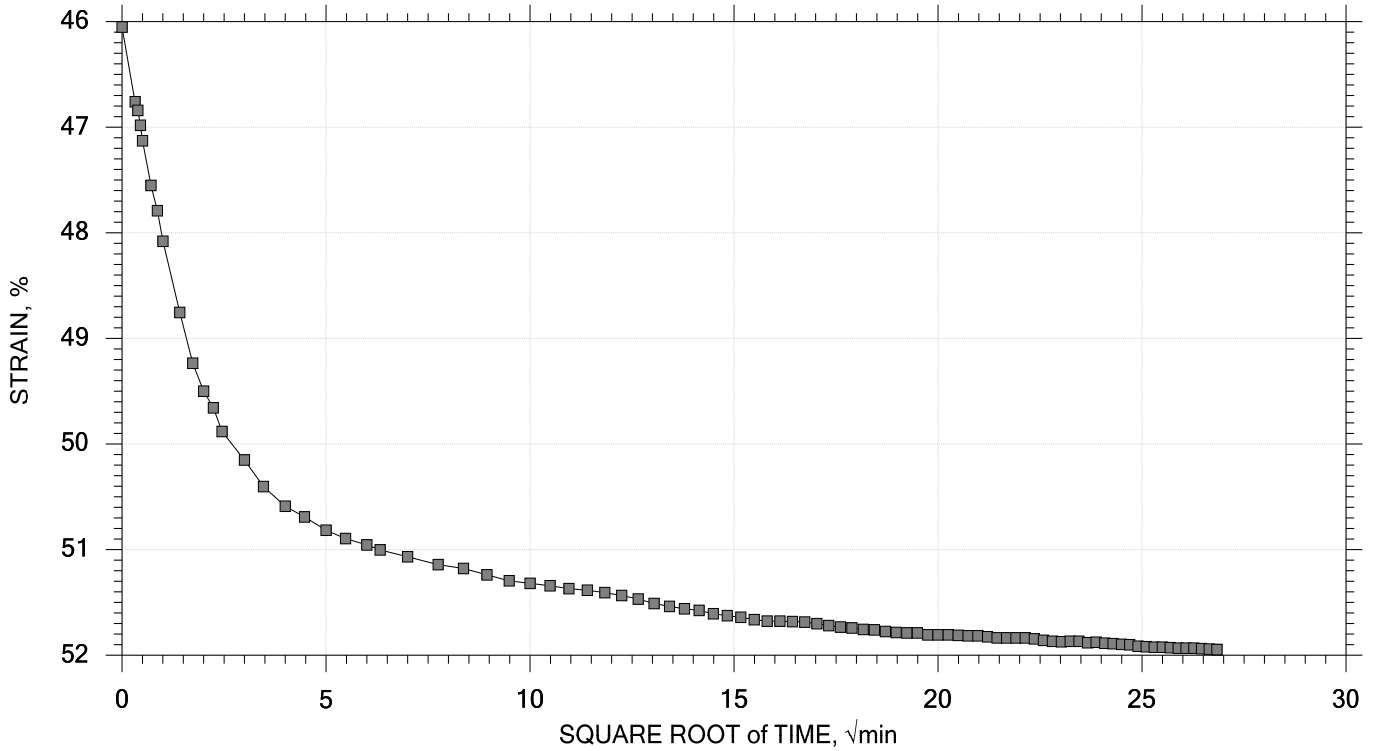
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 8 of 15

Stress: 8 tsf





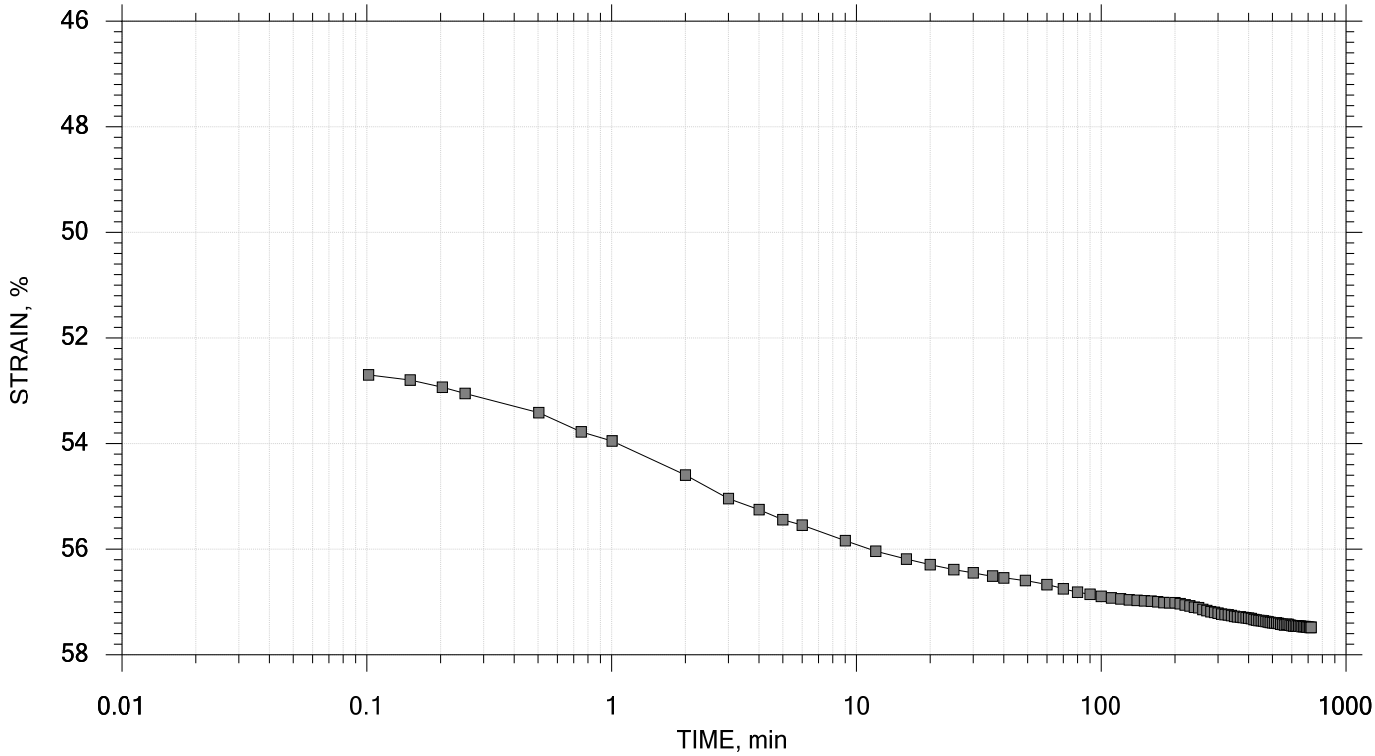
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-17	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/20/17	Test No.: IP-3
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt with sand		
	Remarks: System X, Swell Pressure = 0.0667 tsf		

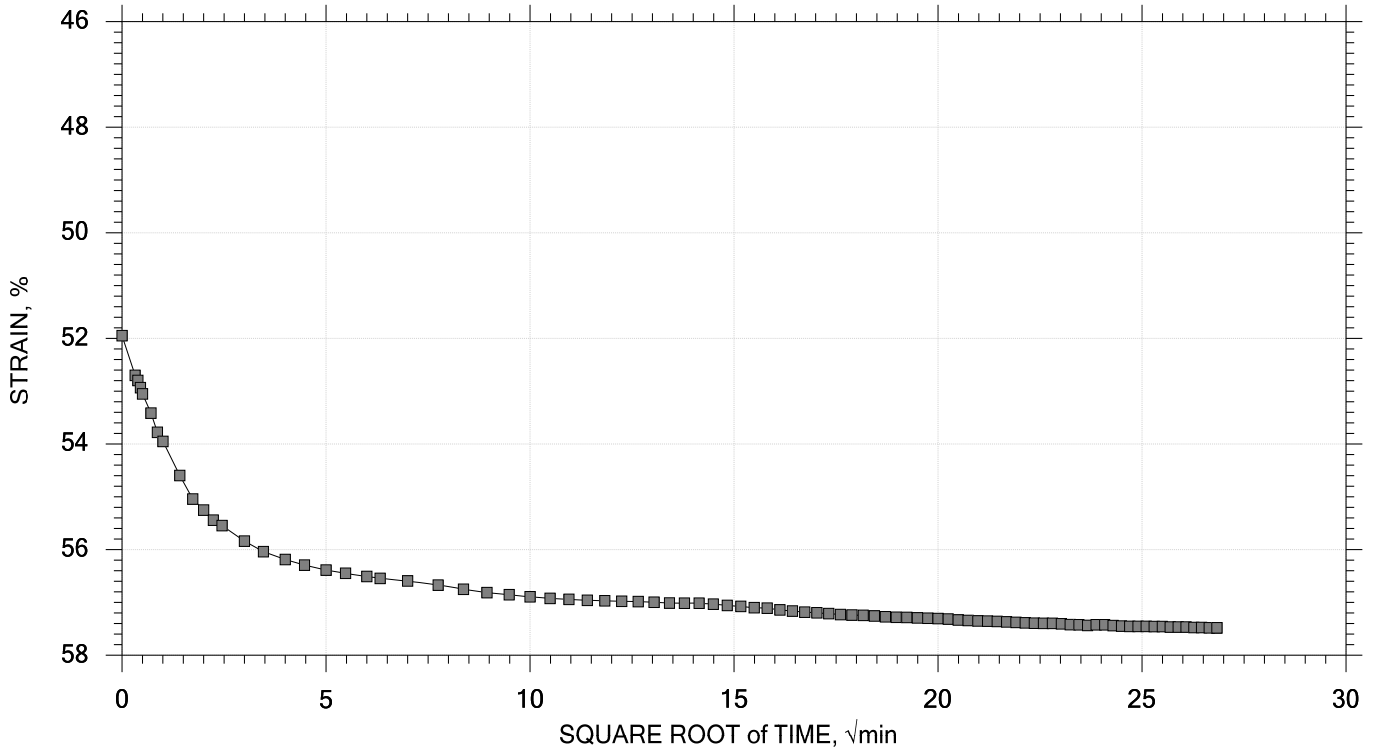
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 9 of 15

Stress: 16 tsf





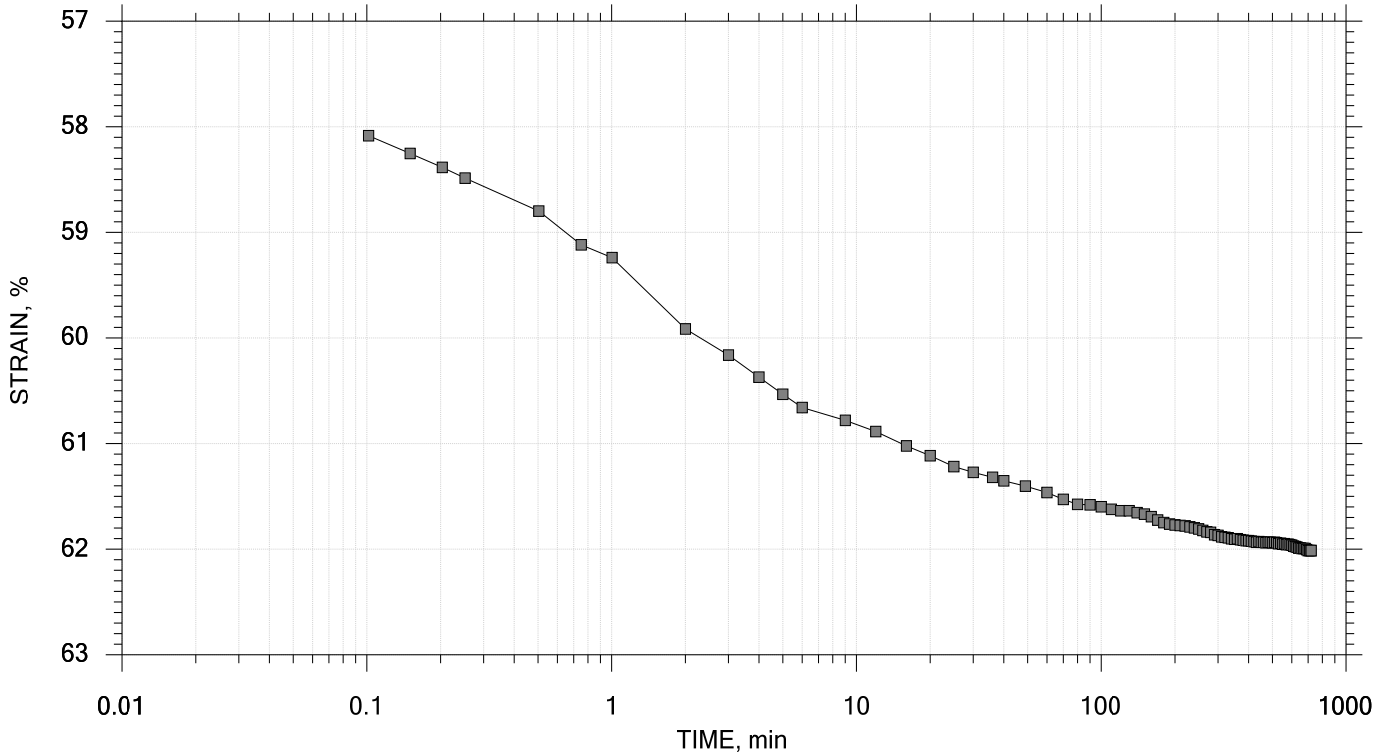
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-17	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/20/17	Test No.: IP-3
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt with sand		
	Remarks: System X, Swell Pressure = 0.0667 tsf		

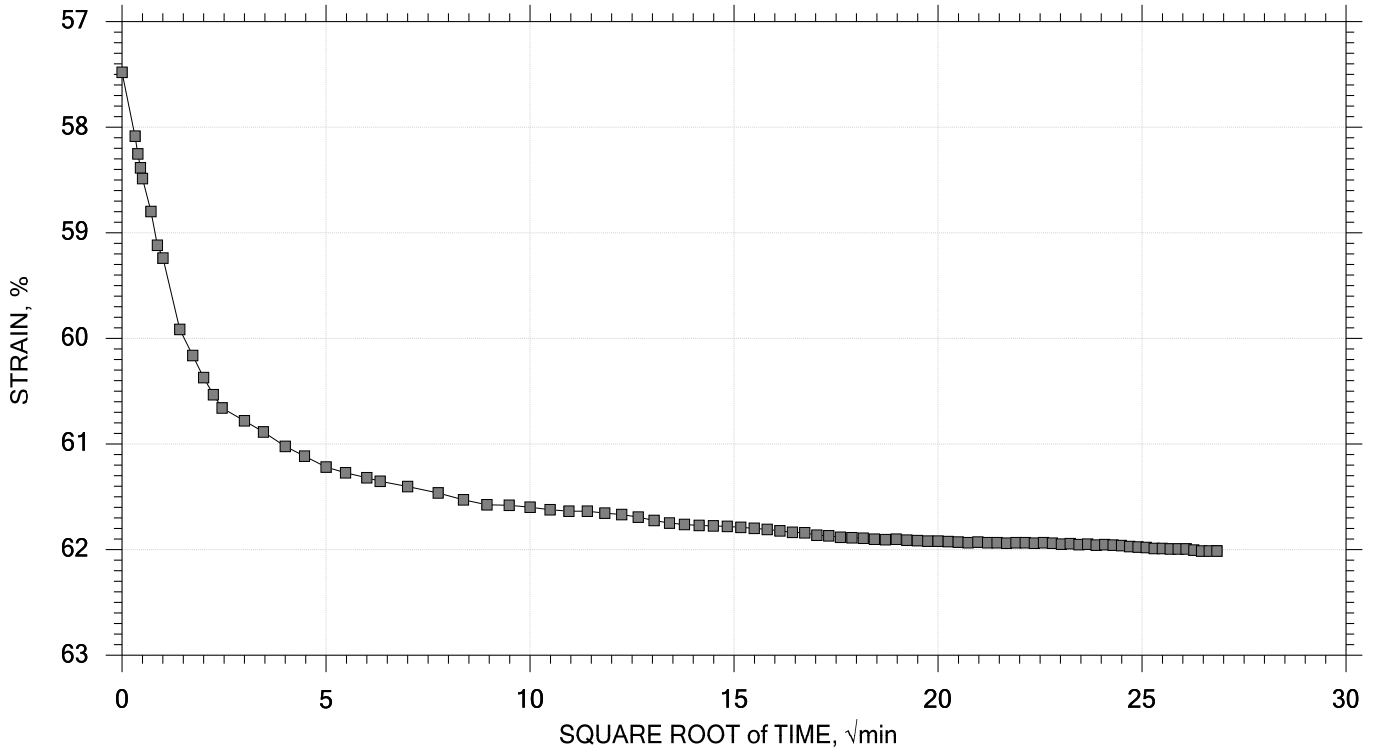
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 10 of 15

Stress: 32 tsf





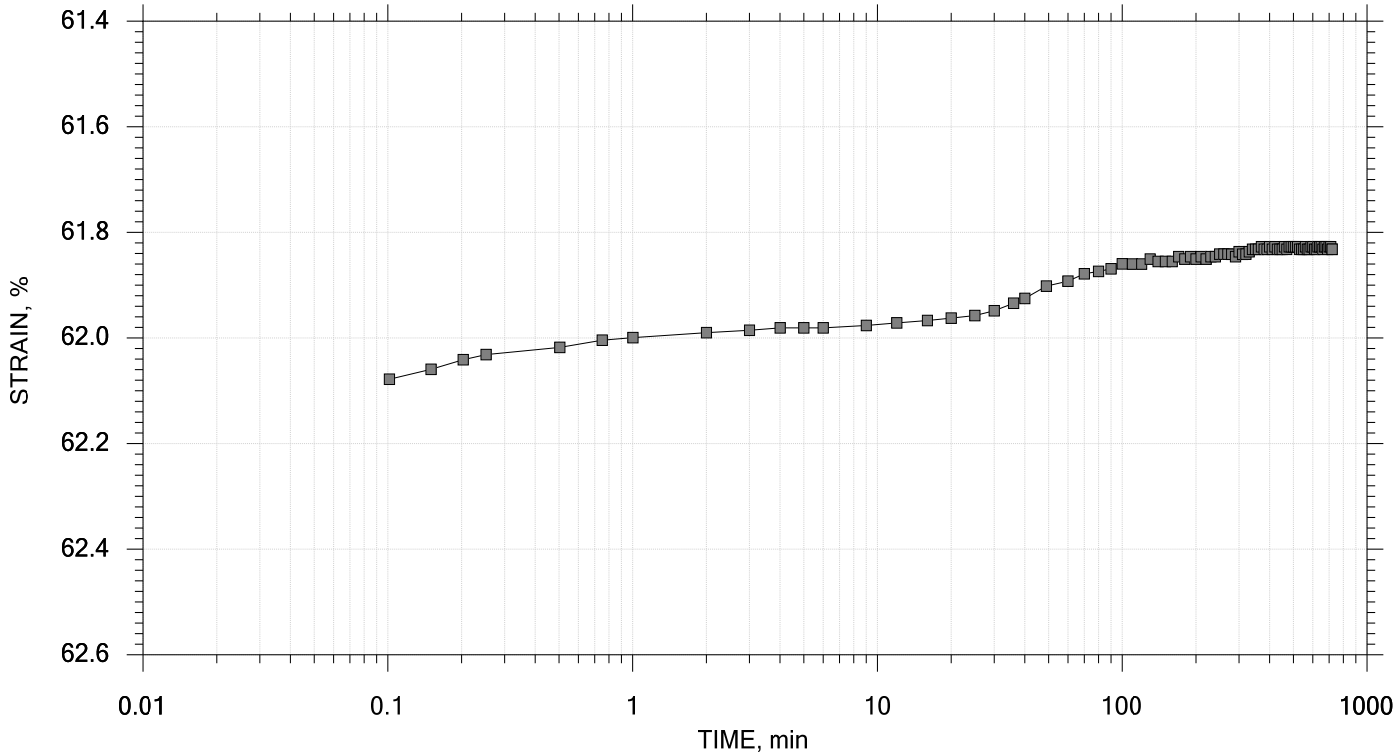
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-17	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/20/17	Test No.: IP-3
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt with sand		
	Remarks: System X, Swell Pressure = 0.0667 tsf		

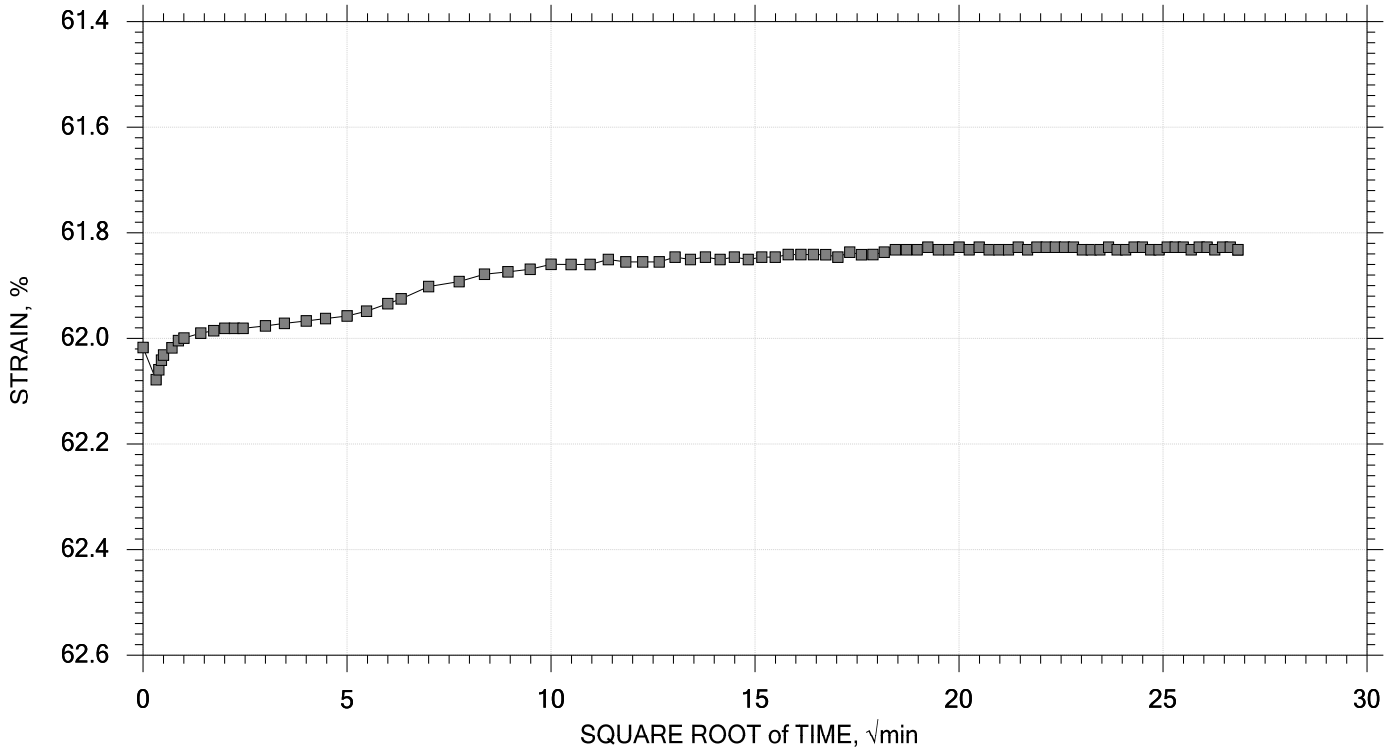
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 11 of 15

Stress: 8 tsf





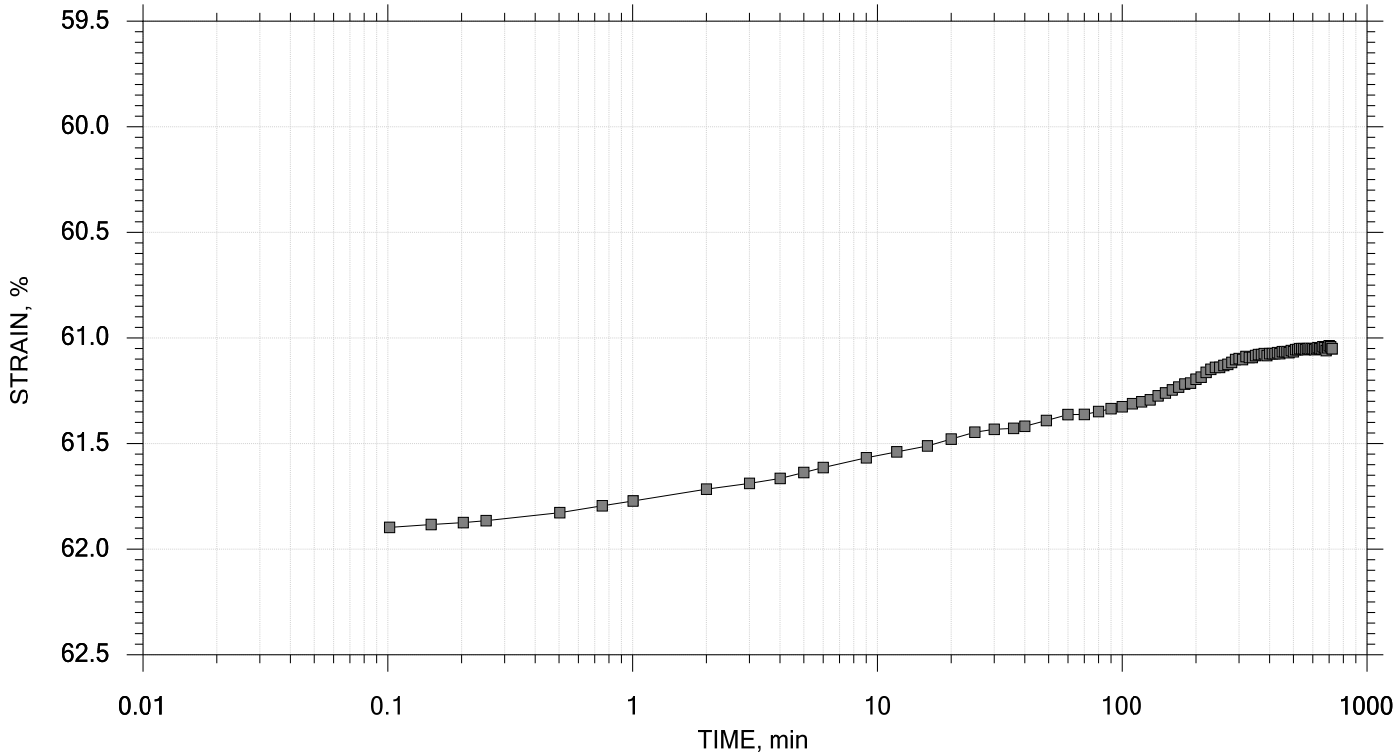
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-17	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/20/17	Test No.: IP-3
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt with sand		
	Remarks: System X, Swell Pressure = 0.0667 tsf		

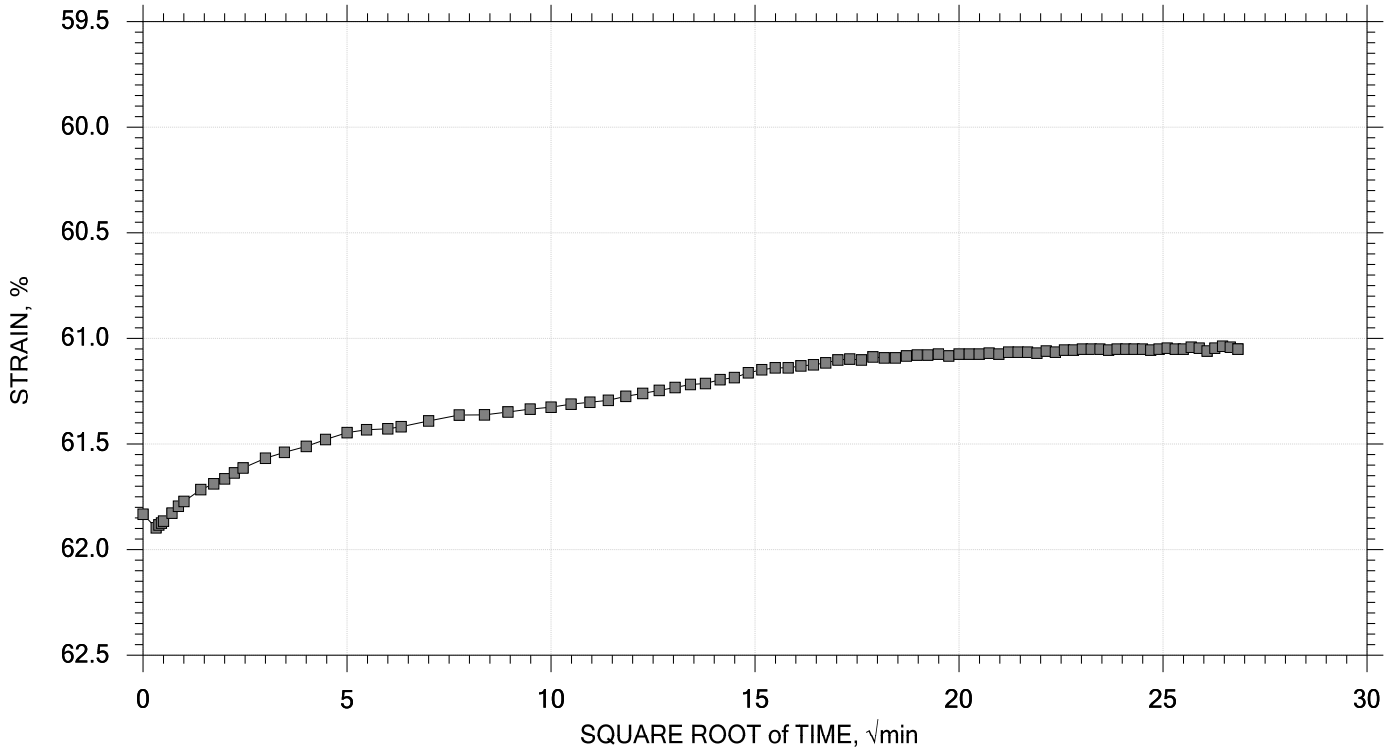
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 12 of 15

Stress: 2 tsf





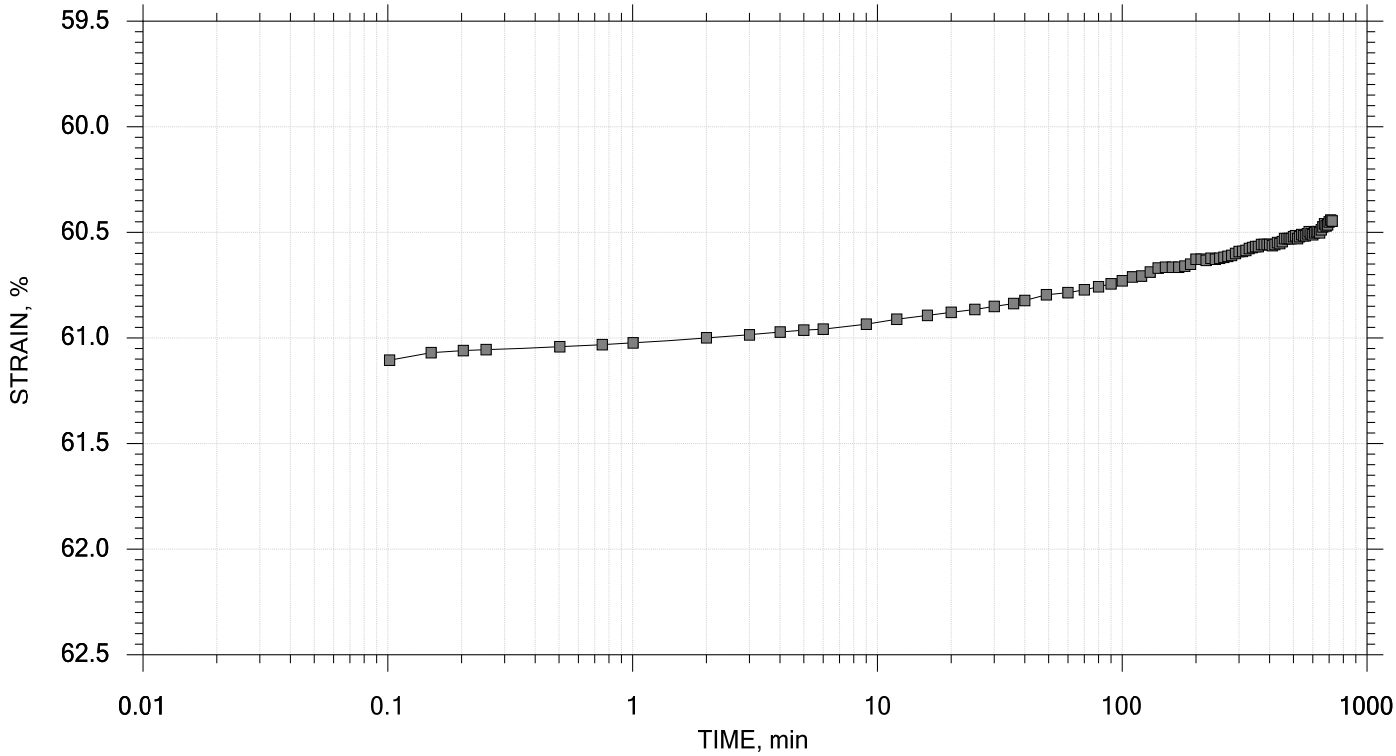
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-17	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/20/17	Test No.: IP-3
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt with sand		
	Remarks: System X, Swell Pressure = 0.0667 tsf		

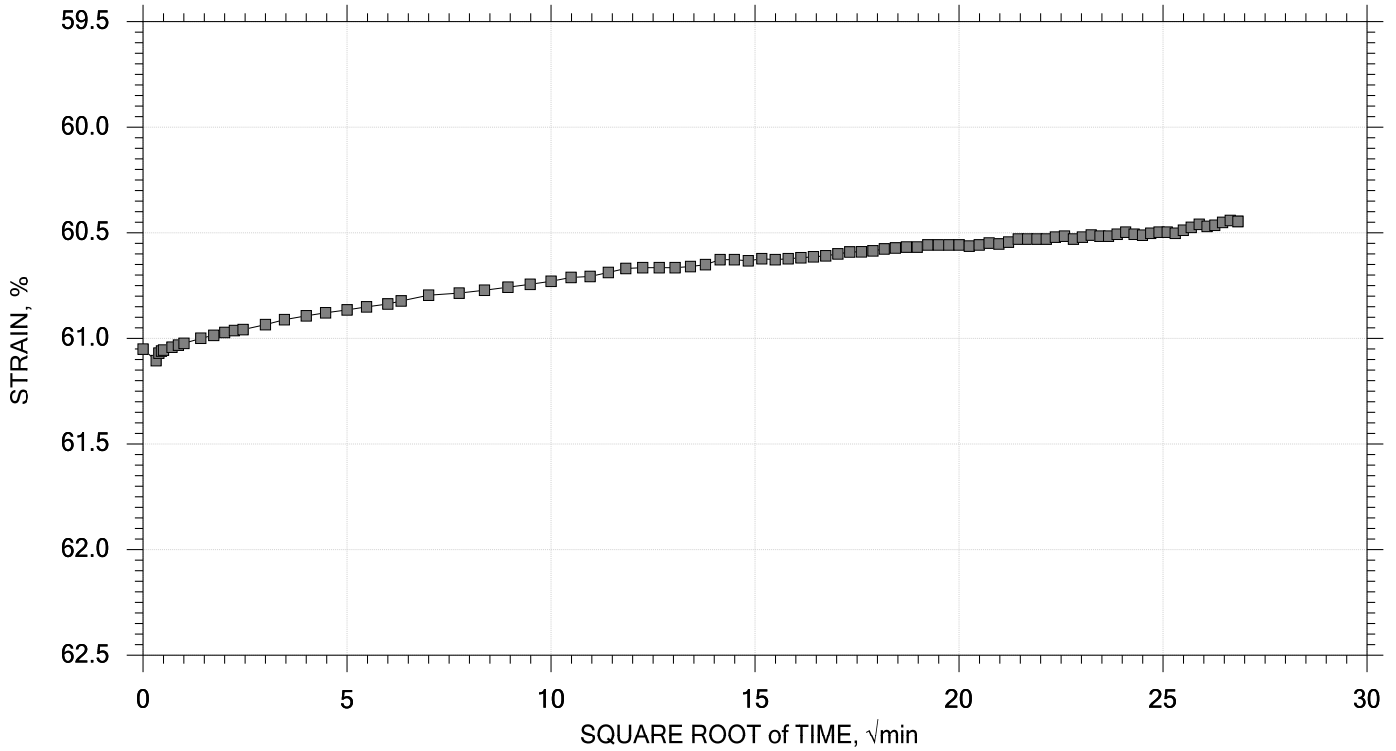
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 13 of 15

Stress: 0.5 tsf





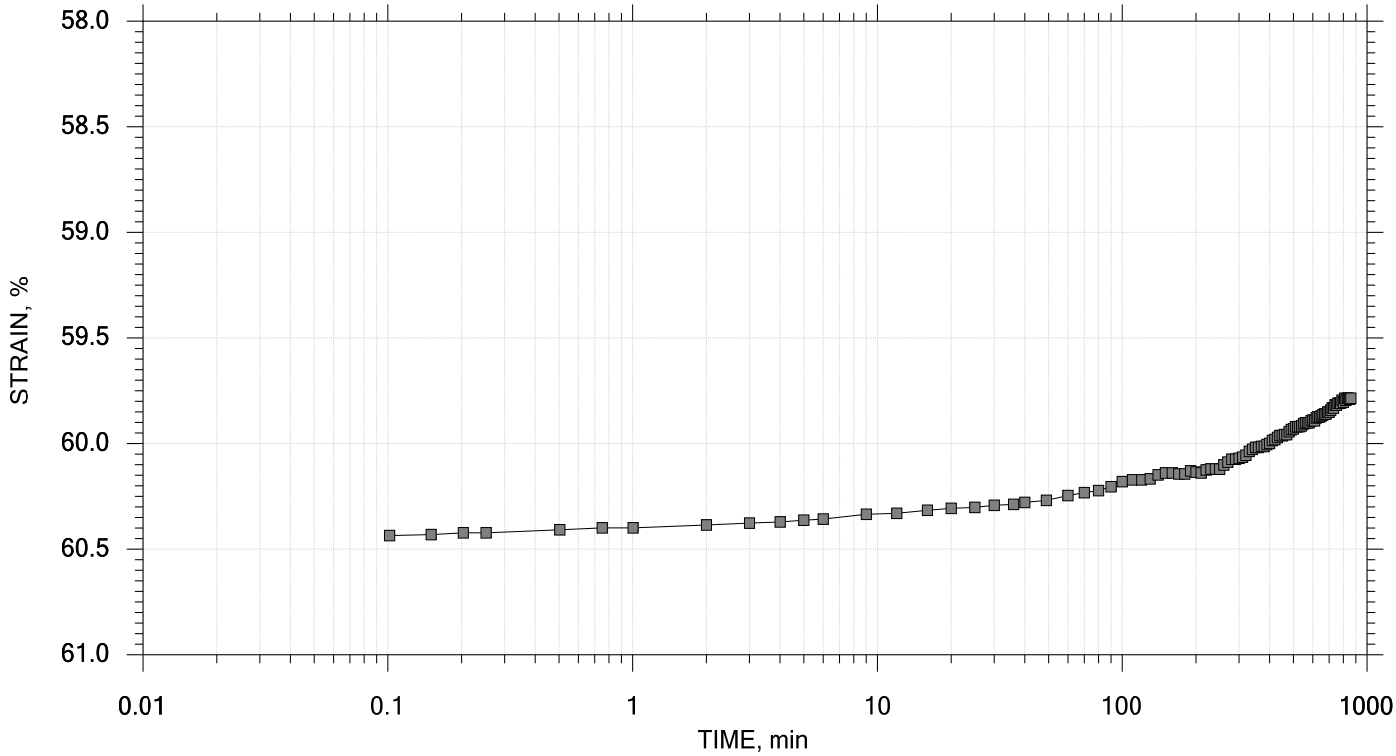
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-17	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/20/17	Test No.: IP-3
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt with sand		
	Remarks: System X, Swell Pressure = 0.0667 tsf		

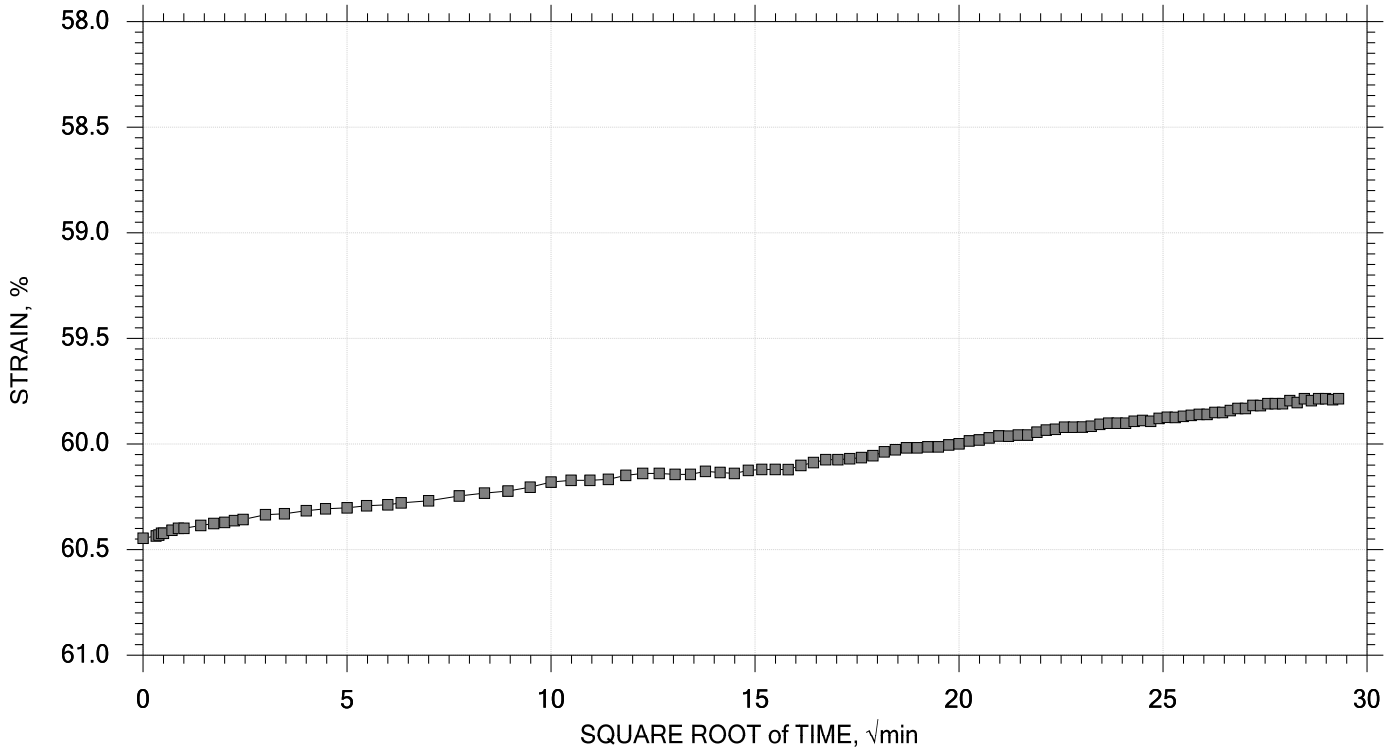
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 14 of 15

Stress: 0.125 tsf





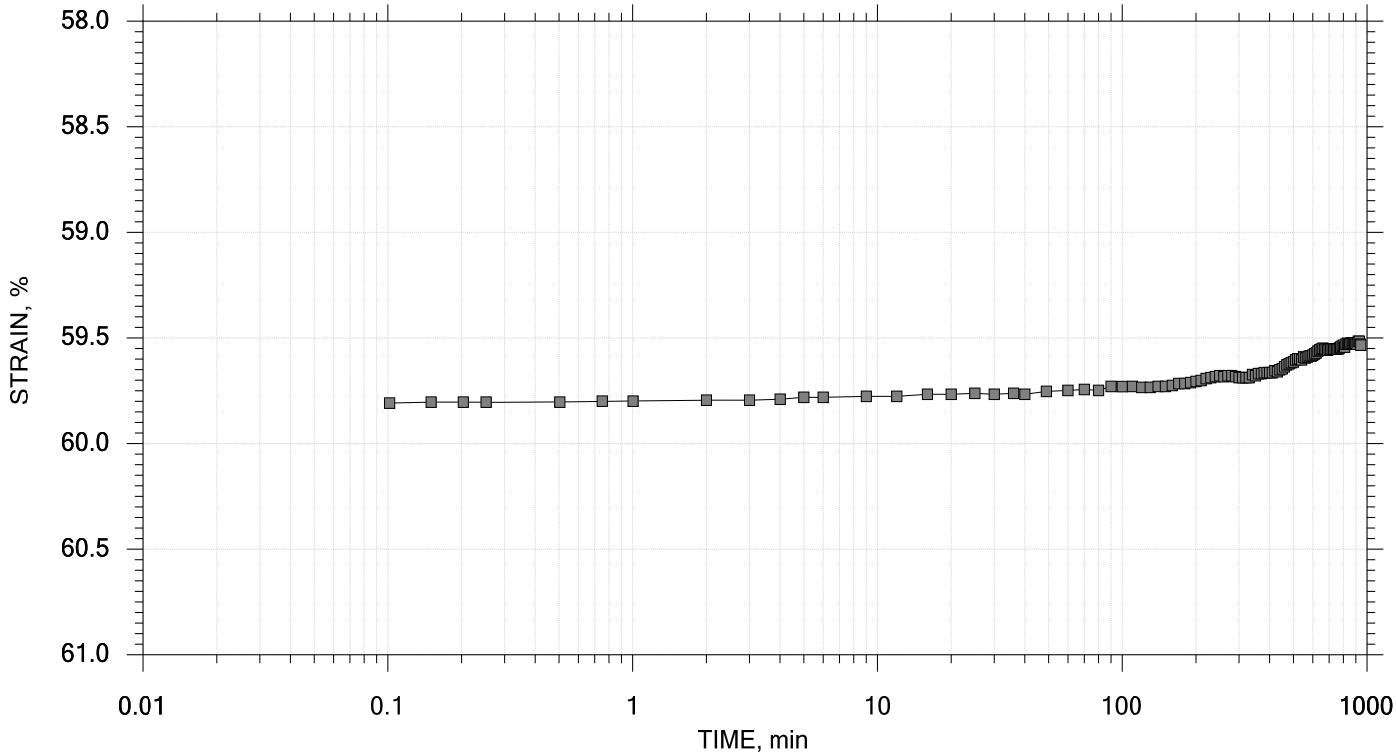
GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-17	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/20/17	Test No.: IP-3
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt with sand		
	Remarks: System X, Swell Pressure = 0.0667 tsf		

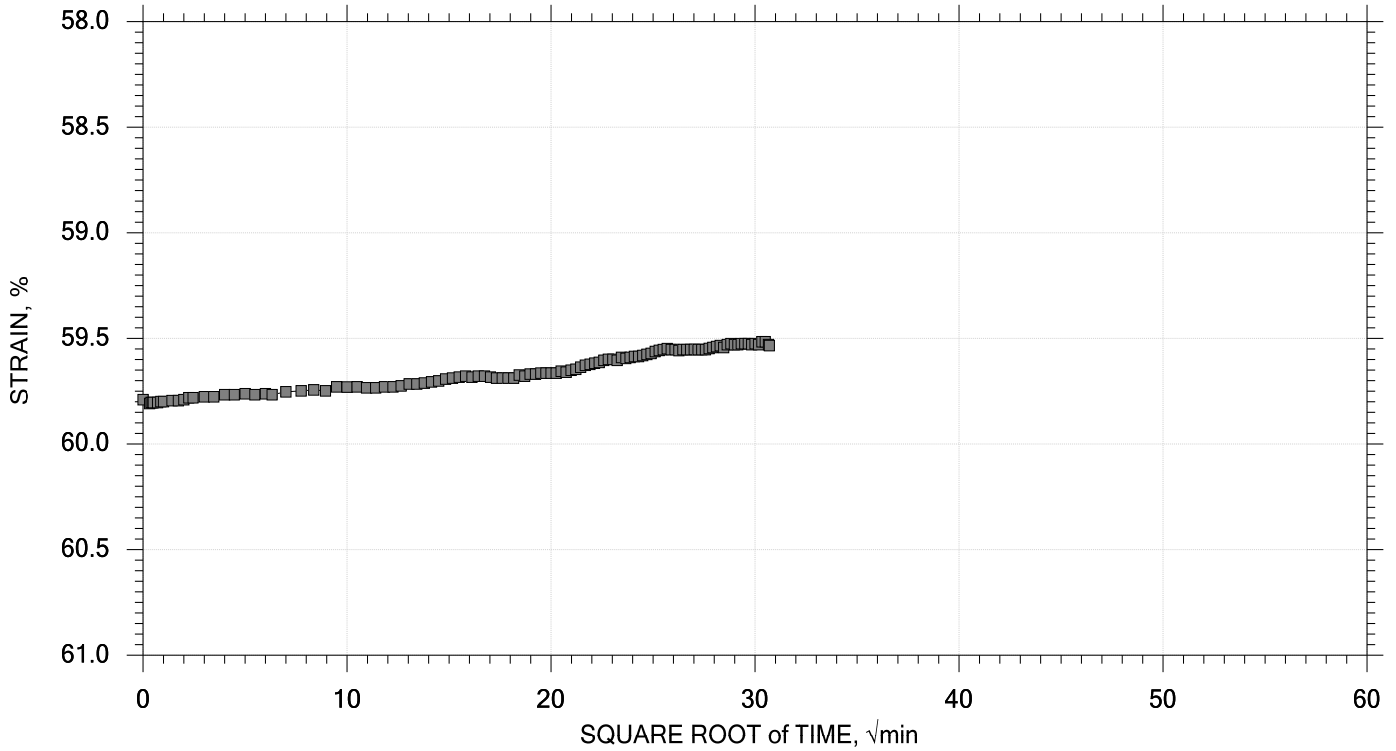
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 15 of 15

Stress: 0.0625 tsf





GeoTesting EXPRESS	Project: Wynn Everett	Location: Everett, MA	Project No.: GTX-306274
	Boring No.: GZ-17	Tested By: md	Checked By: njh
	Sample No.: S1	Test Date: 04/20/17	Test No.: IP-3
	Depth: 18.5-19 ft	Sample Type: intact	Elevation: ---
	Description: Wet, dark gray silt with sand		
	Remarks: System X, Swell Pressure = 0.0667 tsf		

GeoTesting EXPRESS

SOIL CHAIN OF CUSTODY & TEST REQUEST

GeoTesting Express, Inc.
125 Nagog Park
Acton, MA 01720
800 434 1062 Toll Free
978 635 0266 Fax

2358 Perimeter Park Drive, Suite 320
Atlanta, GA 30341
770 645 6575 Tel
770 645 6570 Fax

www.geotesting.com

CLIENT		INVOICE (complete if different from Client)	
Company: AMEC FOSTER WHEELER		Company: AMEC FOSTER WHEELER	
Address: 271 MILL RD		Address: 271 MILL RD	
City, State, Zip: CHELMSFORD, MA		City, State, Zip: CHELMSFORD, MA	
Contact: BRIAN WEYER	Phone: 919-765-0015	Contact: MATT GROVE	Phone: 978-392-5398
E-mail: brian.weyer@ameefw.com	Cell: 919-937-4291	E-mail: matt.grove@amecfw.com	Cell: 978-265-1458

PROJECT		
Project Name: WYNN EVERETT	Client Project #:	Purchase Order#:
Project Location: EVERETT, MA	GTX Sales Order #:	Requested Turnaround:
On-site Contact:	E-mail:	Phone:

SOIL

Boring ID	Sample ID	Depth	Atterberg Limits (ASTM D 4318)	USCS – Classification (ASTM D 2487)	Grain Size: ASTM D 422 ☐ Sieve Only ☐ Sieve & Hydrometer ☑	Density: ASTM D 2937 ☐ ASTM D 7263 ☑	Moisture Content (ASTM D 2216)	Organic Content (ASTM D 2974)	pH (ASTM D 4972)	Specific Gravity (ASTM D 854)	Electrical Resistivity (ASTM G 57)	Proctor Compaction: ☐ Standard – ASTM D 698 ☐ Modified – ASTM D 1557	California Bearing Ratio * (ASTM D 1883)	Direct Shear* (ASTM D 3080)	Triaxial Shear* : ☐ UU – ASTM D 2850 ☐ CU – ASTM D 4767 ☐ CD – ASTM D7181	Incremental Consolidation* (ASTM D 2435)	Permeability/ Hydraulic Conductivity* : Fixed Wall – ASTM D 2434 ☐ Flexible Wall – ASTM D 5084 ☐	Unconfined Compression (ASTM D 2166)	Other:	Other:
GZ-2	S1	-18 to -18.5	/		/	/	/			/						/				
GZ-2	S2	-18.5 to -19																		
GZ-6	S1	-20 to -20.5	/		/	/	/			/						/				
GZ-6	S2	-20.5 to -21																		
GZ-12	S1	-18 to -18.5																		
GZ-12	S2	-18.5 to -19	/		/	/	/			/						/				
GZ-17	S1	-18.5 to -19	/		/	/	/			/						/				
GZ-17	S2	-19 to -19.5																		

*Specify Test Conditions (Undisturbed or Remolded, Density and moisture, Test Normal Loads, Test Confining Stresses, etc.):

Depths are Elevations

MAIN CONTAMINENT IS METALS WITH PETROLEUM PRESENT

*SAMPLES ARE FROM KNOWN MCP SITE *

AUTHORIZE BY SIGNING AND DATING:

SIGNATURE: [signature] PRINT NAME: BRIAN WEYER DATE: 4/6/17

For GTX Use Only
Incoming Sample Inspection Performed ☐
Adverse conditions:

Relinquished By: S. MIZUSAWA	DATE: 4/6/17 (SM) 7	Received By: [signature]	DATE: 4/7/17
	TIME: 6:30		TIME: 8:50AM
Relinquished By:	DATE:	Received By:	DATE:
	TIME:		TIME:

GeoTesting EXPRESS

WARRANTY and LIABILITY

GeoTesting Express (GTX) warrants that all tests it performs are run in general accordance with the specified test procedures and accepted industry practice. GTX will correct or repeat any test that does not comply with this warranty. GTX has no specific knowledge as to conditioning, origin, sampling procedure or intended use of the material.

GTX may report engineering parameters that require us to interpret the test data. Such parameters are determined using accepted engineering procedures. However, GTX does not warrant that these parameters accurately reflect the true engineering properties of the *in situ* material. Responsibility for interpretation and use of the test data and these parameters for engineering and/or construction purposes rests solely with the user and not with GTX or any of its employees.

GTX's liability will be limited to correcting or repeating a test which fails our warranty. GTX's liability for damages to the Purchaser of testing services for any cause whatsoever shall be limited to the amount GTX received for the testing services. GTX will not be liable for any damages, or for any lost benefits or other consequential damages resulting from the use of these test results, even if GTX has been advised of the possibility of such damages. GTX will not be responsible for any liability of the Purchaser to any third party.

Commonly Used Symbols

A	pore pressure parameter for $\Delta\sigma_1 - \Delta\sigma_3$
B	pore pressure parameter for $\Delta\sigma_3$
CAI	CERCHAR Abrasiveness Index
CIU	isotropically consolidated undrained triaxial shear test
CR	compression ratio for one dimensional consolidation
CSR	cyclic stress ratio
C_c	coefficient of curvature, $(D_{30})^2 / (D_{10} \times D_{60})$
C_u	coefficient of uniformity, D_{60}/D_{10}
C_c	compression index for one dimensional consolidation
C_α	coefficient of secondary compression
c_v	coefficient of consolidation
c	cohesion intercept for total stresses
c'	cohesion intercept for effective stresses
D	diameter of specimen
D	damping ratio
D_{10}	diameter at which 10% of soil is finer
D_{15}	diameter at which 15% of soil is finer
D_{30}	diameter at which 30% of soil is finer
D_{50}	diameter at which 50% of soil is finer
D_{60}	diameter at which 60% of soil is finer
D_{85}	diameter at which 85% of soil is finer
d_{50}	displacement for 50% consolidation
d_{90}	displacement for 90% consolidation
d_{100}	displacement for 100% consolidation
E	Young's modulus
e	void ratio
e_c	void ratio after consolidation
e_o	initial void ratio
G	shear modulus
G_s	specific gravity of soil particles
H	height of specimen
H_R	Rebound Hardness number
i	gradient
I_S	Uncorrected point load strength
$I_{S(50)}$	Size corrected point load strength index
H_A	Modified Taber Abrasion
H_T	Total hardness
K_o	lateral stress ratio for one dimensional strain
k	permeability
LI	Liquidity Index
m_v	coefficient of volume change
n	porosity
PI	plasticity index
P_c	preconsolidation pressure
p	$(\sigma_1 + \sigma_3) / 2$, $(\sigma_v + \sigma_h) / 2$
p'	$(\sigma'_1 + \sigma'_3) / 2$, $(\sigma'_v + \sigma'_h) / 2$
p'_c	p' at consolidation
Q	quantity of flow
q	$(\sigma_1 - \sigma_3) / 2$
q_f	q at failure
q_o, q_i	initial q
q_c	q at consolidation
S_r	Post cyclic undrained shear strength
T	temperature
t	time
U, UC	unconfined compression test
UU, Q	unconsolidated undrained triaxial test
u_a	pore gas pressure
u_e	excess pore water pressure
u, u_w	pore water pressure
V	total volume
V_g	volume of gas
V_s	volume of solids
V_s	shear wave velocity
V_v	volume of voids
V_w	volume of water
V_o	initial volume
v	velocity
W	total weight
W_s	weight of solids
W_w	weight of water
w	water content
w_c	water content at consolidation
w_f	final water content
w_l	liquid limit
w_n	natural water content
w_p	plastic limit
w_s	shrinkage limit
w_o, w_i	initial water content
α	slope of q_f versus p_f
α'	slope of q_f versus p_f'
γ_t	total unit weight
γ_d	dry unit weight
γ_s	unit weight of solids
γ_w	unit weight of water
ε	strain
ε_{vol}	volume strain
ε_h, ε_v	horizontal strain, vertical strain
μ	Poisson's ratio, also viscosity
σ	normal stress
σ'	effective normal stress
σ_c, σ'_c	consolidation stress in isotropic stress system
σ_h, σ'_h	horizontal normal stress
σ_v, σ'_v	vertical normal stress
σ'_{vc}	Effective vertical consolidation stress
σ_1	major principal stress
σ_2	intermediate principal stress
σ_3	minor principal stress
τ	shear stress
φ	friction angle based on total stresses
φ'	friction angle based on effective stresses
φ'_r	residual friction angle
φ_{ult}	φ for ultimate strength

APPENDIX C

Calculation Packages

Amec Foster Wheeler Design Calculation or Analysis Cover Sheet

Project : **Wynn Boston Harbor Development**	Calc/Analysis No. **G-001**	Amec Foster Wheeler Project No. **3651-16-0042**
Title: **Bearing Capacity of Soft Sediments**		

Computer Software and Version No.

Purpose and Objective

Determine the bearing capacity of the soft sediment located within the embayment against bearing failure of the proposed subaqueous cap of sand and gravel. Analysis includes local failure mechanisms.

Summary of Conclusion

Based on the soil properties used for these analyses, the sediments will provide sufficient support for the proposed cap in the 3 subject areas of the embayment. Factors of safety against local bearing failure range from 0.8 to 6.8. Factors of safety against bearing failure analyzing the cohesion only range from 1.1 to 8.6.

A factor of safety less than 1 was calculated using the local bearing capacity failure method in the NDA. Although the factor is less than one, the calculation assumes the load is applied all at one time. If the cap is placed, as recommended, in thin lifts, the excess pore pressures will be allowed to dissipate as the cap is constructed and reduce the potential for a bearing capacity failure.

Revision Log

Rev. No.	Revision Description:
0	Original Issue

Rev. No.	Originator (Print) Brian Weyer P.E. Sign / Date	Checker (Print) David Garrett, P.E. Sign / Date	Independent Technical Reviewer (Print) J. Allan Tice, P.E. Sign / Date
0	5/16/17	5-16-17	5/16/17

Contents

1.0 Purpose

Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) was retained by Wynn Everett (Wynn) to develop the design for a subaqueous cap within the embayment at the Wynn Everett development, being constructed at the former Everett Staging Yard in Everett, Massachusetts.

The purpose of this calculation package is to evaluate the bearing capacity of the contaminated, soft sediments that will be capped within the embayment. Analysis will include both general and local failure mechanisms in three main areas of the embayment including:

- Main Channel
- Tidal Flats
- Navigational Dredge Area

2.0 Proposed Cap Design Criteria

Due to the presence of contamination, Wynn proposes that the subgrade materials in the embayment be capped to provide a suitable environment for benthic organisms. The cap will extend from the NE end of the embayment to the mouth at the Mystic River. Three proposed cap areas within the embayment are detailed below with the proposed cap material. In all three cap areas, the proposed clean cap thickness is 18 inches with a 6 inch mixing zone as determined from sediment-cap mixing calculations. For the purposes of these calculations, 24 inches of material is assumed to be placed to account for the clean cap and mixing zone.

- Main Channel Area: Proposed plan is to cap the existing subgrade sediment with approximately 24 inches of Coarse Sand, per erosion calculations by others. Tentative gradation of material is tabulated below:

Sieve Size Mesh	% Passing Target Value	% Passing Tolerance
No. 4 (4.75mm)	100	-
No. 10 (2.00mm)	78	-
No. 20 (0.841mm)	16	-
No. 200 (0.074mm)	5	-

- Navigational Dredge Area: Proposed plan is to dredge this area to El. -16.5 feet NAVD88, and cap the remaining subgrade sediment with approximately 24 inches of medium gravel, per erosion calculations by others. Tentative gradation of material is tabulated below:

Sieve Size Mesh	% Passing Target Value	% Passing Tolerance
1" (25.0mm)	100	0
3/8 in. (9.51mm)	78	±10
No. 4 (4.75mm)	16	±10
No. 200 (0.074mm)	5	±5

- Tidal Flat Area: Proposed plan is to excavate and replace to match existing grade between Mean High Water (MHW) elevation and Mean Low Water (MLW) elevation. The tentative cap material is sandy silt, per others, with an expected cap thickness of 24 inches.

Sieve Size Mesh	% Passing Target Value	% Passing Tolerance
No. 4 (4.75mm)	95-100	-
No. 10 (2.00mm)	90-95	-
No. 20 (0.841mm)	75-95	-
No. 200 (0.074mm)	60-75	-

3.0 Assumptions

Listed below are assumption used in the presented calculations:

1. Bearing failure occurs by local bearing failure mechanisms.

2. The soil properties and parameters for analysis are based on geotechnical laboratory testing (performed by GeoTesting Express on Amec Foster Wheeler samples) performed on samples obtained from vibracore samples obtained from within the embayment. Laboratory testing includes index testing, consolidation and laboratory miniature vane shear. Core locations are shown on the attached Figure 1.

3. Sediment and cap materials are submerged in the Main channel area and navigational dredge area. Sediment is submerged but cap materials are not submerged in the Tidal Flats area.

4. Cap materials will be placed in 3 foot wide strips at the surface of the in place sediments. Cap materials, gradations and proposed thicknesses as detailed in Section 2.0 will be used.

5. Analysis is performed using a 24 inch thick cap to provide allowance for a 6 inch thick mixing zone between the clean cap materials and the soft sediments.

4.0 Soil Properties

Laboratory testing was performed on selected samples recovered during the subsurface exploration performed by Amec Foster Wheeler in March and April of 2017. The following laboratory tests were performed by GeoTesting Express of Acton, Massachusetts. All tests were performed in accordance with applicable ASTM standards.

- Grain Size Distribution with Hydrometer Analysis (ASTM D422)
- Atterberg Limits (ASTM D4318)
- Moisture Content (ASTM D2216)
- Specific Gravity (ASTM D854)
- Density (ASTM D7263)
- Incremental 1-D Consolidation (ASTM D2435)

The following table represents the soil properties used for calculation of bearing capacity. Soil properties are based on laboratory testing results and typical values from Reference 1:

Parameter	**Equation Symbol**	**Value Used**	**Units**	**Comments**
Cap Properties				
Thickness of Cap (Sand Layer)	D_{cap1}	2.0	feet	Proposed value.
Thickness of Cap (Gravel Layer)	D_{cap2}	2.0	feet	Proposed value.
Width of cap placed per pass	B	3.0	feet	Assumed value.
Foundation (Subgrade) Depth below Sediment Surface	D_f	0.0	feet	Design value.
Cap (Sand) Submerged Unit Weight	γ_{sand}	60.0	pcf	
Cap (Gravel) Submerged Unit Weight	γ_{gravel}	65.0	pcf	
Parameter	**Equation Symbol**	**Value Used**	**Units**	**Comments**
Sediment Properties				
Sediment Submerged Unit Weight	γ_{sub}	40.0	pcf	Assumed value. To confirm with laboratory testing results when received.
Cohesion (Main Channel Area)	c	100.0	psf	Values from field data. Range from 101.3 to 447.8 psf.
Cohesion (Tidal Flat Area)	c	300.0	psf	Values from field data. Range from 122.9 – 553.13 psf.
Cohesion (Navigational Dredge Area)	c	45.0	psf	Values from field data. Range from 22.4 to 268.5 psf.
Angle of internal friction (Main Channel Area)	φ	17	degrees	Conservative value selected based on subaqueous conditions of sediment.
Angle of internal friction (Tidal Flat Area)	φ	20	degrees	Conservative value selected based on subaqueous conditions of sediment.
Angle of internal friction (Navigational Dredge Area)	φ	15	degrees	Conservative value selected based on subaqueous conditions of sediment.

5.0 Bearing Capacity Calculations

Terzaghi's bearing capacity theory for continuous footings was used to calculate the bearing capacity of the soft sediments (as shown in Equation 1 and detailed in Reference 2). Values calculated are based on an average unit weight and cohesion and represent the average bearing capacity across the designated areas. Calculations were performed for the 3 areas of the embayment referenced in Section 1.0.

Two cases of bearing failure were analyzed for each of the 3 areas. Local bearing failure represents the most probable failure mechanism for the proposed cap due to the soft nature of the subgrade sediments.The second method represents a conservative situation where the sediment materials are analyzed with only cohesive strength and no frictional strength. This analysis case is conservative, but may more closely represent the conditions in the Navigational Dredge Area, post dredging. It is possible that

the dredging operations may disturb the upper portion of the subgrade sediments, reducing the in-situ strength of the deposits. In both analysis cases, it is assumed that the cap will behave like a continuous footing.

The local bearing failure case was calculated using Equation 1 for continuous footings due to the soft nature of the sediments.

$$q_u = \frac{2}{3} cN_c' + qN_q' + 0.5\gamma BN_\gamma' \qquad (1)$$

Where:

q_u = ultimate bearing capacity
c = cohesion of soil
γ = unit weight of soil
q = γD_f
N_c', N_q', N_γ' = modified bearing capacity factors (non-dimensional)

A modified version of Terzhagi's bearing capacity method for local failure detailed in Reference 3 was also utilized. This method is the most conservative as it does not take into account any frictional resistance of the material and relies solely on the cohesive strength. The materials within the embayment are typically elastic silt that typically have some frictional strength. Clay content of the samples was approximately 30-40 percent. This method was used as a conservative estimate assuming that the subgrade materials were disturbed during dredging operations (within the navigational dredge area) prior to placement of cap materials. Equation 2 was used to calculate the ultimate bearing capacity.

$$q_u = \frac{2}{3} c'N_c \qquad (2)$$

Where:

q_u = ultimate bearing capacity
c' = cohesion of soil
N_c = $2+\pi$

To calculate the FOS against bearing failure, the weight of the cap placed on top of the soft sediments was calculated with Equation 3. See Table 1 for description of terms used in the equation.

$$w_{cap} = \left(D_{cap1} \times \gamma_{sand}\right) + \left(D_{cap2} \times \gamma_{gravel}\right) \qquad (3)$$

The FOS against bearing capacity failure for all 3 analysis cases was calculated using Equation 4. For the cohesion only case, the ultimate bearing capacity is not divided by 3. It is assumed that this case is already conservative and does not warrant the need to reduce the capacity as the other 2 cases.

$$FOS = \frac{q_u/3}{w_{cap}} \qquad (4)$$

Where:

q_u = ultimate bearing capacity
w_{cap} = weight of cap

6.0 Conclusions and Results

Based on the soil properties used for these analyses, the sediments will provide sufficient support for the proposed cap in the 3 subject areas of the embayment. The following table presents the bearing capacity results for the 3 areas and 2 cases analyzed.

A factor of safety less than 1 was calculated using the local bearing capacity failure method in the NDA. Although the factor is less than one, the calculation assumes the load is applied all at one time. If the cap is placed, as recommended, in thin lifts, the potential for a bearing capacity failure will be reduced.

	Factor of Safety	
Area	Local Bearing Capacity	Cohesion Only Bearing Capacity
Main Channel	2.1	2.9
Tidal Flat	6.8	8.6
Navigational Dredge Area	0.8	1.1

7.0 References

1. Holtz R. and Kovacs, W. *An Introduction to Geotechnical Engineering.* Prentice-Hall, Inc. Englewood Cliffs, New Jersey. 1981.

2. Das, Braja M. *Principles of Foundation Engineering: Fifth Edition*. Brooks/Cole. Pacific Grove, California. 2004.

3. Palermo, M., Maynord, S., Miller, J., and Reible, D. 1998. “Guidance for In-Situ Subaqueous Capping of Contaminated Sediments,” EPA 905-B96-004. Great Lakes National Program Office, Chicago, IL.

BEARING CAPACITY CALCULATIONS

Project Name: Wynn Boston Harbor
Project Number: 3651-16-0042

CAP PROPERTIES

Thickness of Cap (Sand Layer)	2 feet	2 feet in Main Channel and Intertidal Flats
Thickness of Cap (Gravel Layer)	2 feet	2 feet in NDA
Cap (sand) submerged unit weight	60 pcf	
Cap (gravel) submerged unit weight	68 pcf	
Width of Cap placed per pass	3 feet	
Foundation Depth below sediment surface	0 feet	
Weight of Cap (NDA)	136 psf	
Weight of Cap (MC and Intertidal)	120 psf	

				Bearing Capacity Factors			Modified Bearing Capacity Factors						
Area	γ_{sub} pcf	**Cohesion** psf	ϕ degrees	N_c	N_q	N_γ	N_c'	N_q'	N_γ'	**Local Bearing Capacity** psf	**Cohesion Only Bearing Capacity** psf	**FOS Local Bearing Capacity**	**FOS Cohesion Only**
Main Channel	40	100	17	14.6	5.45	2.18	10.47	3.13	0.76	744	342.84	2.1	2.9
Tidal Flats	40	300	20	17.69	7.44	3.64	11.85	3.88	1.12	2438	1028.51	6.8	8.6
Navigational Dredge Area	40	45	15	12.86	4.45	1.52	9.67	2.73	0.57	324	154.28	0.8	1.1

Prepared By: BJW Date: 5/10/2017
Checked By: Date: 5-16-17

Amec Foster Wheeler Design Calculation or Analysis Cover Sheet

Project : **Wynn Boston Harbor Development**	Calc/Analysis No. **G-002**	Amec Foster Wheeler Project No. **3651-16-0042**
Title: **Consolidation of Soft Sediments**		

Computer Software and Version No.

Purpose and Objective

Determine the magnitude of consolidation of the materials in the Navigational Dredge Area (NDA) and Main Channel areas. The Tidal Flat area was not analyzed as the quantity of materials dredged are being replaced with clean cap material and the net change in pressure is minimal. Recompression settlement is considered for the NDA due to removal of material with dredging and primary consolidation settlement is considered for the NDA.

Summary of Conclusion

Recompression consolidation settlements in the NDA should be minimal, in most cases less than 0.1 inches. In most cases, the load of material being removed during the dredging process is greater than the load of the applied cap. It is not anticipated that the proposed cap will experience damage from consolidation settlement of the soft, subgrade sediments.

Consolidation settlements in the Main Channel area may range in magnitude from 11 to 13 inches. Test data from location GZ-7 was an outlier and calculations showed roughly 5.5 inches of settlement. This data is not considered in the range of settlement magnitude. The estimated settlements may occur over a period of 0.5 to 2.5 years. Settlements of these magnitudes are not expected to compromise the effectiveness of the cap.

Revision Log

Rev. No.	Revision Description:
0	Original Issue

Rev. No.	Originator (Print) Brian Weyer P.E. Sign / Date	Checker (Print) David Garrett, P.E. Sign / Date	Independent Technical Reviewer (Print) J. Allan Tice, P.E. Sign / Date
0	5/17/17	5.17.17	5/17/17

Contents

1.0 Purpose

Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) was retained by Wynn Everett (Wynn) to develop the design for a subaqueous cap within the embayment at the Wynn Everett development, being constructed at the former Everett Staging Yard in Everett, Massachusetts.

The purpose of this calculation package is to evaluate the consolidation of the soft sediments under the load of the proposed cap within the embayment. Two consolidation scenarios were performed based on the proposed subaqueous cap in the 3 areas of the embayment. Consolidation settlement in the tidal flat areas is not considered a concern as the proposed plan is to dredge 24 inches of material and replace with 24 inches of clean material (sandy silt; see Section 2.0 for material gradation).

The first scenario includes consolidation by recompression in the Navigational Dredge Area (NDA). Recompression of the soft sediments was evaluated in this area due to the net change in stress from the cap construction being less than the pressure of the overburden sediment being removed during the dredging process. Due to the dredging operations, the characteristics of the sediment in the NDA will behave more in a recompression nature than virgin compression.

The second scenario evaluated was for the Main Channel area. In this area, the proposed cap includes approximately 24 inches of coarse sand. The gradation of the coarse sand material is detailed in Section 2.0. Due to the increase in net pressure from construction of the cap, this area was evaluated based on virgin compression. The laboratory test data from the NDA was used for the evaluation as no consolidation data from the Main Channel area was available. Based on the field undrained shear strength testing performed in April 2017, the sediments in the Main Channel area had a higher shear strength than those in the NDA. Due to the higher strength, using the consolidation data from the NDA provides conservative estimates of consolidation for the soft sediments below the cap in the Main Channel area.

2.0 Proposed Cap Design Criteria

Due to the presence of contamination, Wynn proposes that the subgrade materials in the embayment be capped to provide a suitable environment for benthic organisms. The cap will extend from the NE end of the embayment to the mouth at the Mystic River. Two of the three proposed cap areas within the embayment are detailed below with the proposed cap material. Of the three areas, this calculation package addresses the NDA and Main Channel Area. Based on sediment-cap mixing calculations, the proposed thickness of the cap in all 3 subject areas of the embayment will need to be a minimum of 24 inches to account for the mixing.

- Navigational Dredge Area: Proposed plan is to dredge this area to El. -16.5 feet NAVD88, and cap the remaining subgrade sediment with approximately 24 inches of medium gravel, per erosion calculations by others at Amec Foster Wheeler. Gradation of material is tabulated below:

Sieve Size Mesh	% Passing Target Value	% Passing Tolerance
1" (25.0mm)	100	0
3/8 in. (9.51mm)	78	±10
No. 4 (4.75mm)	16	±10
No. 200 (0.074mm)	5	±5

- Main Channel Area: Proposed plan is to cap the existing subgrade sediment with approximately 24 inches of Coarse Sand, per erosion calculations by others at Amec Foster Wheeler. Gradation of material is tabulated below:

Sieve Size Mesh	% Passing Target Value	% Passing Tolerance
No. 4 (4.75mm)	100	-
No. 10 (2.00mm)	78	-
No. 20 (0.841mm)	16	-
No. 200 (0.074mm)	5	-

3.0 Assumptions

Listed below are assumption used in the presented calculations:

1. Consolidation of the soft sediments within the NDA is initiated by placement of the cap, consisting of 24 inches of medium gravel.

2. Consolidation of the soft sediments within the Main Channel Area is initiated by placement of the cap, consisting of 24 inches of coarse sand.

3. Due to the uncertainty of the layering of the sediment deposits, 1-way drainage was assumed. To estimate the shortest time to complete consolidation, 2-way drainage was also used.

4. The sediment layer is 20 feet thick for the purpose of this analysis, based on waterfront borings performed by GZA GeoEnvironmental, Inc. in 2015.

5. Consolidation is evaluated based on the laboratory test results of 4 incremental consolidation tests performed on sediment samples obtained from the embayment. All samples were obtained from within the NDA.

6. The sediment and cap are all submerged.

7. Based on the amount of material being dredged out of the NDA area, the consolidation analysis only considers recompression based on the recompression curve results from laboratory testing. The current dredging plan removes enough material that the net pressure change in all of the evaluated areas is less than the pressure applied by the in-situ sediments above cap subgrade elevation. Due to the proposed dredging, it is assumed that the remaining materials will undergo recompression under the lesser weight of the cap materials.

8. The laboratory consolidation data obtained from samples taken in the NDA will provide conservative values for settlement in the Main Channel area because the undrained shear strengths of the Main Channel area are higher than those in the NDA, indicating a stiffer, less compressible material.

9. C_c values from the laboratory data were reduced by 50% for calculation of primary settlement in the Main Channel area. The percent consolidation is 50% for calculation of time-rate. Using values greater than 50% will provide overly conservative values of consolidation settlement. Soil Properties

Laboratory testing was performed on selected samples recovered during the subsurface exploration performed by Amec Foster Wheeler in March and April of 2017. The following laboratory tests were performed by GeoTesting Express of Acton, Massachusetts. All tests were performed in accordance with applicable ASTM standards.

- Grain Size Distribution with Hydrometer Analysis (ASTM D422)
- Atterberg Limits (ASTM D4318)
- Moisture Content (ASTM D2216)
- Specific Gravity (ASTM D854)
- Density (ASTM D7263)
- Incremental 1-D Consolidation (ASTM D2435)

The following table represents the soil properties used for calculation of consolidation of the soft sediments. Soil properties are based on laboratory testing results and typical values from Reference 1:

Parameter	**Equation Symbol**	**GZ-2**	**GZ-6**	**GZ-12**	**GZ-17**	**Units**
Initial Void Ratio	e_o	8.43	14.4	7.04	4.04	-
Compression Index	C_c	2.82	5.55	2.82	1.46	-
Recompression Index	C_r	0.01	0.03	0.01	0.04	-
Coefficient of Consolidation	c_v	48.88	32.80	9.62	34.69	ft^2/year
Sediment saturated unit weight	γ_{sat}	75.61	102.0	78.13	83.93	pcf
Cap (Sand) Submerged Unit Weight	γ_{sand}	60.0	60.0	60.0	60.0	pcf
Cap (Gravel) Submerged Unit Weight	γ_{gravel}	65.0	65.0	65.0	65.0	pcf
Percent Consolidation	U	50	50	50	50	%

The c_v values were selected from laboratory test data corresponding to the load increment around 0.06 tsf. This test data point in each of the tests closely resembles the pressure applied by the proposed cap.

4.0 Consolidation Calculations

Terzaghi's one dimensional consolidation theory was used to calculate the recompression consolidation in the NDA based on the recompression data from laboratory testing. Primary consolidation was only considered in the Main Channel area where no dredging is being performed. In the NDA, primary consolidation was not considered as the change in stress on the material is within the recompression zone of the material at subgrade depth. The theory is detailed in Reference 1. The following equations were used to perform these calculations. The sediments in the embayment are typically unconsolidated and very soft in consistency.

Recompression consolidation was calculated using Equation 1.

$$R_c = C_r \frac{H_o}{1+e_o} log \frac{\sigma_{vo}' + \Delta\sigma_v}{\sigma_{vo}} \qquad (1)$$

Where:

R_c	=	Recompression consolidation (feet)
C_r	=	Recompression Index
H_o	=	Thickness of consolidated layer (feet)
σ_{vo}'	=	Effective overburden pressure (psf)
$\Delta\sigma'$	=	Change in effective overburden pressure (psf)

Primary (virgin) consolidation was calculated for the Main Channel Area using equation 1, but substituting C_r with C_c from the consolidation curves.

The Time-rate of consolidation equation was used to calculate the time period to achieve the assumed percent of consolidation. The equation to calculate the time-rate of consolidation is presented in Equation 2.

$$T_v = \frac{c_v * t}{H_{dr}^2} \qquad (2)$$

Where:

c_v	=	Coefficient of Consolidation (ft^2/day)
t	=	Time to reach percent consolidation
H_{dr}	=	Length of drainage path (feet)
T_v	=	Time Factor

5.0 Conclusions and Results

Navigational Dredge Area

Based on the soil properties used for these analyses, consolidation settlement, and recompression consolidation settlements in the NDA should be minimal, in most cases less than 0.1 inches. In most cases, the load of material being removed during the dredging process is greater than the load of the applied cap. It is not anticipated that the proposed cap will experience damage from consolidation settlement of the soft, subgrade sediments.

Main Channel Area

Based on calculations using the primary consolidation theory, it is estimated that consolidation settlements in the Main Channel area may range in magnitude from 11 to 13 inches. Test data from location GZ-7 was an outlier and calculations showed roughly 5.5 inches of settlement. This data is not considered in the range of settlement magnitude. The estimated settlements may occur over a period of 0.5 to 2.5 years. Settlements of these magnitudes are not expected to compromise the effectiveness of the cap.

6.0 References

1. Holtz R. and Kovacs, W. *An Introduction to Geotechnical Engineering.* Prentice-Hall, Inc. Englewood Cliffs, New Jersey. 1981.

2. Das B. *Principles of Geotechnical Engineering: Seventh Edition.* Cengage Learning. Stamford, Connecticut. 2010.

RECOMPRESSION CONSOLIDATION CALCULATIONS

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Sample Information

Core:	GZ-2
Location:	Navigational Dredge Area
Material	Elastic Silt (MH)
Current Mudline Elev. (NAVD88)	-10
Proposed Cap Subgrade Elev. (NAVD88)	-16.5

Proposed Cap	Thickness (ft)	γ_{sat} (psf)	γ_{sub} (psf)
Sand	0.0	120	57.6
Gravel	2.0	130	67.6

Parameters

Sediment Saturated Unit Weight	75.61	psf
Sediment Submerged Unit Weight	13.21	psf
Cap Load	135.2	psf
Pressure removed from dredging	85.865	psf
Net change in pressure ($\Delta\sigma_v$)	49.335	psf
C_r	0.01	
H_o	20	ft
e_o	8.43	
σ_{vo}'	132.1	psf

Total Recompression Settlement **0.04 inches**

Prepared By: BJW Date: 5/10/2017

Checked By: Date: 5-17-17

RECOMPRESSION CONSOLIDATION CALCULATIONS

amec foster wheeler

Sample Information

Core:	GZ-6
Location:	Navigational Dredge Area
Material	Elastic Silt (MH)
Current Mudline Elev. (NAVD88)	-10
Proposed Cap Subgrade Elev. (NAVD88)	-16.5

Proposed Cap	Thickness (ft)	γ_{sat} (psf)	γ_{sub} (psf)
Sand	0.0	120	57.6
Gravel	2.0	130	67.6

Parameters

Sediment Saturated Unit Weight	75.61	psf
Sediment Submerged Unit Weight	13.21	psf
Cap Load	135.2	psf
Pressure removed from dredging	85.865	psf
Net change in pressure ($\Delta\sigma_v$)	49.335	psf
C_r	0.03	-
H_o	20	ft
e_o	14.4	-
σ_{vo}'	132.1	psf

Total Recompression Settlement **0.06 inches**

Prepared By: BJW Date: 5/10/2017

Checked By: Date: 5-17-17

RECOMPRESSION CONSOLIDATION CALCULATIONS

amec foster wheeler

Sample Information

Core:	GZ-12
Location:	Navigational Dredge Area
Material	Elastic Silt (MH)
Current Mudline Elev. (NAVD88)	-8
Proposed Cap Subgrade Elev. (NAVD88)	-16.5

Proposed Cap	Thickness (ft)	γ_{sat} (psf)	γ_{sub} (psf)
Sand	0.0	120	57.6
Gravel	2.0	130	67.6

Parameters

Sediment Saturated Unit Weight	75.61	psf
Sediment Submerged Unit Weight	13.21	psf
Cap Load	135.2	psf
Pressure removed from dredging	112.285	psf
Net change in pressure ($\Delta\sigma_v$)	22.915	psf
C_r	0.01	-
H_o	20	ft
e_o	7.04	-
σ_{vo}'	132.1	psf

Total Recompression Settlement **0.02 inches**

Prepared By: BJW Date: 5/10/2017

Checked By: Date: 5-17-17

RECOMPRESSION CONSOLIDATION CALCULATIONS

amec foster wheeler

Sample Information

Core:	GZ-17
Location:	Navigational Dredge Area
Material	Elastic Silt (MH)
Current Mudline Elev. (NAVD88)	-6
Proposed Cap Subgrade Elev. (NAVD88)	-16.5

Proposed Cap	Thickness (ft)	γ_{sat} (psf)	γ_{sub} (psf)
Sand	0.0	120	57.6
Gravel	2.0	130	67.6

Parameters

Sediment Saturated Unit Weight	75.61	psf
Sediment Submerged Unit Weight	13.21	psf
Cap Load	135.2	psf
Pressure removed from dredging	138.705	psf
Net change in pressure ($\Delta\sigma_v$)	-3.505	psf
C_r	0.01	-
H_o	20	ft
e_o	8.43	-
σ_{vo}'	132.1	psf

Total Recompression Settlement **0.00 inches**

Prepared By: BJW Date: 5/10/2017

Checked By: Date: 5-17-17

PRIMARY CONSOLIDATION CALCULATIONS

amec foster wheeler

Sample Information

Core:	GZ-2	
Location:	Main Channel Area	
Material	Elastic Silt (MH)	
Current Mudline Elev. (NAVD88)	-10	
Proposed Cap Subgrade Elev. (NAVD88)	-10	Assumed value to make Δp=0. Not representative of actual Main Channel subgrade elevation

Proposed Cap	**Thickness (ft)**	**γ_{sat} (psf)**	**γ_{sub} (psf)**
Sand	0.0	120	57.6
Gravel	2.0	130	67.6

Parameters

Sediment Saturated Unit Weight	75.61	psf
Sediment Submerged Unit Weight	13.21	psf
Cap Load	135.2	psf
Pressure removed from dredging	0	psf
Net change in pressure ($\Delta\sigma_v$)	135.2	psf
C_c	1.41	
H_o	20	ft
e_o	8.43	
σ_{vo}'	132.1	psf

Total Primary Consolidation Settlement **10.98 inches**

Prepared By: BJW Date: 5/10/2017

Checked By: Date: 5-17-17

PRIMARY CONSOLIDATION CALCULATIONS

amec foster wheeler

Sample Information

Core:	GZ-6	
Location:	Main Channel Area	
Material	Elastic Silt (MH)	
Current Mudline Elev. (NAVD88)	-10	
Proposed Cap Subgrade Elev. (NAVD88)	-10	Assumed value to make Δp=0. Not representative of actual Main Channel subgrade elevation

Proposed Cap	Thickness (ft)	γ_{sat} (psf)	γ_{sub} (psf)
Sand	0.0	120	57.6
Gravel	2.0	130	67.6

Parameters

Sediment Saturated Unit Weight	75.61	psf
Sediment Submerged Unit Weight	13.21	psf
Cap Load	135.2	psf
Pressure removed from dredging	0	psf
Net change in pressure ($\Delta\sigma_v$)	135.2	psf
C_c	2.78	-
H_o	20	ft
e_o	14.4	-
σ_{vo}'	132.1	psf

Total Primary Consolidation Settlement **13.26 inches**

Prepared By: BJW Date: 5/10/2017

Checked By: Date: 5-17-17

PRIMARY CONSOLIDATION CALCULATIONS

amec foster wheeler

Sample Information

Core:	GZ-12	
Location:	Main Channel Area	
Material	Elastic Silt (MH)	
Current Mudline Elev. (NAVD88)	-8	
Proposed Cap Subgrade Elev. (NAVD88)	-8	Assumed value to make Δp=0. Not representative of actual Main Channel subgrade elevation

Proposed Cap	Thickness (ft)	γ_{sat} (psf)	γ_{sub} (psf)
Sand	0.0	120	57.6
Gravel	2.0	130	67.6

Parameters

Sediment Saturated Unit Weight	75.61	psf
Sediment Submerged Unit Weight	13.21	psf
Cap Load	135.2	psf
Pressure removed from dredging	0	psf
Net change in pressure ($\Delta\sigma_v$)	135.2	psf
C_c	1.41	-
H_o	20	ft
e_o	7.04	-
σ_{vo}'	132.1	psf

Total Primary Consolidation Settlement **12.88 inches**

Prepared By: BJW Date: 5/10/2017

Checked By: Date: 5-17-17

PRIMARY CONSOLIDATION CALCULATIONS

amec foster wheeler

Sample Information

Core:	GZ-17	
Location:	Main Channel Area	
Material	Elastic Silt (MH)	
Current Mudline Elev. (NAVD88)	-6	
Proposed Cap Subgrade Elev. (NAVD88)	-6	Assumed value to make Δp=0. Not representative of actual Main Channel subgrade elevation

Proposed Cap	Thickness (ft)	γ_{sat} (psf)	γ_{sub} (psf)
Sand	0.0	120	57.6
Gravel	2.0	130	67.6

Parameters

Sediment Saturated Unit Weight	75.61	psf
Sediment Submerged Unit Weight	13.21	psf
Cap Load	135.2	psf
Pressure removed from dredging	0	psf
Net change in pressure ($\Delta\sigma_v$)	135.2	psf
C_c	0.73	-
H_o	20	ft
e_o	8.43	-
σ_{vo}'	132.1	psf

Total Primary Consolidation Settlement **5.69 inches**

Prepared By: BJW Date: 5/10/2017

Checked By: _____ Date: 5-17-17

TIME-RATE OF CONSOLIDATION

Boring	Degree of Consolidation	Time Factor T_v	Drainage Path H_{dr}	Coefficient of Consolidation c_v	Load Increment for c_v (tsf)	Time t (years)	Time t (days)
GZ-2	50	0.197	20	48.88	0.0678	1.612	588
GZ-6	50	0.197	20	32.8	0.0656	2.402	877
GZ-12	50	0.197	20	9.62	0.0654	8.191	2990
GZ-17	50	0.197	20	34.69	0.0667	2.272	829

Boring	Degree of Consolidation	Time Factor T_v	Drainage Path H_{dr}	Coefficient of Consolidation c_v	Load Increment for c_v (tsf)	Time t (years)	Time t (days)
GZ-2	50	0.197	10	48.88	0.0678	0.403	147
GZ-6	50	0.197	10	32.8	0.0656	0.601	219
GZ-12	50	0.197	10	9.62	0.0654	2.048	747
GZ-17	50	0.197	10	34.69	0.0667	0.568	207

Prepared By: BJW Date: 5/10/2017

Checked By: _____ Date: 5-17-17

amec foster wheeler

Amec Foster Wheeler Design Calculation or Analysis Cover Sheet

Project : Wynn Boston Harbor Development	Calc/Analysis No. G-003	Amec Foster Wheeler Project No. 3651-16-0042
Title: Sediment-Cap Mixing		

Computer Software and Version No.

Purpose and Objective

Determine appropriate ranges of gradation for a sand filter between three proposed sand and gravel caps and the underlying sediment within the embayment. Filter layers, when properly placed, will minimize the mixing of dissimilar soils. Estimate mixing layer thicknesses for the different cap designs.

Summary of Conclusion

The gradation of Coarse Sand tentatively planned for the Main Channel appears suitable for the initial six-inch thick layer for both the Main Channel and the Navigational Dredge Area. Estimated mixing zone thickness is 2 inches (or more) in the Main Channel, 4 to 6 inches in the NDA. The initial six-inch layer in the NDA will be sacrificial for stiffening the upper sediments for support of the Medium Gravel cover. The Sandy Silt proposed for the Tidal Flats area will experience negligible mixing. All caps are to be 24 inches thickness and placed in a minimum of four gradual, evenly dispersed layers.

Revision Log

Rev. No.	Revision Description:
0	Original Issue

Rev. No.	Originator (Print)	Checker (Print)	Independent Technical Reviewer (Print)
0	David Garrett, P.E.	Brian J. Weyer, P.E.	J. Allan Tice, P.E.
	Sign / Date 5-17-2017	Sign / Date 5/17/17	Sign / Date 5/17/17

Contents

1.0 Purpose

Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) was retained by Wynn Everett (Wynn) to develop the design for a subaqueous cap within the embayment at the Wynn Everett development, being constructed at the former Everett Staging Yard in Everett, Massachusetts.

The purpose of this calculation package is to evaluate sand filter designs for three different cap sections, to be used for capping the contaminated, soft sediments present after dredging within the embayment. Estimates for mixing layer thicknesses will be given for these areas:

- Main Channel
- Tidal Flats
- Navigational Dredge Area

2.0 Proposed Cap Design Criteria

Due to the presence of contamination, it is proposed that the subgrade materials in the embayment be capped to provide a suitable environment for benthic organisms. The cap will extend from the NE end of the embayment to the mouth at the Mystic River. Three proposed cap areas within the embayment are detailed below with the proposed cap material. The proposed clean cap thickness within the Main Channel Area and the NDA is 18 inches. In the tidal flat area, the proposed clean cap thickness is 24 inches. This calculation package will determine the need for additional material based on mixing of clean cap material with the contaminated sediments in the embayment.

- Main Channel Area: Proposed plan is to cap the existing subgrade sediment with approximately 18 inches of Coarse Sand, per erosion calculations by others. Tentative gradation of material is tabulated below:

Sieve Size Mesh	% Passing Target Value	% Passing Tolerance
No. 4 (4.75 mm)	100	-
No. 10 (2.00 mm)	78	-
No. 20 (0.85 mm)	16	-
No. 200 (0.075 mm)	5	-

- Navigational Dredge Area: Proposed plan is to dredge this area to El. -16.5 feet NAVD88, and cap the remaining subgrade sediment with approximately 18 inches of Medium Gravel, per erosion calculations by others. Tentative gradation of material is tabulated below:

Sieve Size Mesh	% Passing Target Value	% Passing Tolerance
1" (25.0 mm)	100	0
3/8 in. (9.51 mm)	78	±10
No. 4 (4.75mm)	16	±10
No. 200 (0.075 mm)	5	±5

- Tidal Flat Area: Proposed plan is to excavate and replace to match existing grade between Mean High Water (MHW) elevation and Mean Low Water (MLW) elevation. The tentative cap material is Sandy Silt, per others, with an expected cap thickness of 24 inches.

Sieve Size Mesh	% Passing Target Value	% Passing Tolerance
No. 4 (4.75 mm)	95-100	-
No. 10 (2.00 mm)	90-95	-
No. 20 (0.85 mm)	75-95	-
No. 200 (0.075 mm)	60-75	-

3.0 Assumptions

Listed below are assumption used in the presented calculations:

1. The degree of mixing of the cap materials and the underlying sediment will depend primarily on placement techniques. Means and methods for cap placement are beyond the scope of this work.

2. Grain size distributions for various samples of the sediment were acquired based on a field investigation of the Navigational Dredge Area (NDA). This work is described elsewhere. Core locations are shown on the attached Figure 1.

3. The finest grain size distribution was selected from the data as a “worst case” scenario. Within the NDA, the remaining sediments after dredging are expected to be softer than the in-situ conditions.

4. Empirical data from published literature indicate that mixing is inevitable. The references point out that the use of filter media, either geotextile of properly graded sand, will minimize the mixing. The references do not point out a means to calculate the thickness of the mixing zone.

5. We chose to go with a sand filter due to the anticipated difficulties of placing geotextiles under water; the relative stiffness of the sediments indicates suitable support (see bearing capacity calcs).

6. Cap materials, including filter layers, must be placed slowly and evenly over large areas to avoid punching into the substrate sediment due to large drop heights.

7. Tentative capping materials and thicknesses for the three areas were provided to us, based on calculations by others concerning erosion resistance and benthic development.

8. The cap is just sand and gravel, no reactive materials.

9. The existing sediments within the Navigational Dredge Area at the proposed dredge depth and the Main Channel are similar in consistency and strength.

10. The tendency to "fluff" or swell during and after dredging will mitigate quickly, such that the strength will not be compromised more than a few inches below the dredge line. In the event that swelling does occur, it is likely that a thicker mixing zone will result.

4.0 Soil Properties

Grain Size Distribution with Hydrometer Analysis (ASTM D422) was performed on four samples of the sediments below the proposed dredge limits in the NDA. The samples were taken from tubes pushed into the sediments via a barge-mounted Geoprobe. Laboratory testing was performed in March and April of 2017 by GeoTesting Express of Acton, Massachusetts. The gradation data follows:

Parameter	**GZ-2**	**GZ-6**	**GZ-12**	**GZ-17**
% Passing No. 4 (4.75 mm)	100	100	100	100
% Passing No. 10 (2.00 mm)	100	100	100	100
% Passing No. 20 (0.85 mm)	100	100	100	100
% Passing No. 40 (0.42 mm)	100	100	100	99
% Passing No. 60 (0.25 mm)	99	100	100	97
% Passing No. 100 (0.15 mm)	98	100	99	94
% Passing No. 200 (0.075 mm)	94	100	99	84
% Sand by weight	5.9	0.3	1.5	16.1
% Silt + Clay by weight	94.1	99.7	98.5	83.9
Approx. % Clay by weight	59	10	61	35
USCS Classification	MH	MH	MH	MH
D85 – Diameter at which 85% is finer	0.0295 mm	0.0404 mm	0.0256 mm	0.0813 mm
D60 – Diameter at which 60% is finer	0.0058 mm	0.0215 mm	0.0053 mm	0.0192 mm
D50 – Diameter at which 50% is finer	0.0033 mm	0.0190 mm	NA	0.0109 mm
D30 – Diameter at which 30% is finer	NA	0.0149 mm	NA	0.0036 mm
D15 – Diameter at which 15% is finer	NA	0.0101 mm	NA	NA
D10 – Diameter at which 10% is finer	NA	0.0064 mm	NA	NA
Cu – Coefficient of Uniformity	NA	3.359	NA	NA
Cc – Coefficient of Curvature	NA	1.613	NA	NA

5.0 Filter Design

Following the guidance presented in EM 1110-2-1901 (Reference 3), the Base Soil (existing sediment) falls into Category 1, whereas silts and clays ("fines") comprise more than 85% by weight. A sand filter, placed between the sediment and a future granular soil cap, is intended to prevent the fines from migrating upward due to regular pressure changes caused by tides. For this application, we wish to limit the migration of fines from the sediments into the granular cap for environmental reasons.

The Filter Criteria is, hence D15 $\leq$ 9 x d85, whereas D is the grain size for the filter and d is the grain size for the protected soil. Reference 3 discusses a Correction Factor to adjust plotted gradation curves if the protected soil contains gravel (>4.75 mm). For the tested samples, all sample passes the No. 200 sieve, hence the Correction Factor is 1. Refer to the Grain Size Distribution curves plotted below.

For a range of values for d85 from 0.0256 mm (GZ-12) to 0.0813 mm (GZ-17), D15 for the filter should be between 0.2304 mm and 0.7317 mm, i.e., the range of maximum values for the D15 of the filter. Larger values of D15 would be expected to result in soil migration.

For permeability, so as not to restrict water movement that could lead to the buildup of excess pore pressure, the minimum D15 for the filter should be 4 times the maximum d85, which equates to 0.1024 mm to 0.3252 mm for these samples. Reference 3 recommends a minimum value of 0.70 mm.

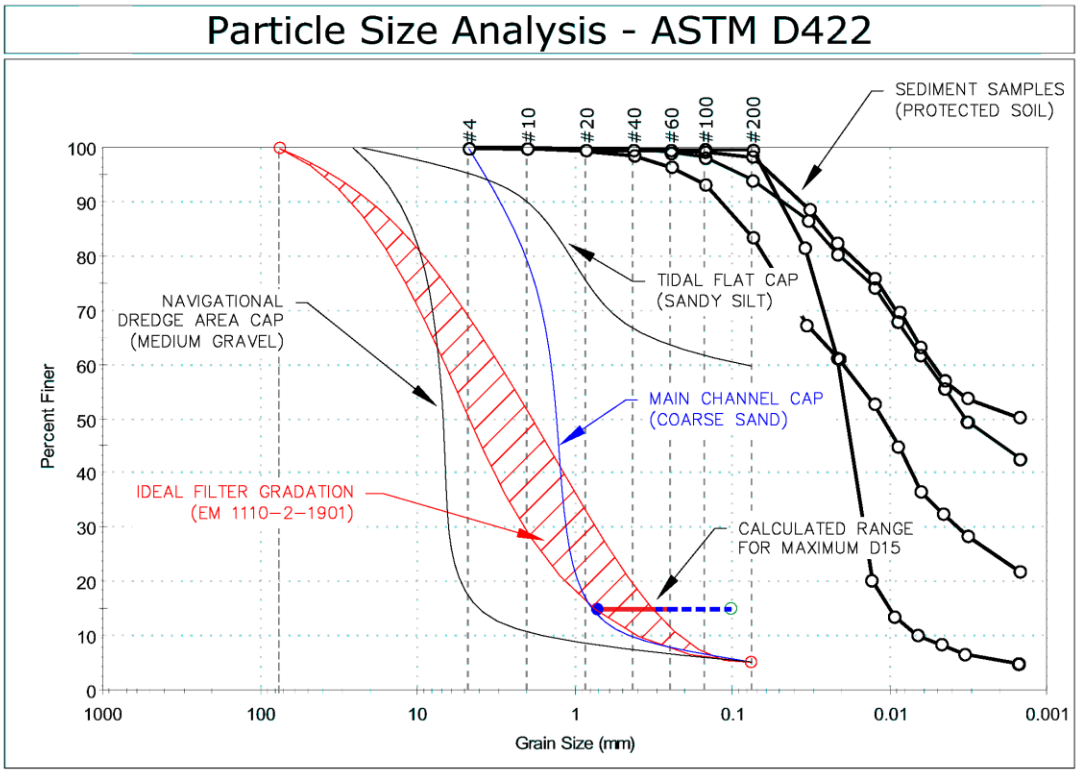
Based on the foregoing, a filter soil with a D15 of 0.70 mm meets both criteria.

Other recommended criteria for the filter soil:

1) Percent passing 3 inches (75 mm) equals 100%
2) Percent passing No. 200 is 5% maximum.
3) Portion passing No. 40 (0.425 mm) must have a PI of zero.
4) Want uniform gradation (not gap graded) and:

If Minimum D10	then D90
<0.5 mm	20 mm
0.5 – 1.0 mm	25 mm
1.0 – 2.0	30 mm
2.0 – 5.0 mm	40 mm
5.0 – 10 mm	50 mm
10 – 50 mm	60 mm

A range of gradation that meets all these criteria for the filter soil is plotted (stiple area) as follows:



6.0 Conclusions and Results

Based on the grain size distribution, the tentative proposed gradation for Coarse Sand – planned for the Main Channel – has a gradation close enough to the idealized filter gradation to serve as the filter layer. In the soil gradation curves, the lower 50th percentile (finer than approximately 1.5 mm) of the Coarse Sand is within the ideal filter gradation calculated for the underlying sediments. The D15 of the sand coincides with a “sweet spot” at 0.7 mm recommended for filtering and permeability for the Class 1 sediments.

Thus, it appears the Coarse Sand will be suitable for the base course of the cap, i.e., the lower six inches placed in the lowest layer in contact with the sediments. This applies to both the Main Channel and the Navigational Dredge Area (NDA), whereas subsequent courses of the Main Channel will be identical Coarse Sand and that of the NDA will be Medium Gravel. It should be noted that the gradations furnished to us for the proposed capping materials are somewhat idealized, thus representative grain size distribution tests should be performed on the actual soils selected for construction.

With respect to mixing zone depths, definitive calculations have not been performed. Rather, empirical data from the literature suggest that mixing zones of 2 inches to 6 inches in thickness have been observed on similar projects. The thickness of the mixing zone is highly dependent on placement techniques. The more slowly and gently the placement is conducted, the less mixing occurs. Particle size and velocity come into play, which have not been calculated, but conclusions drawn from the empirical data suggest:

- Coarse Sand Placed into Main Channel Area – estimate 2 inches of mixing for initial 6-inch layer. It is recommended that the proposed cap thickness in the Main Channel include a 6 inch sacrificial mixing layer of material for a total thickness of 24 inches of placed cap material (i.e., Coarse Sand).

- Coarse Sand placed into NDA area (post-dredging) – estimate 4 to 6 inches of mixing, or total loss of initial 6-inch layer (sacrificial for stiffening the substrate to support the 18-inch thick cover). The proposed cap thickness in the NDA shall include a 6 inch sacrificial mixing layer of coarse sand, for a total thickness of 24 inches of placed materials (i.e., 6 inches of coarse sand, 18 inches of medium gravel).

The foregoing estimates are contingent on a gradual and even dispersion of the capping soils, and the estimated values could vary. This analysis should provide a basis for bidding the project, although it is highly recommended that field demonstrations be performed for the various cap areas. Some means of gauging performance, e.g., bathymetric surveys and/or soil sampling, should be performed to verify the cap meets the design requirements. Long-term, a monitoring and maintenance program should be conducted. This is particularly important within submerged areas subject to currents and prop wash.

Within the Tidal Flat, the soil going into the excavated areas will be similar in grain size (a little coarser) and unit weight as that being removed. The Silty Sand replacement soils are sufficiently fine – at the tentatively proposed gradation – that filtering will not be an issue and permeability will be similar to the sediments. It is possible that fines from the underlying sediments could migrate upward over time, whereas the surface pressure will be constantly changing with the tides. However, initial mixing it expected to be negligible. We do recommend that the capping soils in the Tidal Flats be placed in three gradual, evenly distributed layers.

7.0 References

1. Palermo, M., Maynord, S., Miller, J., and Reible, D. (1998). “Guidance for In-Situ Subaqueous Capping of Contaminated Sediments.” EPA 905-B96-004. United States Environmental Protection Agency, Great Lakes National Program Office, Chicago, IL.

2. Engineer Manual 1110-2-1901. “Seepage Analysis and Control for Dams.” Department of the Army, US Army Corps of Engineers, Washington, DC, 1993.

3. Engineer Manual 1110-2-2300. “General Design and Construction Considerations for Earth and Rock-Fill Dams.” Department of the Army, US Army Corps of Engineers, Washington, DC, 2004.

4. Palermo, M.R., et al., Fredette, T.J., Randall, R.E. (1998). “Guidance for Subaqueous Dredged Material Capping.” Technical Report DOER-1. US Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS.

5. Bailey, S.E., and Palermo, M.R. (2005). “Equipment and Placement Techniques for Subaqueous Capping.” ERDC TN-DOER-R9. U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Date: May 28, 2017
Project: Wynn Project Shallow Draft Channel Design and Bid Documents
Task: Vessel Propeller Wash induced Subaqueous Cap Erosion Calculations
Amec Foster Wheeler Project: No. 3651160042.008
Shallow Draft Channel Design Lead: Joe Wagner, PE, D.NE
Reviewer: William Tucker, PE

Objective:

Amec Foster Wheeler Shallow Draft Channel Design Lead conducted a desktop analysis of a limited set of proposed project elements. Each specified project element may result in alterations or potential impacts to the originally proposed channel and turning basin design. This memorandum specifically focuses on vessel propeller wash induced cap erosion and determining a water-column separation distance (vertical offset) to minimize cap erosion effects due to propeller wash.

Introduction:

A subaqueous capping of contaminated sediments project should be designed to reduce risk through three primary planning processes, contingent on the contaminants and sediment environment involved (US EPA, 1998):

- Physical isolation of the contaminated sediments
  - lessen exposure due to direct contact
  - discourage colonization by burrowing organisms, thus limiting bioturbation and release of underlying contaminants
- Chemical isolation of contaminated sediment
  - reduce exposure from soluble and colloidally bound sediments being transported into water-column
- Erosion protection of sediment and cap
  - stabilization of contaminated sediment
  - reduce resuspension and transport of contaminated sediment to other sites

Several key site-specific conditions affect nearly every aspect of a subaqueous capping of contaminated sediments project including project design, equipment and cap material selection, and even the site's monitoring and management programs (US EPA, 1998). These site-specific conditions include:

- Physical Environment
  - Bathymetry (vertical depth, horizontal dimensions, slope, etc.) of sediment bed, and flow patterns, including tides, currents, and other potential disturbances in colder climates, including possible ice scour
  - Existing infrastructure such as piers, docks, other marine structures, bridges, and even utility-crossings or outfalls
- Waterway Uses
  - Acceptable draft of vessels allowed to navigate over a capped area depends on water level fluctuations (e.g., seasonal, tidal, and wave)

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- Potential waterway use effects include:
  - vessel groundings on the cap
  - potential cap erosion caused by propeller wash
  - other activities that may affect cap integrity such as the potential for routine anchoring of large vessels
  - restriction of some activities and vessels is often necessary

- Sediment Characteristics
  - Shear strength, especially undrained shear strength, of contaminated sediment deposits is of particular importance in determining the feasibility of in-situ capping
    - most contaminated sediments are fine-grained, and are usually high in water content and relatively low in shear strength
    - although a cap can be constructed on sediment with low shear strengths, the ability of the sediment to support a cap and the need to construct the cap using appropriate methods to avoid displacement of the contaminated sediment should be carefully considered
  - Physical, chemical, and biological characteristics of the contaminated sediment
  - Presence of other materials within the sediment bed, such as debris, wood chips, high sludge fractions, or other non-mineral-based sediment fractions, can also present special problems when interpreting grain size and other geotechnical properties of the sediment, but their presence can also improve sediment stability under a cap
  - Chemical characteristics of the contaminated sediment are an important factor that may affect design or selection of a cap, especially if capping highly mobile or highly toxic sediment

Detailed Calculations:

Documented below are a detailed set if calculations for a design vessel operating within the planned Wynn Properties channel and turning basin. The general approach used for this calculation, specific parameters used and illustrated systematic calculations for the specific design vessels follows.

1) Proposed basin characteristics (after dredging and capping)
   a) Tidal datum
      i) Mean Low Water (MLW) = -5.21 ft. North American Vertical Datum of 1988 (NAVD 88)
      ii) Mean High Water (MHW) = +4.35 ft. NAVD 88
   b) Dredged depth
      i) -11.29 ft. MLW
      ii) -16.5 ft. NAVD 88
   c) Capped depth
      i) -9.79 ft. MLW
      ii) -15 ft. NAVD 88
   d) Cap material
      i) Varies (Coarse Sand and Medium Gravel)
      ii) 1.5 ft. thick

2) Design vessels characteristics
   a) Listed information is based on client (Wynn Properties) discussions or provided reference sources (vessel manufacture)

i) Prototypical Passenger Design Vessel: Wynn Properties staff proposed a prototypical passenger ferry that when fully loaded carries roughly 50 passengers.
   a. Total length: 65.0 ft.
   b. Total beam: 22.5 ft.
   c. Number of engines: Twin Screws
   d. Installed engine power: 500 horsepower (hp) per engine
   e. Engine location: Rear inboard engines
   f. Propeller shaft depth: 3.0 ft. (estimated)
   g. Ducted propeller: No (assumed)
   h. Propeller diameter: 1.25 ft. (estimated)

ii) Emergency Vessel: MS Father Dan Boston Marine Unit 2 is a 2016 FireStorm 32 High Speed Aluminum Fireboat (see Exhibit A).
   a. Total length: 34.0 ft.
   b. Total beam: 10.5 ft.
   c. Number of engines: Twin Mercury outboards
   d. Installed engine power: 250 horsepower (hp) per engine
   e. Engine location: Rear inboard engines
   f. Propeller shaft depth: 1.5 ft. (estimated)
   g. Ducted propeller: No (assumed)
   h. Propeller diameter: 2.3 ft. (estimated)

b) Based on the provided, acquired, and estimated parameters the prototypical passenger design vessel was selected for the listed design calculations (below) due to its frequency of use, dimension, engine power, and potential to induce erosion of the cap.

c) Similar calculation results for the remaining design vessel (MS Father Dan 2016 FireStorm 32 Fireboat) is also listed, following the prototypical passenger design vessel calculations.

3) Maximum bottom velocities related to propeller wash of the maneuvering prototypical design vessel.

a) The equation for jet velocity exiting a propeller is listed in Appendix A of US EPA (1998) and Blaauw and van de Kaa (1978)

$$U_0 = C_2\left(\frac{P_d}{D_p^2}\right)^{\frac{1}{3}} = 9.72\left(\frac{150}{1.25^2}\right)^{\frac{1}{3}} = 44.506\,\text{fps}$$

b) where:

i) U_0 = jet velocity exiting propeller in ft. per second (fps)

ii) P_d = applied engine power/propeller in hp
   a. While transiting to and from the Wynn Properties docks, channel, and turning basin it is assumed, based on discussions with the various passenger ferry operators that the prototypical passenger design vessel will use from 15 to 20% of potential horsepower
   b. If operated at 15 to 20% of potential horsepower, the prototypical passenger design vessel's twin screws would provide between 150 and 200 hp

iii) D_P = Propeller diameter in ft.
   a. Prototypical passenger design vessel's propeller diameter is 1.25 ft.,

iv) C_2 = 9.72 for non-ducted propellers or 7.68 for ducted propellers
   a. Prototypical passenger design vessel likely has non-ducted propellers

c) The equation for the resulting maximum bottom velocities related to propeller wash of the maneuvering prototypical passenger design vessel is listed in Appendix A of US EPA (1998) and Blaauw and van de Kaa (1978)

$$V_{B(max)} = \left(\frac{C_1 U_0 D_P}{H_P}\right) = \left(\frac{(0.22)(44.506)(1.25)}{6.79}\right) = 1.803 \text{ fps}$$

d) where:
   i) C_1 = 0.22 for non-ducted propellers or 0.30 for ducted propellers
      a. Prototypical passenger design vessel likely has non-ducted propellers
   ii) H_P = Distance from the propeller shaft to channel bottom in ft.
      a. 9.79 ft. is the minimum water depth with a propeller 3.0 ft. below the surface or 6.79 ft. distance from the propeller shaft to channel bottom

e) Thus, the maximum bottom velocities related to propeller wash of the maneuvering prototypical passenger design vessel at 15% of engine power (150 hp) is 1.803 fps using the equation from Appendix A of US EPA (1998) and Blaauw and van de Kaa (1978).

4) The stable sediment size necessary to resist the propeller wash of the maneuvering prototypical passenger design vessel

a) The equation used to compute the stable sediment sizes to resist the propeller wash of the maneuvering prototypical passenger design vessel is listed in Appendix A of US EPA (1998) and Blaauw and van de Kaa (1978) and the stable particle size to resist erosion from

$$V_{B(max)} = C_s \left[g \left(\frac{\gamma_s - \gamma_w}{\gamma_w} \right) D_{50} \right]^{\frac{1}{2}}$$

$$D_{50} = \frac{\left(\frac{V_{B(max)}}{C_s}\right)^2}{g\left(\frac{\gamma_s - \gamma_w}{\gamma_w}\right)} = \frac{\left(\frac{1.803}{0.7}\right)^2}{32.2\left(\frac{165-62.4}{62.4}\right)} = 0.125 \text{ ft. (1.50 inches)}$$

b) where:
   i) C_3 = sediment transport coefficient of
      a. 0.55 provides good agreement with experimental results for no transport and should be used in harbor areas where repeated attack can be expected and no movement can be allowed
      b. 0.6 to 0.7 should be used in design for channel protection where infrequent attack can be expected
      c. C_3 = 0.7 ft since limited movement is allowed
   ii) g = acceleration of gravity approximately 32.2 ft./sec.^{2}
   iii) Υ_s = unit weight of stone= 165 pounds per cubic foot (lbs./ft.^{3})
   iv) Υ_w = unit weight of water = 62.4 lbs./ft.^{3}

c) Thus the computed particle size for the operating in 9.79 ft. of water (minimum water depth) at 15% of engine power (150 hp) is 1.50 inches (Coarse Gravel), using the Blaauw and van de Kaa (1978) equation.

d) Varieties of empirical relations have been developed to determine the size of stable bed material based upon either water velocity or shear stress. While all these methods have different underlying conditions or assumptions, they do provide a range of empirically derived values upon which to evaluate appropriate sized backfill material for geomorphic stability.

i) Is should be noted that the equation from Appendix A of US EPA (1998) and Blaauw and van de Kaa (1978) provides a conservative stable particle size to resist erosion compared to most of these other methods.

ii) For example the stable particle size to resist a 1.803 fps bottom current velocity using the Shields parameter (Shields 1936) and the modified Isbash equation (Recking et al. 2013) yields 0.72 inches (Medium Gravel) and 0.50 inches (Medium Gravel), respectively.

iii) Because the Isbash equation gives a critical velocity, while the Shields parameter give a critical shear stress, the Isbash equation has been adopted as recommended in (Recking et al. 2013).

$$V_{B(max)} = C_4\left(2g\left(\frac{\gamma_s - \gamma_w}{\gamma_w}\right)D_{50}\right)^{\frac{1}{2}}$$

$$D_{50} = \frac{C_4{}^2\, V_{B(max)}{}^2}{2g\left(\frac{\gamma_s - \gamma_w}{\gamma_w}\right)}$$

iv) where:

a. C_4 = Isbash constant

1. 0.86 is in good agreement with experimental results for no transport and should be used in harbor areas where repeated attack can be expected and no movement can be allowed.
2. 1.2 should be used in design for channel protection where infrequent attack can be expected.
3. C_4 = 1.2 since limited movement is allowed

b. g = acceleration of gravity approximately 32.2 ft./sec.^{2}

c. Ys = unit weight of stone= 165 pounds per cubic foot (lbs./ft.^{3})

d. Yw = unit weight of water = 62.4 lbs./ft.^{3}

e) Thus, using the Isbash equation, the computed particle size for the prototypical passenger design vessel operating in a set depth of water at some portion of the total engine power can be calculated.

a. The computed particle size for the operating in 9.79 ft. of water (minimum water depth) at 15% (150 hp) of engine power is 0.50 inches (Medium Gravel).

b. The computed particle size for the operating in 9.79 ft. of water (minimum water depth) at 20% (200 hp) of engine power is 0.60 inches (Medium Gravel).

c. The computed particle size for the operating in 19.35 ft. of water (maximum water depth) at 15% (150 hp) of engine power is 0.09 inches (Fine Gravel).

d. The computed particle size for the operating in 19.35 ft. of water (maximum water depth) at 20% (200 hp) of engine power is 0.10 inches (Fine Gravel).

5) Based on the results above, the equations were rerun several more times to determine the stable minimum depth necessary to resist the propeller wash of the maneuvering prototypical passenger design vessel for various sediment sizes.

a) At 15% (150 hp) of engine power. See Table 1.

Table 1 – Minimum Depths to avoid Vessel Propeller Wash induced Subaqueous Cap Erosion from the Prototypical Passenger Design Vessel at 15% (150 hp) of Engine Power

	D_{50} (in.)	MLW (ft.)	NAVD 88 (ft.)
Cobble	7.87	-4.71	-9.92
Coarse Gravel	2.48	-6.04	-11.25
Medium Gravel	0.79	-8.40	-13.61
Fine Gravel	0.25	-12.62	-17.83
Coarse Sand	0.08	-20.07	-25.28

b) At 20% (200 hp) of engine power. See Table 2.

Table 2 – Minimum Depths to avoid Vessel Propeller Wash induced Subaqueous Cap Erosion from the Prototypical Passenger Design Vessel at 20% (200 hp) of Engine Power

	D_{50} (in.)	MLW (ft.)	NAVD 88 (ft.)
Cobble	7.87	-4.88	-10.17
Coarse Gravel	2.48	-6.35	-11.64
Medium Gravel	0.79	-8.94	-14.23
Fine Gravel	0.25	-13.59	-18.88
Coarse Sand	0.08	-21.79	-27.08

6) Based on the results above, the equations were rerun several more times to determine the stable minimum depth necessary to resist the propeller wash of a maneuvering vessel for the remaining design vessel, MS Father Dan 2016 FireStorm 32 Fireboat
   a) For the MS Father Dan 2016 FireStorm 32 Fireboat at both 15% (75 hp) and 20% (100 hp) of engine power. See Table 3.

Table 3 – Minimum Depths to avoid Vessel Propeller Wash induced Subaqueous Cap Erosion from the MS Father Dan 2016 FireStorm 32 Fireboat at 15% (75 hp) and 20% (100 hp) of Engine Power

		15% (75 hp)		20% (100 hp)	
	D_{50} (in.)	MLW (ft.)	NAVD 88 (ft.)	MLW (ft.)	NAVD 88 (ft.)
Cobble	7.87	-3.16	-8.37	-3.33	-8.54
Coarse Gravel	2.48	-4.46	-9.67	-4.76	-9.97
Medium Gravel	0.79	-6.75	-11.96	-7.28	-12.49
Fine Gravel	0.25	-10.86	-16.07	-11.80	-17.01
Coarse Sand	0.08	-18.11	-23.32	-19.78	-24.99

Summary:

Please note that the provided detailed calculations only cover a *small portion* of the design elements, listed in the **Introduction Section**, which can affect nearly every aspect of a subaqueous capping of contaminated sediments project including project design, equipment and cap material selection, and even the site's monitoring and management programs. As noted above, these site-specific conditions can be grouped as, physical environment, waterway uses, sediment characteristics, and habitat alterations.

The detailed calculations are provided for two design vessels selected by Wynn Properties staff

- Prototypical Passenger Design Vessel, 65 ft. long and fully loaded (50 passenger)
- MS Father Dan Boston Marine Unit 2 (2016 FireStorm) 32 ft. long High Speed Aluminum Fireboat

In order to simulate the most likely conditions to cause vessel propeller wash induced cap erosion and to determine an adequate water-column separation distance (vertical offset) to minimize cap erosion effects due to propeller wash, each design vessel is assumed to be operating at worst case conditions. For example, each design vessel was assumed to be operating at a portion (15 to 20%) of the total installed engine horsepower as the design vessel accelerates while leaving its dockage during the peak of an average low tide event (-9.79 ft. MLW, -15 ft. NAVD 88). Propeller wash induced cap erosion calculations were used to determining a water-column separation distance (vertical offset) to minimize cap erosion effects due to propeller wash, see Table 4, and Table 5, for comparison purposes.

Table 4 – Minimum Depths to avoid Vessel Propeller Wash induced Subaqueous Cap Erosion Prototypical Passenger Design Vessel at 15% (150 hp) and 20% (2000 hp) of Total Engine Power

		15% (390 hp)		20% (520 hp)	
	D_{50} (in.)	MLW (ft.)	NAVD 88 (ft.)	MLW (ft.)	NAVD 88 (ft.)
Cobble	7.87	-4.71	-9.92	-4.88	-10.17
Coarse Gravel	2.48	-6.04	-11.25	-6.35	-11.64
Medium Gravel	0.79	-8.40	-13.61	-8.94	-14.23
Fine Gravel	0.25	-12.62	-17.83	-13.59	-18.88
Coarse Sand	0.08	-20.07	-25.28	-21.79	-27.08

Table 5 – Minimum Depths to avoid Vessel Propeller Wash induced Subaqueous Cap Erosion at 15% (75 hp) and 20% (100 hp) of Total Engine Power for the MS Father Dan 2016 FireStorm 32 Fireboat

		15% (75 hp)		20% (100 hp)	
	D_{50} (in.)	MLW (ft.)	NAVD 88 (ft.)	MLW (ft.)	NAVD 88 (ft.)
Cobble	7.87	-3.16	-8.45	-3.33	-8.62
Coarse Gravel	2.48	-4.46	-9.75	-4.76	-10.05
Medium Gravel	0.79	-6.75	-12.04	-7.28	-12.57
Fine Gravel	0.25	-10.86	-16.15	-11.80	-17.09
Coarse Sand	0.08	-18.11	-23.40	-19.78	-25.07

Although it is desirable to only design in-situ site capping projects in low-energy areas with little or no potential for cap erosion, these conditions are obviously are not always available. Under higher energy conditions, like those present at the project basin, the potential for erosion needs to be taken into account when designing the cap. In each case, the analyzed design vessel, operating under the assumed conditions, will potentially produce significant vessel propeller wash induced cap erosion to warrant a redesign of the proposed 18-inch thick sand only cap. To minimize cap erosion effects due to propeller wash, several design elements were verified and the cap design was modified, as necessary.

The most important design element to verify was the design vehicle itself. If a larger and more powerful vessel were utilized deepening the final cap depth, or more likely some combination of all design elements would need to be pursued. Other design elements, such as operating the design vessel only during higher tide events could also prove

beneficial. However, a change like this may restrict the usefulness of passenger ferry service and thus likely be impractical.

Essentially, if the design vessel and design depth cannot be altered, an additional layer of courser material must be added to the overall cap thickness to account for expected erosion over a finite time. The amount of expected erosion will be a function of the depth of the capped mound, mound geometry, the material used for the cap, and environmental forcing functions at the site, waves and currents, and their duration.

Knowledge of the frequency of occurrence of vertical erosion (i.e., how often a given amount of vertical erosion will occur) is a critical component of a probabilistic cap design. Too thin an erosion layer may compromise the cap, potentially allowing the contaminants to be dispersed over the site and surrounding area. Equally, too thick cap will have an unnecessarily high cost and reduce the capacity of the site to contain additional dredged material.

To better understand the impact of the propeller wash induced cap erosion, several additional calculations were used to determine a specific water-column separation distance (vertical offset) to minimize cap erosion effects for a specified prototypical passenger vessel (specified by the client) at various horsepower limits.

Prototypical passenger design vessel propeller wash induced cap erosion calculations were then used to determining a water-column separation distance (vertical offset) to minimize cap erosion effects due to propeller wash, see Table 6.

Table 6 – Minimum Depths to avoid Vessel Propeller Wash induced Subaqueous Cap Erosion at Various Total Engine Power (hp) for the Prototypical Passenger Design Vessel at set depths

	D_{50} (in.)	-9.79 ft. MLW (-15.0 ft. NAVD 88)
Cobble	7.87	100% (1,000 hp)
Coarse Gravel	2.48	100% (1,000 hp)
Medium Gravel	0.79	~29% (288 hp)
Fine Gravel	0.25	~5.1% (51 hp)
Coarse Sand	0.08	~0.9% (9 hp)

Based on the results of these calculations and discussions with Wynn Properties staff a final cap design, based solely on the vessel propeller wash induced cap erosion calculations listed above, is proposed.

The design provides an adequate water-column separation distance (vertical offset) to minimize cap erosion effects due to propeller wash and proper density cap material to stabilize contaminated sediments.

Design Specifications: a modification to the existing 1.5 ft. deep sand only cap. Since even a coarse sand cap (Table 7) is anticipated to be significantly disturbed by the prototypical passenger design vessel, a Medium Gravel (Table 8) top layer is proposed.

- Base layer: 12 inches (±3 inches) of Coarse Sand (D_{50} = 0.08 in.) over the contaminated sediments
- Top layer: 6 inches (±3 inches) of Medium Gravel (D_{50} = 0.79 in.)

Table 7 – Coarse Sand Gradation Limits

Sieve Size Mesh	% Passing Target Value	% Passing Tolerance
No. 8 (2.38 mm)	100	0
No. 10 (2.00 mm)	78	+/- 10
No. 20 (0.841 mm)	16	+/- 10
No. 200 (0.074 mm)	5	+/- 5

Table 8 – Medium Gravel Gradation Limits

Sieve Size Mesh	% Passing Target Value	% Passing Tolerance
1”(25.0 mm)	100	0
3/8 in. (9.51 mm)	78	+/- 10
No. 4 (4.75 mm)	16	+/- 10
No. 200 (0.074 mm)	5	+/- 5

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Exhibit A

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Fax (904) 396-5703
www.amecfw.com

CBRN

FireStorm

FAST RESPONSE • MEDIVAC • EMERGENCY RESPONSE • AMBULANCE • RESCUE • FIRE

BENEFITS OF CBRN FIREBOATS

MetalCraft Marine CBRN defence systems can actively:
SHIELD the expedition from exposure with built-in respiratory and ocular protection; SUSTAIN the mission with decontamination facilities to provide front-line medical response; SENSE the agents for continuous point and stand-off detection providing prompt situation appraisal; SHAPE the environment with both situation management and response capability.

WHY FIREBOATS?

CBRN vessels are usually managed by Fire Departments due to the extensive Hazmat and First Responder training that firefighters complete. Because of the broad responsibilities of Fire Departments, all FireStorm's can be equipped with CBRN defence systems.

FUNDING AND ASSISTANCE

Acquisition of necessary CBRN defense equipment is an integral part of preparing and improving emergency preparedness. CBRN vessels are mandated under several FEMA Grant Programs and USCG Risk Management Plans.

CBRN DEFENCE SYSTEMS

MetalCraft Marine classifies CBRN defence systems equipped on the FireStorm into four capabilities:

PROTECTION - crew is protected from CBRN agents through isolation from the environment with air handling and isolation systems:

- Integral storage for specialized hazmat and chemical contamination response equipment
- Onboard breathable air system based on convention SCBA personal protective equipment
- Positive cabin air pressurization with gas particulate air filtration system to remove CBRN contaminates from air and interior and exterior pressure detectors with system control module in the pilothouse

DECONTAMINATION - CBRN decontamination areas for patients, emergency responders and equipment

- Decontamination area with cold or hot fresh water shower
- Toxic-Free Area including the pilothouse and part of the lower cabin with a double air lock Safe Entry and Decontamination Area

DETECTION - CBRN agents are detected through the use of sensors and instrumentation:

- Fixed gas detectors for toxic chemicals and flammable gasses
- Chemical warfare and toxic industrial chemical detection and identification
- Multiple threat CBRN detection and identification
- CBRN monitors for hazardous materials and emergency response management

MANAGEMENT - command and control of CBRN threats through integrated emergency management and response capabilities to perform missions in a CBRN environment.

- Active CBRN threat detection that initiates on board protection
- Real-time wireless CBRN threat control solutions that relay data from wireless monitors and detectors to a central command location
- Rapid monitoring and assessment of situations involving CBRN substances by integrating wireless monitors and detectors, weather data and advanced computer software to analysis the best course of action for protection and containment

MetalCraft Marine

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FireStorm

FAST RESPONSE • MEDIVAC • EMERGENCY RESPONSE • AMBULANCE • RESCUE • FIRE

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FireStorm 32

FAST RESPONSE • MEDIVAC • EMERGENCY RESPONSE • AMBULANCE • RESCUE • FIRE

THE MOST CAPABLE FIREBOAT OF ITS SIZE & BESTSELLING FIREBOAT IN AMERICA

The FireStorm 32's shallow draft, maneuverability and firefighting capability make it the first choice for operation in shallow waters close to concentrated shoreline populations, around busy recreational traffic and commercial shipping routes. Most emergency situations occur in shallow or inaccessible water outside of marked navigation channels or close to shore. The diesel water-jet configuration is able to operate in very shallow waters without risk to damaging the drive unit from hitting submerged objects. The simplicity of the propulsion and firefighting systems ensure ease of maintenance and service. The FireStorm 32 is the highest pumping fireboat for its size and can be configured to meet a broad range of performance requirements, regional service availability and budgets. Even during firefighting missions the boat can be safely operated with only two crew members. With a single 1750 GPM rated firefighting pump the FireStorm 32 can produce flow meter results of 2,000 GPM at 150 PSI and 2,400 GPM at 60 PSI for LDH shore hydrant supply. A remote operated monitor mounted on the cabin roof provides the primary firefighting capability from a dedicated console within the cabin and an optional secondary monitor can be mounted on the bow. Two 2.5" discharges and a 5" Storz are fitted on the aft deck. Twin diesel inboard engines matched to water-jet propulsion units can propel the boat to speeds of 42 knots and allow the boat to perform emergency stops and change direction within two boat lengths. Aft working deck space is maximized with well-defined steps that allow clear access to the oversized dive platform/recovery deck which provides water level working space for deployment and recovery.

L.O.A.	34'
B.O.A.	10'6"
Draft	18"
Pump	1750 GPM
Discharges	2 monitors; 2 discharges; 1 LDH
Engine	Twin diesel
Propulsion	Water-jet

MetalCraft Marine

www.metalcraftmarine.com

FireStorm 32

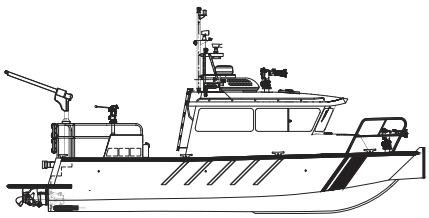
FAST RESPONSE • MEDIVAC • EMERGENCY RESPONSE • AMBULANCE • RESCUE • FIRE

FIRE FIGHTING SYSTEMS

- Single 1750 fire pump
- Roof mounted, remote operated 2000 GPM monitor
- LDH 5" Storz connection for supply to land units
- 2×2½" capped discharges
- All fire controls and gauges at dedicated console

EMS SUPPORT

- Heated patient care area with primary patient care berth and 1 secondary patient area
- Dedicated EMS equipment storage with AC outlets for battery chargers
- SCBA storage panel



ELECTRICAL SYSTEM

- Shore power 2×30 amp
- DC (12V) breakers - 16
- AC (110V) breakers - 12
- DC outlets - 3
- AC outlets - 3
- Corrosion Meter
- Cabin, scene & spot lights
- NAV & RAM lights
- Battery charger

ELECTRONICS

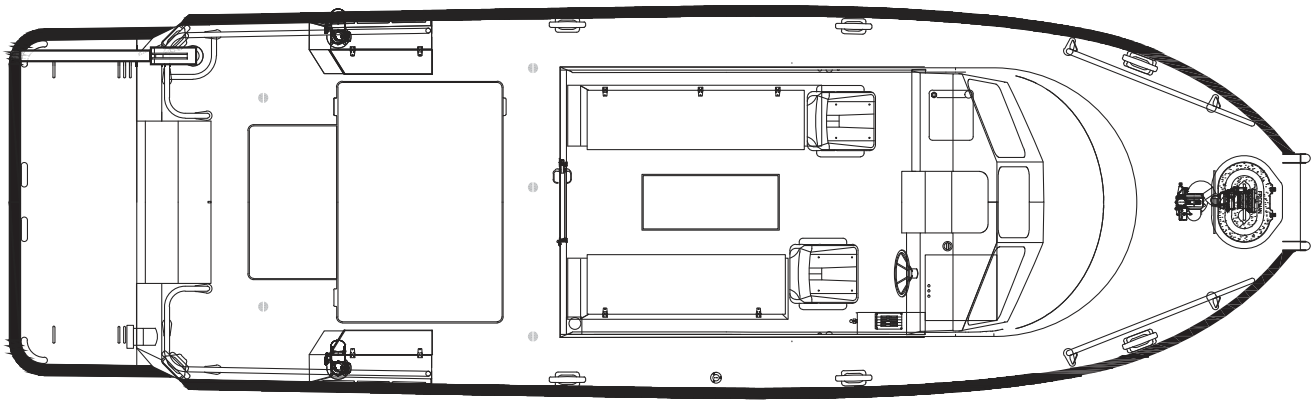
- VHF, Radar integrated w/GPS
- GPS, chart plotter w/depth
- Compass
- Loud hailer/fog horn
- Siren
- Emergency lights
- Many available options- FLIR etc.

STANDARDS

- Meets NFPA 1925 pumping
- Meets OSHA Db rating
- USCG CFR 46
- USCG interior flame retardant rating
- American Boat & Yacht Council
- American Bureau of Shipping Welding standards

OTHER FEATURES AND OPTIONS

- Chart table
- Suspension helm seat
- Non skid 24"side decks
- Safety railings
- Anchor locker with collision bulkhead
- 3 watertight compartments
- Rubber sound matting
- 3"'D' rubber fendering
- Fully finished pilot house interior
- High security engine hatch locks
- High security battery switches & start sequence
- 5 gallon & 50 gallon foam canister storage
- Tinted side windows, clear windshields
- Raked forward windshields to reduce glare and improve water clearing
- 2 speed wipers w/washers
- 40,000 BTU cabin heater w/defrost
- Hinged mast w/radar arch
- Floatable dive/roof ladder
- Push knee with collision zone
- Ice clearing roof design
- Access to all piping and valves



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Builders of High Speed, Fire/Rescue, Patrol and Work Boats

FireStorm 32 High Speed Aluminum Fireboat

Download: FireStorm 32 (PDF) CBRN Options (PDF)

Newport News' newest fireboat, a MetalCraft Marine FireStorm 32, shown here supporting dive operations in Hampton Roads, Virginia.

The FireStorm 32 has more speed, maneuverability and pumping capacity than any other vessel in its class. It is the highest pumping 32' fireboat in North America.

The FireStorm 32 is a new generation in fireboat technology. It is a culmination of years of study and research into high volume pumping systems and their effects on a small boat's stability, controllability, and dynamic loading.

Standard Configuration	
Max speed	40 kt fully loaded
L.O.A.	34'
B.O.A.	10'6"
Draft	18"
Discharges	2 monitors; 2 discharges; 1 LDH
Propulsion	Water-jet

CBRN Options

This fireboat can be equipped with **Chemical, Biological, Radiological, and Nuclear (CBRN) options** for advanced readiness. **Click for more...**

Delaware City (DE) Fire Company

FireStorm 32

Delaware City (DE) Fire Company

Max speed	40 Knots
L.O.A.	34'
B.O.A.	10' 9"
Weight	16,236 lbs
Horsepower	840 hp.
Pumps	Hale
Discharges	3 monitors; 1 LDH
Flow	2,700 GPM
Engines	2 Iveco
Jets	2 Hamilton
Other	CBRNE; onboard foam deployment; Aft helm

City of Alexandria, VA Fire Department

FireStorm 32

City of Alexandria, VA Fire Department

Max speed	42 MPH
L.O.A.	33'6"
B.O.A.	10'6"
NFPA	Class C*
Pumps	Darley PSM 1500 GPM
Flow	2200 GPM
Monitors	Elkhart
Engines	Twin Cummins Diesel D 4.2 L EI 300
Jets	Hamilton 241

Sausalito CA Fire Department

FireStorm 32
Sausalito CA Fire Department

Max speed	42 MPH
L.O.A.	33'6"
B.O.A.	10'6"
NFPA	Class C*
Pumps	Darley PSM 1500 GPM
Flow	2200 GPM
Monitors	Elkhart
Engines	Twin Cummins Diesel D 4.2 L EI 300

Jets	Hamilton 241

Osage Beach, MO Fire Department

FireStorm 32

Osage Beach, MO Fire Department

Max speed	42 MPH
L.O.A.	33'6"
B.O.A.	10'6"
NFPA	Class C*
Pumps	(rated) Darley PSM 1500 GPM
Flow	2200 GPM
Monitors	Akron
Engines	Twin Cummins Diesel 4.2 300 HP
Jets	Hamilton 241

Seward, AK Fire Department

FireStorm 32

Seward, AK Fire Department

Max speed	42 MPH
L.O.A.	33'6"
B.O.A.	10'6"
Draft	1'10"
NFPA	Class C*
Pumps	Hale 1250 GPM with Mercury V8 Engine
Flow	1800 GPM
Monitors	Akron
Engines	Twin 225 HP 4 Stroke Outboards

Fire Systems

High pump numbers are due to a unique MetalCraft Marine proprietary designed sea chest.

This sea chest has an intake as large as a firefighter himself. It can be inspected and cleaned while underway and provides a positive head to the pump. It provides a filtered water source to the pump while self draining with the boat on plane.

The monitor location is central for further range and is close to the center of buoyancy. This permits the helmsman to pivot the boat around a high thrust load at full stream while running a low engine rpm, not unlike a towboat.

Operators are amazed at the boat's control under full streaming at any angle. The boat's head never blows off its course.

Simplicity is the key to the FireStorm fire system. Its fire truck-based designs promote easy maintenance and reparability.

All FireStorm fireboats pack a huge punch for their size, and their shallow draft gets them into the smallest of marinas and very close to shore.

* Some exceptions to the NFPA 1925 apply, based on individual specifications.

Hull Shape

The Firestorm operates on the Kingston hull design platform. This proprietary design features a delta-pad center planing flat. This provides additional lift resulting a lower trim angle through the pre-planing transition zone, "the hump".

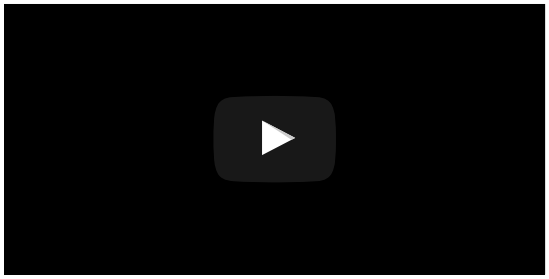
Fireboats are about 25% heavier than a conventional patrol boat because of firefighting equipment and rescue gear. This can cause the planning hull surface area to be marginal, or even too low in the water, to plane at all. A heavy boat with a small water plane causes exaggerated high bow planning angles, and heavier loads on engines reducing their longevity.

MetalCraft Marine's high-efficiency hulls offset the FireStorm's high gear-loads, providing additional speed and better fuel economy. MetalCraft Marine FireStorm fireboats give you speed and performance without compromising the equipment list.

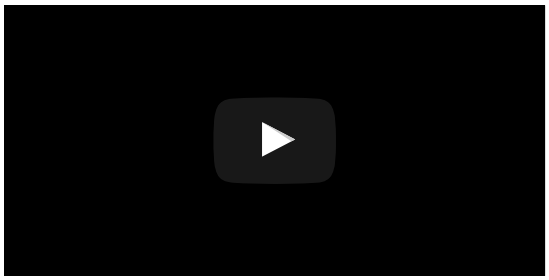
Rescue Options

- Heated & A/C patient care area with primary patient care bench & secondary care berth
- Hinged critical care berth
- Dedicated EMS equipment storage with power taps for battery chargers
- Piped oxygen supply to patient berths
- Forward loading capability for stokes through forward hinged window
- Aid bag, stokes and back board storage
- 500lb. manual or electric davit
- Aft deck steering station for crew and patient safety

Here's a video courtesy of City of Monterey



Here's a video courtesy of Cornelius-Lemlay Fire Rescue



FireStorm 32 High Speed Aluminum Fireboat Photos

GSA Contract **GS-07F-0084J**

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Last updated: February 14 2017

Date: June 1, 2017
Project: Wynn Casino Contaminated Sediment Cap Design
Boston and Everett, Massachusetts, USA
Task: Coastal erosion forced by surface gravity waves

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Amec Foster Wheeler Project No.: 3651160042.008

Executive Summary

The objective of this technical memorandum is to analyze proposed cap sediment sizes, and structural systems necessary to mitigate erosion of cap sediment due to surface gravity waves forced by the wind of an episodic design storm. A sediment cap composed of coarse sand (sediment grain diameter between 0.5 and 1.0 millimeter), or of larger sediment, will remain immobile in the central part of the channel during a weak category 1 hurricane. We propose three approaches to mitigate erosion of cap material on tidal flats in the embayment: (A) to employ no mitigation system, and to replace eroded cap sediment after episodic events; (B) to construct rubble mound breakwaters; or (C) to armor the cap with larger-diameter sediment. . Combinations of each of the three options are also viable to mitigate episodic erosion of the tidal flats. For beaches along the Mystic River, we propose armor or replace. A recommendation is not made in this technical memo, for the tidal flats or beaches, as cost, permit, regulatory, and client constraints govern the decision. This technical memorandum is intended to inform that decision.

Introduction

Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) proposes to construct a sediment cap in the former Everett staging yard, Boston and Everett, Massachusetts (fig. 1). The primary objective of the cap is to isolate contaminated sediments. The design achieves the following secondary objectives:

- Stabilize contaminated sediment
- Decrease direct human, animal, and plant contact with contaminated sediment
- Discourage colonization of contaminated parts of the benthic zone by burrowing organisms
- Encourage colonization of parts of the benthic zone by benthic organisms
- Reduce resuspension and transport of contaminated sediment by benthic water flows

This technical memorandum is part of a larger design. The objective of this technical memorandum is to recommend cap sediment sizes and other structural systems necessary to resist or minimize erosion of cap sediment, due to surface gravity waves forced by the wind of an episodic design storm.

Figure 1. Former Everett staging yard, Boston and Everett, Massachusetts, and north beach, north tidal flat, central channel, south tidal flat, south beach, embayment, and Mystic River area designations, near 42° 23’ 35.6” N, 71° 04’ 17.0” W. No scale intended. Image from Google Earth.

This memorandum uses equations detailed in Cao and others (2006), Chaudhry (2013), Dean and Dalrymple (1991), and U.S. Army Corps of Engineers (1984, 1986, and 2002). The technical approach described in this memorandum is appropriate to the qualitative conclusions[1].

This technical memorandum first presents methods used in analyses, followed by a justification for the wind velocity for the episodic design storm. Calculations are itemized. Options for a cap design are detailed. A brief operations-and-maintenance statement is made.

Method

Methods are presented for the calculation of wave height, wave orbital velocity at the bed, shear stress at the bed, and rubble-mound breakwater dimensions.

Wave Height

Significant surface-gravity wave height forced by wind, and associated surface-gravity wave period were calculated as a function of fetch and depth (USACE, 1984, eqns. 3–39 and 3–40):

[1] More complex tools exist in the practice of coastal engineering to address problems of surface gravity waves, sediment transport forced by surface gravity waves, refraction, diffraction, shoreline stability forced by episodic events, surface-gravity wave forces on coastal structures, profile equilibrium, and risk analyses.

$$\frac{gH}{U_A^2} = 0.283 \tanh\left[0.530\left(\frac{gd}{U_A^2}\right)^{3/4}\right] \tanh\left\{\frac{0.00565\left(\frac{gF}{U_A^2}\right)^{1/2}}{\tanh\left[0.530\left(\frac{gd}{U_A^2}\right)^{3/4}\right]}\right\} \quad (3\text{-}39)$$

$$\frac{gT}{U_A} = 7.54 \tanh\left[0.833\left(\frac{gd}{U_A^2}\right)^{3/8}\right] \tanh\left\{\frac{0.0379\left(\frac{gF}{U_A^2}\right)^{1/3}}{\tanh\left[0.833\left(\frac{gd}{U_A^2}\right)^{3/8}\right]}\right\} \quad (3\text{-}40)$$

Where g is gravitational acceleration, H is significant wave height, $U_A=0.71u_{10}^{1.23}$ is adjusted wind velocity, u_{10} is wind velocity 10 meters (m) above the water surface, d is depth, F is fetch, and T is surface-gravity wave period associated with the calculated significant wave height.

Surface gravity waves break when the ratio of wave height to water depth exceeds a breaking parameter with a canonical value of 0.78 (Dean and Dalrymple, 1991).

Wave Orbital Velocity

Wave orbital velocity was calculated at the bed with the following equation from Airy wave theory (Dean and Dalrymple, 1991):

$$u_z(\boldsymbol{x}, z, t) = \boldsymbol{e}_k \, \sigma \, a \, \frac{\cosh\left(k\,(z+h)\right)}{\sinh\left(k\,h\right)} \cos\,\theta$$

where x is an arbitrary horizontal coordinate, z is a vertical coordinate, t is an arbitrary time, u_z is the horizontal component of the wave orbital at space-time coordinate (x,z,t), e_k is a unit vector, $\sigma=2\pi/T$ is angular frequency, $a=H/2$ is wave amplitude, $k=2\pi/L$ is wave number, L is wave length, h is depth, and θ is wave phase.

Angular frequency σ is calculated with the following dispersion equation:

$$\sigma = \sqrt{g\,k\,\tanh\left(k\,h\right)}$$

The dispersion equation is solved iteratively for k.

Shear Stress

Shear stress at the bed, τ, is (Chaudhry, 2013)

$$\tau = \frac{1}{8} \cdot f_D \cdot \rho \cdot \langle v \rangle^2$$

where f_D is the Darcy-Weisbach friction factor, ρ is water density, and $v=u_z$ is a representative velocity at the bed.

Particle Reynolds number, Re_p^*, at the bed is

$$\mathrm{Re}_p* = \frac{u_* D}{\nu}$$

Where $u_*=(\rho\tau)^{0.5}$ is the friction velocity, D is the sediment diameter, and ν is water viscosity.

Critical shear stress τ_c for incipient motion of a sediment particle is related to particle Reynolds number at the bed with the Shields curve (fig. 2), and calculated with Critical Shields stress, θ_c,

$$\theta_c \quad = \quad \tau* = \frac{\tau}{(\rho_s - \rho)(g)(D)}$$

Where τ in this equation is critical shear stress, τ_c, at which incipient motion occurs.

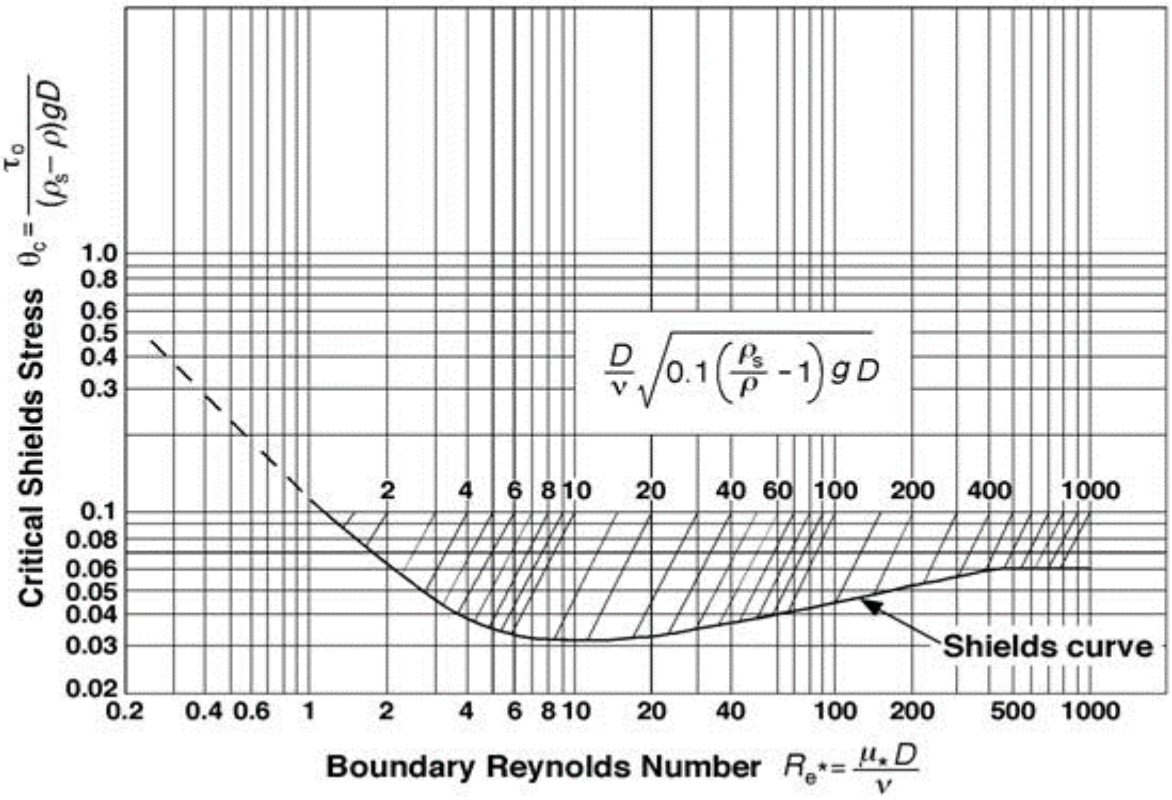


Figure 2. Critical Shields stress versus Boundary Reynolds number (Cao, Pender, and Meng, 2006).

If $\tau_b > \tau_c$, the surface gravity wave will move the sediment particle. If $\tau_b < \tau_c$, the surface gravity wave will not move the sediment particle.

Breakwater Dimensions

The Hudson stability equation (USACE, 1986, eqn. 4–1)

$$W_a = \frac{\gamma_a H^3}{K_D (S_a - 1)^3 \cot \alpha}$$

quantifies the pound weight, Wa, of an individual design armor unit in a rubble mound breakwater, where γ_a is the unit weight of the armor unit, in pounds per cubic foot, H is the design monocramatic wave height, K_D is a stability coefficient, S_a is the specific gravity of the armor unit, and α is the angle of the structure slope measured from the horizontal. The specific gravity of the armor unit, S_a, is the ratio of the unit weight of the armor unit, γ_a, to the unit weight of water, γ_w.

The stability coefficient K_D varies as a function of armor unit shape, placement, position on the breakwater, angle of the breakwater face, and wave-breaking condition (USACE, 1986, table 4–2).

An equivalent spherical sediment volume $V_a=W_a/\gamma_a$. An equivalent spherical radius, r_{eq}, is calculated from the volume of a sphere, where $V_a=4\pi r^3/3$, such that $r_{eq}=[3V_a/(4\pi)]^{1/3}$.

The proposed rubble mound breakwater will be composed of three layers, with three sediment sizes that decrease in diameter, with the largest diameter armor unit on the surface of the mound, the smallest diameter sediment in the core of the mound, and the middle sediment diameter under the top and over the core (USACE, 1986). The weight of each sediment particle in the top, middle, and core layers of the rubble mound breakwater are equivalent to the weight of the design armor unit, 1/10 the weight of the design armor unit, and a maximum of 1/200 the weight of the design armor unit (USACE, 1986), respectively.

The thickness, r, of each layer is (USACE, 1986, eqn. 4–3)

$$r = nk_\Delta \left[\frac{W_a}{\gamma_a}\right]^{1/3}$$

where n is the number of armor units that comprise the layer, and k_D is a layer thickness coefficient, which is equivalent to 1 for both smooth and rough stones (USACE, 1986, table 4-3).

The depth to which the breakwater should extend below mean low water is equivalent to twice the wave height.

The minimum top width, β, is (USACE, 1986, eqn. 4–2)

$$\beta = 3k_\Delta \left[\frac{W_a}{\gamma_a}\right]^{1/3}$$

Design Wind Velocity

Significant surface-gravity wave height is calculated as a function of wind velocity. For the purposes of this analysis, the 74 mile-per-hour, minimum wind velocity for a category 1 hurricane is adopted as the design wind velocity. Between 1869 and 2011, one hundred and forty-two tropical depressions, tropical storms, extratropical storms, and hurricanes made landfall in New England (table 1).

Table 1. Tropical depressions, tropical storms, extratropical storms, and hurricanes that made landfall in New England, from 1869 to 2011.

	Category			
Storm	Peak intensity	Intensity at landfall	Season	Date of landfall
Hurricane Six	Category 3 Hurricane	Category 3 Hurricane	1869	September 9, 1869
1869 Saxby Gale	Category 2 Hurricane	Category 2 Hurricane	1869	October 4, 1869
Hurricane Five	Category 1 Hurricane	Tropical Storm	1872	October 27, 1872
Hurricane Six	Category 1 Hurricane	Tropical Storm	1874	September 30, 1874
San Felipe Hurricane	Category 3 Hurricane	Tropical Depression	1876	September 19, 1876
Unnamed	Category 3 Hurricane	Extratropical Storm	1877	October 5, 1877
Gale of 1878	Category 2 Hurricane	Extratropical Storm	1878	October 24, 1878
Hurricane Two	Category 3 Hurricane	Category 1 Hurricane	1879	August 19, 1879
Tropical Storm Eleven	Tropical Storm	Extratropical Storm	1880	October 23, 1880
Hurricane Three	Category 3 Hurricane	Tropical Storm	1888	August 22, 1888
Tropical Storm Five	Tropical Storm	Extratropical Storm	1888	September 12, 1888
Hurricane Six	Category 1 Hurricane	Category 1 Hurricane	1888	September 26, 1888
Hurricane Six	Category 2 Hurricane	Tropical Storm	1889	September 25, 1889
Hurricane Four	Category 3 Hurricane	Category 1 Hurricane	1893	August 24, 1893
1893 Sea Islands Hurricane	Category 3 Hurricane	Tropical Storm	1893	August 29, 1893
Hurricane Five	Category 3 Hurricane	Category 1 Hurricane	1894	October 10, 1894
1938 New England hurricane	Category 5 Hurricane	Category 3 Hurricane	1938	September 21, 1938
1944 Great Atlantic Hurricane	Category 4 Hurricane	Category 1 Hurricane	1944	September 15, 1944
Hurricane Able	Category 2 Hurricane	Tropical Depression	1952	September 1, 1952
Hurricane Carol	Category 3 Hurricane	Category 3 Hurricane	1954	August 31, 1954
Hurricane Edna	Category 3 Hurricane	Category 1 Hurricane	1954	September 11, 1954
Hurricane Diane	Category 3 Hurricane	Tropical Storm	1955	August 18–19, 1955
Hurricane Cindy	Category 1 Hurricane	Tropical Storm	1959	July 11, 1959
Hurricane Donna	Category 4 Hurricane	Category 2 Hurricane	1960	September 12, 1960
Hurricane Esther	Category 4 Hurricane	Tropical Storm	1961	September 26, 1961
Hurricane Alma	Category 3 Hurricane	Extratropical Storm	1966	June 13, 1966
Tropical Storm Doria	Tropical Storm	Tropical storm	1971	August 29, 1971
Hurricane Agnes	Category 1 Hurricane	Tropical Storm	1972	June 22, 1972
Tropical Storm Carrie	Tropical Storm	Tropical Storm	1972	September 3, 1972
Subtropical Storm Alfa	Tropical Storm	Subtropical Storm	1973	July 30, 1973
Hurricane Belle	Category 3 Hurricane	Tropical Storm	1976	August 10, 1976
Tropical Storm Henri	Tropical Storm	Tropical Depression	1985	September 23, 1985
Hurricane Gloria	Category 4 Hurricane	Category 1 Hurricane	1985	September 27, 1985
Tropical Storm Chris	Tropical Storm	Tropical Depression	1988	August 29, 1988

	Category			
Storm	Peak intensity	Intensity at landfall	Season	Date of landfall
Hurricane Bob	Category 3 Hurricane	Category 2 Hurricane	1991	August 19, 1991
Hurricane Bertha	Category 3 Hurricane	Tropical Storm	1996	July 13, 1996
Hurricane Floyd	Category 4 Hurricane	Tropical Storm	1999	September 16–17, 1999
Tropical Storm Hermine	Tropical Storm	Tropical Storm	2004	August 31, 2004
Tropical Storm Beryl	Tropical Storm	Tropical Storm	2006	July 21, 2006
Tropical Storm Barry	Tropical Storm	Extratropical Storm	2007	June 4, 2007
Tropical Storm Danny	Tropical Storm	Extratropical Storm	2009	August 29, 2009
Hurricane Irene	Category 3 Hurricane	Tropical Storm	2011	August 28, 2011
		number of years	142	

source: https://en.wikipedia.org/wiki/List_of_New_England_hurricanes

Hurricanes of category 1 or greater have a nine percent chance of making landfall in New England, in any given year (table 2), based on 142 years of record (table 1). This analysis assumes that landfall is a random event, and that the chance of landfall is the same in any given year.

Table 2. Number of tropical depressions, tropical storms, extratropical storms, and hurricanes that made landfall in New England, between 1869 and 2011; minimum wind velocity, maximum wind velocity, occurrence probability of the storm category, and exceedance probability of the minimum wind velocity.

	Wind Velocity		Landfall		Exceedance of Minimum Wind Velocity
Category	Minimum	Maximum	Number	Occurrence	
Tropical Depression	0	38	4	3%	29%
Tropical or Extratropical Storm	39	73	24	17%	26%
Category 1 Hurricane	74	95	7	5%	9%
Category 2 Hurricane	96	110	3	2%	4%
Category 3 Hurricane	111	129	3	2%	2%

The rate of landfall in New England is not uniform. Over 51 years, from 1960 to 2011, three hurricanes made landfall in New England. Over 44 years, from 1894 to 1938, no hurricanes made landfall. Over 25 years, from 1869 to 1894, six hurricanes made landfall in New England. Wind generated surface gravity waves may occur in urban environments, in New England, during hurricanes (fig. 3).

Although the choice of 74 mile-per-hour design velocity is somewhat arbitrary, the roughly ten-percent annual chance that this velocity will be exceeded somewhere in New England is reasonable for consideration as a design wind velocity. Schwerdt *et al.* (1979) defined a standard project hurricane as the most severe hurricane reasonably characteristic of New England. The standard project hurricane has less than a one-half of one-percent chance of occurring in any given year. The standard project hurricane is rarer than the weak category 1 hurricane considered in this technical memorandum. The standard project hurricane is too rare for consideration in this design. The system under consideration is not intended to protect human life. The system necessary to mitigate the standard project hurricane may be considered by some to be too robust to protect a sediment cap. If the client or regulators prefer a more robust system, analyses presented in this technical memorandum can be re-worked to mitigate the standard project hurricane.

Figure 3. Wind-generated, fetch-limited, surface gravity waves in Providence, Rhode Island, during category 2 Hurricane Carol, in 1954 (Epstein, 2013).

New England is more frequently subjected to nor'easter storms. However, significant differences between nor'easters and hurricanes make hurricanes better for design consideration. The strongest hurricane winds occur near the surface; the strongest nor'easter winds occur in the upper atmosphere. Nor'easter winds typically blow from the northeast to the southwest, or when the storm is to the south of a given location, from the east to the west. These orientations will generate waves that propagate away from the former Everett staging yard. Although Nor'easters are more common than hurricanes, hurricane wind velocities are greater than nor'easter wind velocities, and preferred for consideration in this technical memorandum.

Calculation

To estimate a design wave that will act on the cap, a fetch oriented from southwest to northeast is determined for the north beach, central channel, and south beach areas (figs. 1 and 4). Measured fetches for the north beach, central channel, and south beach were 417 m, 536 m, and 265 m, respectively (fig. 4).

(*A*) (*B*) (*C*)

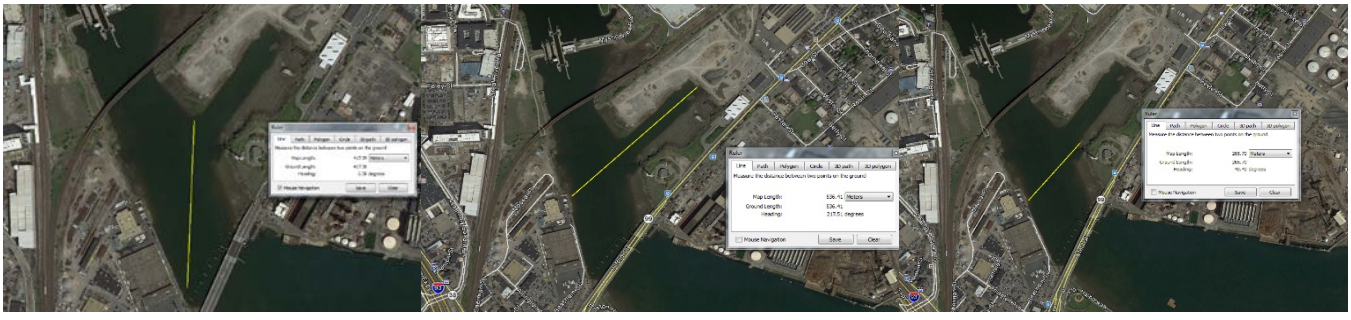


Figure 4. Fetch orientations and measurements for the (*A*) north beach, (*B*) central channel, and (*C*) south beach. No scale intended. Image from Google Earth.

Incipient motion and design sediment diameters were calculated with the following general strategy for the central channel, shown as design sheet 1 at the back of the present memorandum:

1. Measure fetch.
2. Adopt the 1-percent annual exceedance probability flood elevation of 9 feet above the North American Vertical Datum of 1988 (NAVD88) as the maximum water surface elevation, and mean lower low water tide elevation of 5.54 feet below NAVD88 as the minimum water surface elevation. The 1-percent annual exceedance probability flood elevation has a 1-percent chance of being exceeded in any given year (USGS, 2010). The Federal Emergency Management Agency base flood elevation is equivalent to the 1-percent annual exceedance probability flood elevation. The mean lower low water elevation is the average elevation of lowest low water elevations during a tidal day, where tide is semidiurnal or mixed, over a 19-year Metonic cycle (the National Tidal Datum Epoch) (USACE, 2002). Where tide is diurnal, mean lower low water elevation is equivalent to mean low water elevation.
3. Adopt 15 feet below NAVD88 as the elevation of the top surface of the sediment cap, at the base of the central channel.
4. Calculate corresponding depth for the maximum and minimum water surface elevations.
5. Adopt 74-mile-per-hour category 1 hurricane, minimum wind velocity as the design wind velocity.
6. Calculate significant wave height H and associated wave period T.
7. Calculate wave number k from the dispersion equation.
8. Calculate horizontal component u_x of wave orbital velocity at the bed in the central channel, 15 feet below the water surface.
9. Adopt canonical water density of 1000 kg/m^3, specific gravity of sediment of 2.65, and Darcy-Weisbach friction factor of 0.032.
10. Calculate bed shear τ_b due to u_x.
11. Calculate shear velocity u*.
12. Adopt a target sediment diameter.
13. Calculate particle Reynolds number.
14. Determine Critical Shields stress θ_c.
15. Calculate critical shear stress τ_c, at which incipient motion occurs for the target sedmient diameter.
16. Compare τ_b and τ_c. If $\tau_b > \tau_c$, the wave will move the sediment particle. If $\tau_b < \tau_c$, the wave will not move the sediment particle.
17. If the sediment particle will move, choose a new target sediment diameter at step 12.
18. Repeat steps 12 to 17 until $\tau_b < \tau_c$.

Incipient motion and design sediment diameters were calculated with a strategy identical to steps 1 to 18 above, for north beach, south beach, and on tidal flats in the embayment, shown as design sheets 2, 3 and 4, respectively—at the back of the present memorandum—with the following exceptions:

- The base flood elevation in step 2 was not considered, as a breaking wave on the beach face governs design on these beaches.

- Water depths at breaking were analyzed.

Cap Design

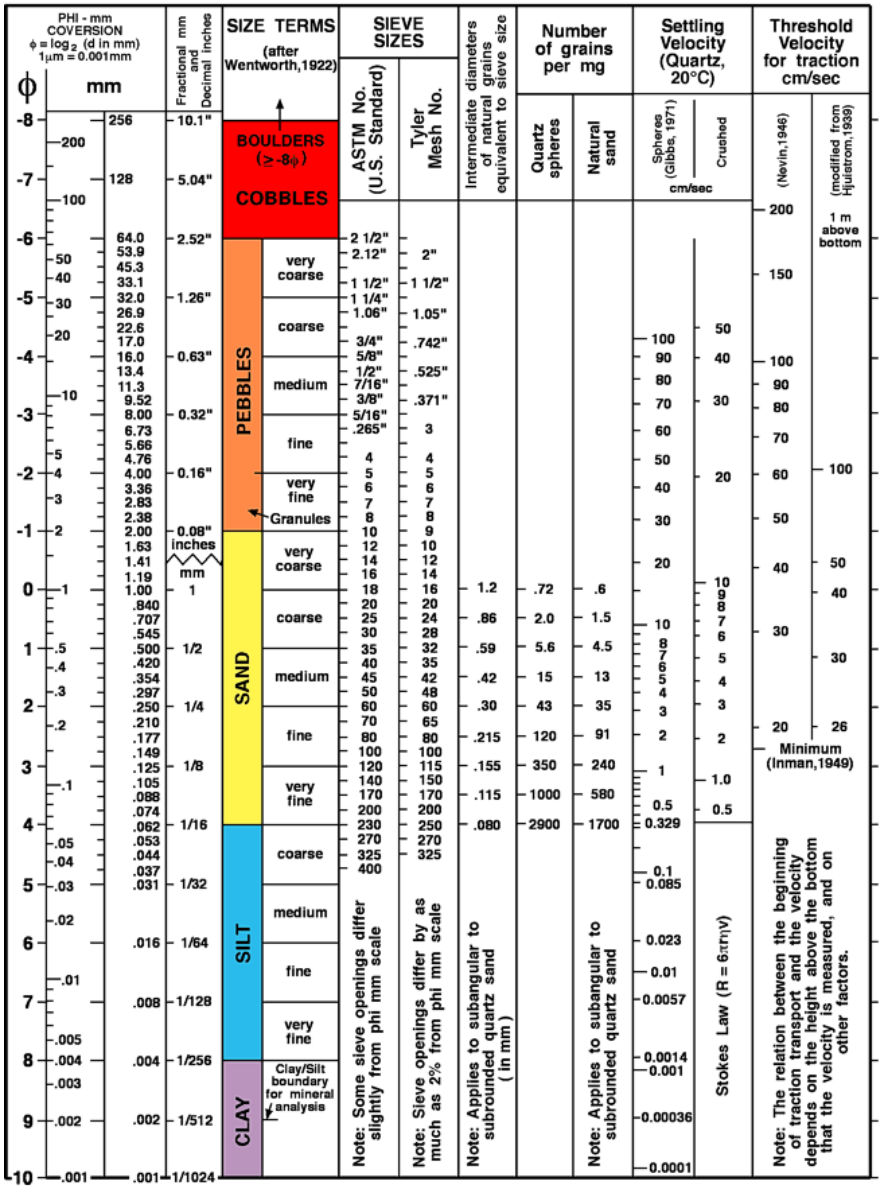
The design of cap sediment sizes and other structural systems necessary to mitigate erosion of cap sediment, due to surface gravity waves forced by the wind of an episodic design storm is presented in the following two parts: (1) design of the sediment cap in the central channel, and (2) design of the sediment cap on tidal flats and on beaches.

Central Channel

In the central channel, the mean-low-water design scenario governed the base-flood-elevation design scenario. For the mean-low-water design scenario, sediment diameters greater than 0.5 millimeter (mm) (fig. 5) will not move in response to a wave with a 0.6-meter wave height, 1.8-second wave period, and 5.3-meter wave length, in 2.9 m of water (design sheet 1). Calculated bed shear stress of 0.06 Pascal (Pa) is five times less than the critical shear stress of 0.3 Pa at a particle Reynolds number of 4.0. This five-fold difference introduces a considerable factor of assurance into the no-motion design for the central channel. Sediment diameters greater than 0.5 mm correspond with coarse sand, very coarse sand, gravels, and cobbles in the Wentworth (1922) sediment classification system (table 3). Placement of cap material greater than 0.5-mm diameter will likely not erode at the bed elevation 15 feet below NAVD88, in response to a surface gravity wave generated by a 74-mile-per-hour wind velocity of a weak category 1 hurricane, at the mean low water surface elevation in the Mystic River.

Figure 5**.** Former Everett staging yard, Boston and Everett, Massachusetts, selected coastal engineering conceptual design elements, near 42° 23’ 35.6” N, 71° 04’ 17.0” W. No scale intended. D is sediment diameter, MHW is mean high water, MLW is mean low water, mm is millimeter. No scale intended. Image from Google Earth.

Table 3. Wentworth sediment classification system USGS (2007).



Tidal Flats and Beaches

In the tidal flats, the design wave will break. The flat is currently in an equlibrium state, which established over a relatively long period of time in response to the existing forcing environment in the system. In the native condition, in response to an eposiodic event—such as a category 1 hurricane—the profile of the tidal flat will likely transition toward an eroded equilibrium, with the most erosion shoreward of an offshore locaiton at which waves break.

Several options are available to mitigate sediment cap erosion in the intertidal zone of northern and southern tidal flats, and on north and south beaches (figs. 1 and 5). Sediment diameters are nominal, for the purposes of these analyses. Specific sediment gradation is detailed in other project documentation. Analyses with a nominal diameter conform to analyses of a graded, composite sediment. The following three options are considered in this technical memorandum:

Option A: No mitigation system

Deploy no structural systems to mitigate erosion during episodic events. Replace eroded cap sediment after every episodic event, to return the cap system to design requirements. Two sediment diameters are considered:

- Coarse-sand sediment diameters, nominally greater than 0.5 mm (table 3) for the purposes of this analysis. Use cap sediment on tidal flats and beaches equivalent to cap sediment in the central channel.
- Silty-sand sediment diameters, nominally less than 0.5 mm, for the purposes of this analysis.

Surface gravity waves forced by a design wind velocity will erode both coarse-sand cap material and silty-sand cap material, placed on tidal flats (design sheet 2). Waves will erode more silty-sand cap material than coarse-sand cap material.

On the south beach, and on sloping transitions from the beach to the bottom of the river, sediment diameters greater than 8 mm will not move in response to a breaking wave with a 0.4-meter wave height, 1.5-second wave period, and 2.8-meter wave length, in 0.5 m of water (design sheet 3). Calculated bed shear stress of 5.6 Pa is less than the critical shear stress of 7.8 Pa for the 8-mm sediment at a particle Reynolds number of 600. Sediment diameters 4 mm and less, including coarse sand and silty sand, will move in response to the breaking wave (design sheet 3). Calculated bed shear stress of 5.6 Pa is greater than the critical shear stress of 3.8 Pa for a 4-mm sediment at a particle Reynolds number of 300.

On the north beach, and on sloping transitions from the beach to the bottom of the river, sediment diameters greater than 8 mm (fig. 5) will not move in response to a breaking wave with a 0.5-meter wave height, 1.7-second wave period, and 3.7-meter wave length, in 0.7 m of water (design sheet 4). Calculated bed shear stress of 7.5 Pa is less than the critical shear stress of 7.8 Pa for the 8-mm sediment at a particle Reynolds number of 690. Sediment diameters 4 mm and less, including coarse sand and silty sand, will move in response to the breaking wave (design sheet 4). Calculated bed shear stress of 7.5 Pa is greater than the critical shear stress of 3.9 Pa for a 4-mm sediment at a particle Reynolds number of 350.

On the northern and southern tidal flats, and on sloping transitions from tidal flats to the base of the central channel, sediment diameters greater than 16 mm will not move in response to a breaking wave with a 0.6-meter wave height, 1.8-second wave period, and 4.2-meter wave length, in 0.7 m of water (design sheet 2). Calculated bed shear stress of 8.7 Pa is less than the critical shear stress of 15.5 Pa for the 16-mm sediment at a particle Reynolds number of 1500. Sediment diameters 8 mm and less, including coarse sand and silty sand, will move in response to the breaking wave (design sheet 2). Calculated bed shear stress of 8.7 Pa is greater than the critical shear stress of 7.8 Pa for an 8-mm sediment at a particle Reynolds number of 750.

Both coarse-sand cap material and silty-sand cap material eroded by episodic storms must be replaced, to a design standard specified in a maintenance plan, during a fixed period after the end of the storm, also specified in a maintenance plan.

Option B: Construct rubble mound breakwaters

Construct rubble mound breakwaters on north and south beaches, at the entrance to the embayment, to dissipate surface-gravity wave energy on tidal flats, northeast of breakwaters (figs. 5–7). Breakwaters should tie into existing grade at the mean high-water line, or higher, and extend below the mean low-water line.

For both breakwaters, waves propagating parallel to the axis of the central channel will be dissipated by direct impact on each breakwater at the water surface, and refract and diffract around the submerged part of the breakwater, bending the wave orthogonal toward an orientation normal to the shoreline of

the tidal flat. The bending wave orthogonal and associated re-oriented wave crest will create a breaking wave that propagates and breaks in an oblique orientation to the shoreline of both the southern and northern tidal flats. If tidal flats are not armored, some erosion of the shoreline will occur in response to this obliquely breaking wave. More erosion will occur on southwestern sides of the embayment than on northeastern sides.

The design wave height of 0.4 m on a 1.5 horizontal to 1 vertical sloping rubble mound breakwater requires a 16-pound armor unit, which is equivalent to a fine boulder in the Wentworth sediment classification system, with a diameter between 256 mm and 512 mm. The breakwater is constructed in three layers, with a middle layer of coarse cobbles weighing 1.6 pounds and having diameters between 128 mm and 256 mm, and a base layer of very coarse pebbles with diameters between 32 mm and 64 mm.

Rubble mound breakwaters will mitigate erosion on the northern and southern tidal flats, northeast of the specified breakwater locations, compared to a sediment cap system without rubble mound breakwaters. The presence of rubble mound breakwaters will not mitigate erosion on the north beach, or riverward of the south beach breakwater.

Option C: Armor tidal flats and beaches

Armor the sediment cap on tidal flats to resist erosion during episodic events, with larger diameter cap material than cap material in the central channel. Three sediment armor deployments are considered:

- Armor the north beach with medium pebble, with sediment diameters between 8 and 16 mm
- Armor the south beach with medium pebble, with sediment diameters between 8 and 16 mm
- Armor tidal flats with coarse pebble, with sediment diameters between 16 and 32 mm

On the south beach, and on sloping transitions from the beach to the bottom of the river, sediment diameters greater than 8 mm will not move in response to a breaking wave with a 0.4-meter wave height, 1.5-second wave period, and 2.8-meter wave length, in 0.5 m of water (design sheet 3). Calculated bed shear stress of 5.6 Pa is less than the critical shear stress of 7.8 Pa for the 8-mm sediment at a particle Reynolds number of 600. Sediment diameters between 8 mm and 16 mm correspond with medium pebble in the Wentworth sediment classification system (table 3).

On the north beach, and on sloping transitions from the beach to the bottom of the river, sediment diameters greater than 8 mm will not move in response to a breaking wave with a 0.5-meter wave height, 1.7-second wave period, and 3.7-meter wave length, in 0.7 m of water (design sheet 4). Calculated bed shear stress of 7.5 Pa is less than the critical shear stress of 7.8 Pa for the 8-mm sediment at a particle Reynolds number of 690. Sediment diameters between 8 mm and 16 mm correspond with medium pebble in the Wentworth sediment classification system (table 3).

On the northern and southern tidal flats, and on sloping transitions from tidal flats to the base of the central channel, sediment diameters greater than 16 mm will not move in response to a breaking wave with a 0.6-meter wave height, 1.8-second wave period, and 4.2-meter wave length, in 0.7 m of water (design sheet 2). Calculated bed shear stress of 8.7 Pa is less than the critical shear stress of 15.5 Pa for the 16-mm sediment at a particle Reynolds number of 1500. Sediment diameters between 16 mm and 32 mm correspond with coarse pebble in the Wentworth sediment classification system (table 3).

A combination of options is also viable. For example, rubble mound breakwaters and armored tidal flats may be deployed.

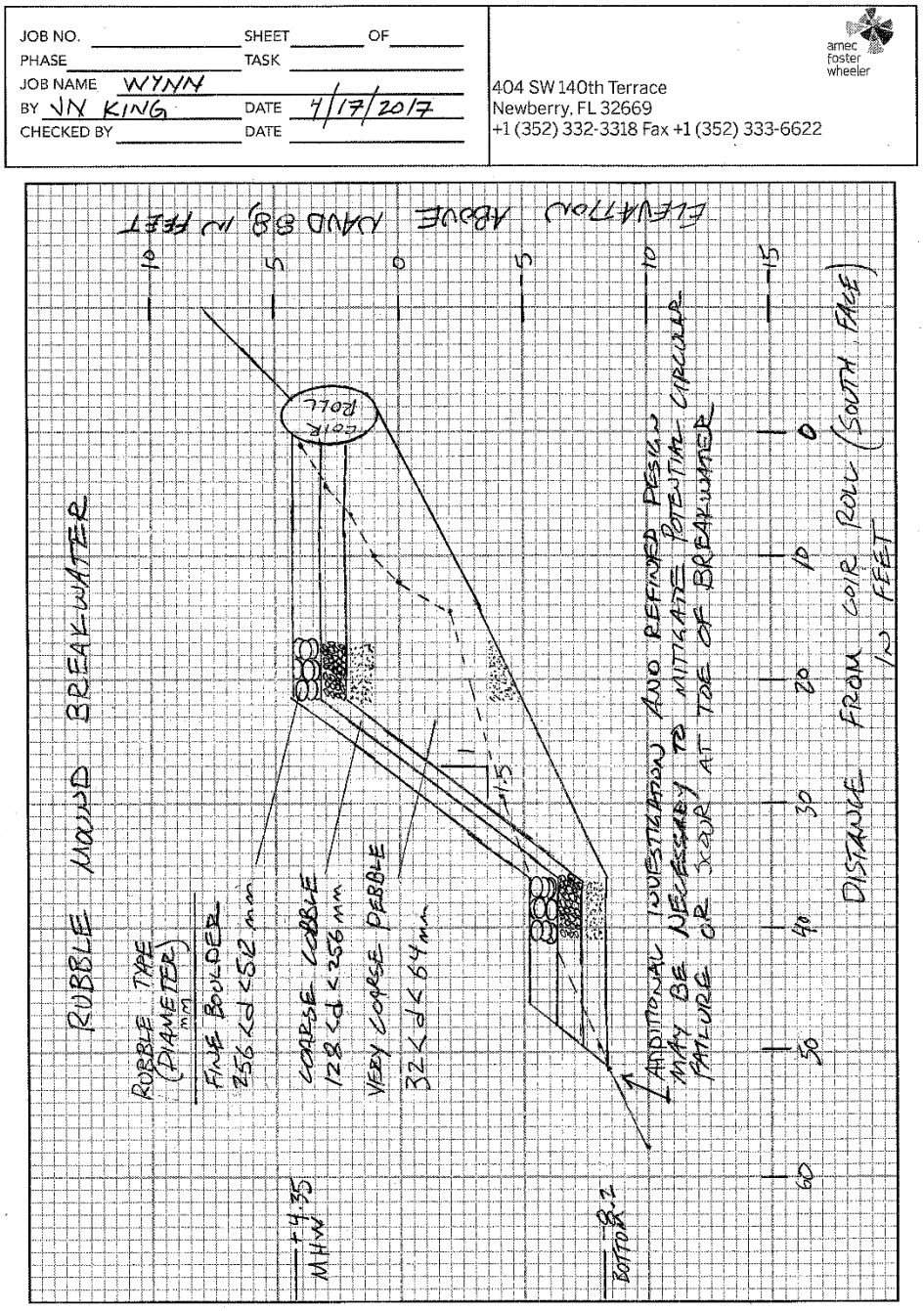


Figure 6. Conceptual section for a proposed rubble mound breakwater. This document is not intended for construction purposes. Additional details and design refinement may be necessary for construction, including but not limited to additional detail at the toe of the structure.

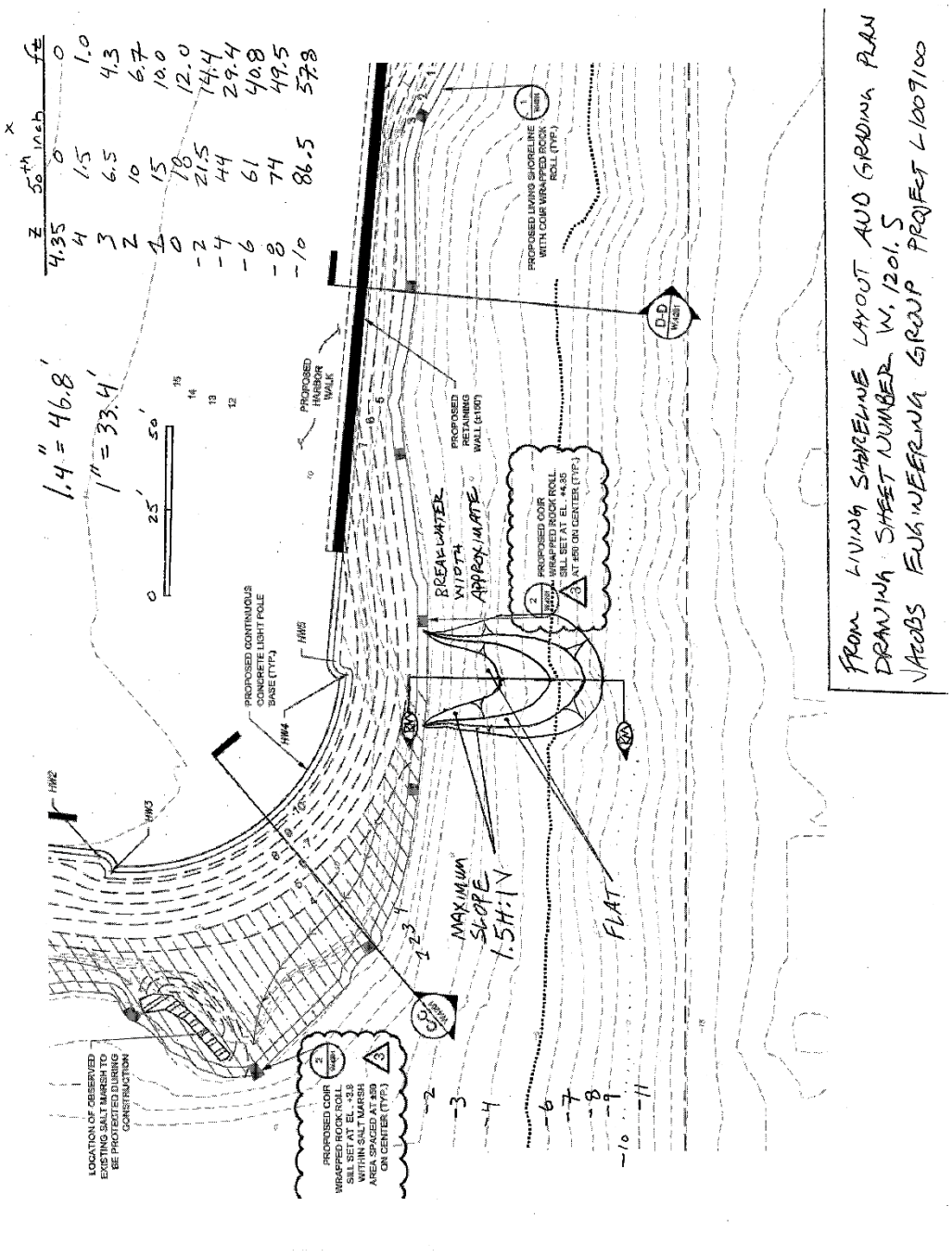


Figure 7. Conceptual plan for a proposed rubble mound breakwater. This document is not intended for construction purposes. Additional details and design refinement may be necessary for construction. The present figure was resized form the original. The cited inch-to-foot scale is not relevant to the present, resized figure.

Erosion Risk

Course-sand cap material placed at the bottom of the central channel, at an elevation less than 15 feet below NAVD88 is not likely to erode in response to a surface gravity wave generated by a 74-mile-per-hour wind velocity of a weak category 1 hurricane, at the mean lower low water surface elevation, 5.54 feet below NAVD88 in the Mystic River.

Erosion risk of some coarse-sand cap material or silty-sand cap material, placed on tidal flats and on beaches, is greater than erosion risk of coarse-sand cap material placed in the central channel at depth.

Rubble mound breakwaters decrease erosion risk for tidal flats northeast of each breakwater, compared with the same tidal-flat sediment-cap system with no breakwater protection.

Armoring of tidal flats and beaches decreases erosion risk, compared with a tidal-flat sediment-cap system composed of smaller-diameter sediment.

The risk for each of these components is greater for stronger hurricanes, and for stronger sustained winds associated with other storms.

Quantitative estimation of the percent of the sediment cap that will be eroded is difficult (table 4). These estimates are simply educated guesses. These estimates are reasonable for waves generated by a southwest to the northeast wind, most relevant to this design. Waves generated by winds with other orientations are less critical, and will deliver less energy to the embayment.

Table 4. Educated guess of the percent eroded in response to surface gravity waves forced by a weak category 1 hurricane. Sediment diameters are nominal, for the purposes of these analyses. Design sediment gradation is detailed in other project documentation. mm is millimeter.

	PERCENT OF TIDAL FLAT ERODED			PERCENT OF BEACH ERODED		
	silty sand	coarse sand	coarse pebble	silty sand	coarse sand	medium pebble
SYSTEM	d < 0.5 mm	0.5 < d < 1.0 mm	16 < d < 32 mm	d < 0.5 mm	0.5 < d < 1.0 mm	8 < d< 16 mm
OPTION A: NO MITIGATION SYSTEM	40%	30%	---	40%	30%	---
OPTIONS B: RUBBLE MOUND BREAKWATER	20%	15%	<1%	40%	30%	<5%
OPTION C: ARMOR	---	---	<5%	---	---	<5%

Operations, Maintenance, and Monitoring

An operation, maintenance and monitoring plan should be prepared to memorialize the nature and frequency of inspections and evaluations to ensure that the thickness and integrity of the cap are maintained. Initially, the monitoring program should include both inspection on an annual basis, and following storms or hurricanes with annual exceedance probabilities less than 10 percent. After an initial period of annual monitoring, the frequency of monitoring may be reduced, depending on cap performance during the initial period.

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Design Sheet 1. Central channel Critical Shield's stress analysis.

input
calculation
linked cell
Note
Output

CONVERSION

1	ft	0.3048	m
1	mile	5280	ft
1	m	1000	mm
1	hour	60	min
1	min	60	sec
1	mph	0.44704	m/s

SIGNIFICANT WAVE HEIGHT

parameter	unit	symbol	value		source
gravitational acceleration	m/s^2	g	9.806		canonical
fetch	m	F	536	536	Google Earth (see figure below)
water surface elevation	ft NAVD88		9	-5.54	Amec Foster Wheeler figure 3-1, dated 1/25/2017
	m NAVD88		2.743	-1.689	
bed elevation	ft NAVD88	z_b; z=-z_b	-15	-15	Amec Foster Wheeler figure 3-1, dated 1/25/2017
	m NAVD88		-4.572	-4.572	
depth	m	d	7.315	2.883	
wind speed @ 10m above surface	mph	u_{10}	74	74	Category 1 hurricane
wind speed @ 10m above surface	m/s		33.081	33.081	
wind stress factor	m/s	U_A	52.522	52.522	
		Grouped terms			
		gF/U_A^2	1.907	1.907	see below
		gd/U_A^2	0.026	0.010	see below
		A	0.034	0.017	see below
		B	0.008	0.008	see below
		C	0.212	0.150	see below
		D	0.047	0.047	see below
		gH/U_A^2	0.00217	0.00207	see below
		gT/U_A	0.348	0.343	see below
significant wave height	m	H_s	0.611	0.581	Shore Protection Manual equations 3-39 and 3-40
wave period for significant wave	s	T	1.87	1.84	Shore Protection Manual equations 3-39 and 3-40

CHECK

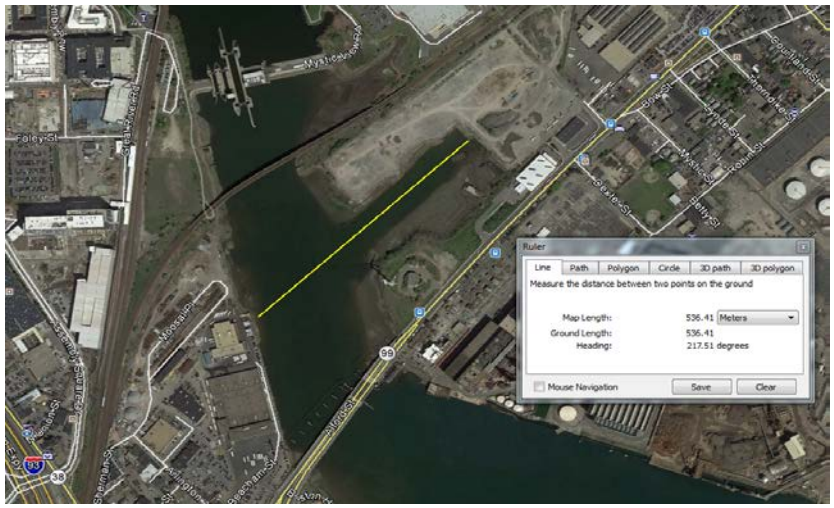
significant wave height	m	H_s	0.611	0.581	online calculator for same model: https://woodshole.er.usgs.gov/project-pages/coastal_model/Tools/fetch_limited.html
			-0.1%	0.0%	OK
wave period for significant wave	s	T	1.87	1.84	online calculator for same model: https://woodshole.er.usgs.gov/project-pages/coastal_model/Tools/fetch_limited.html
			0.0%	0.1%	OK

Shore Protection Manual

$$\frac{gH}{U_A^2} = 0.283 \tanh\left[0.530\left(\frac{gd}{U_A^2}\right)^{3/4}\right] \tanh\left\{\frac{0.00565\left(\frac{gF}{U_A^2}\right)^{1/2}}{\tanh\left[0.530\left(\frac{gd}{U_A^2}\right)^{3/4}\right]}\right\} \quad (3\text{-}39)$$

$$\frac{gT}{U_A} = 7.54 \tanh\left[0.833\left(\frac{gd}{U_A^2}\right)^{3/8}\right] \tanh\left\{\frac{0.0379\left(\frac{gF}{U_A^2}\right)^{1/3}}{\tanh\left[0.833\left(\frac{gd}{U_A^2}\right)^{3/8}\right]}\right\} \quad (3\text{-}40)$$

A, B, C, D

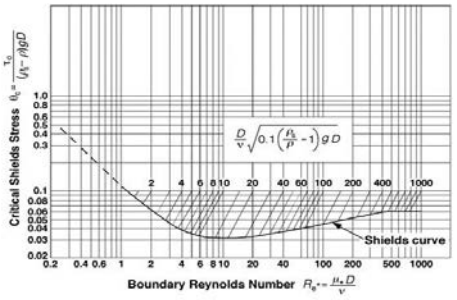


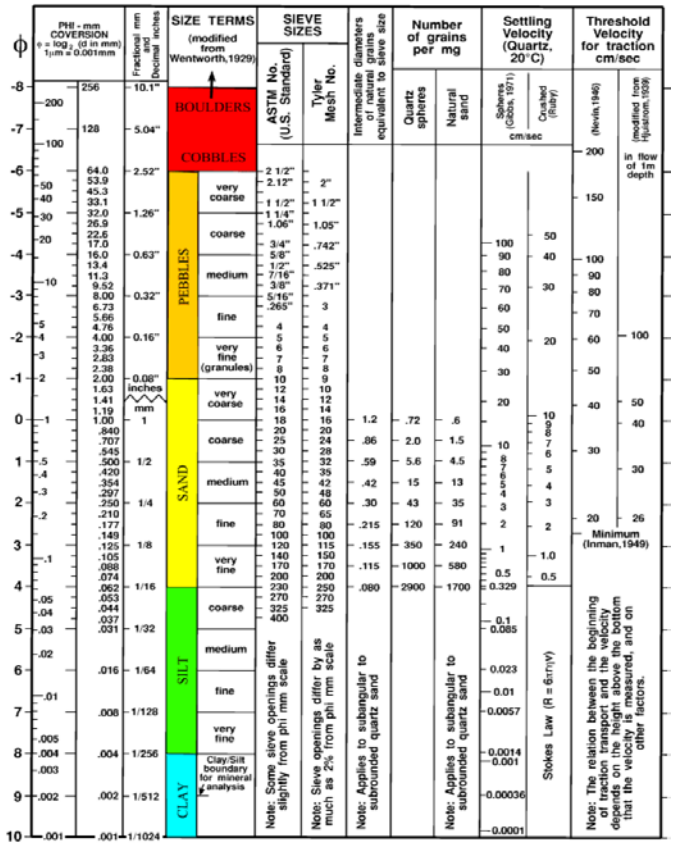
WAVE ORBITAL VELOCITY

parameter	unit	symbol	value		source
wave period for significant wave	s	T	1.87	1.84	
wave angular velocity	s	σ	3.366	3.420	2π/T
gravitational acceleration	m/s²	g	9.806		
depth	m	d	7.315	2.883	
significant wave height	m	H_s	0.611	0.581	
wave amplitude	m	a	0.305	0.291	
iteration parameter	1/m	k_{guess}	1.155	1.195	iteration parameter to solve dispersion equation
wave number	1/m	k	1.155	1.195	dispersion equation
iteration check		σ_{check}	3.366	3.420	check
percent difference			0%	0%	OK
wave length	m	λ	5.438	5.256	2π/k
wave condition			deep water	deep water	
		kd	8.453	3.447	
		sinh(kd)	2343.8	15.7	
		x	0.000	0.000	
		t	0.00	0.00	
		θ	0.00	0.00	kx-σt
		cosθ	1.00	1.00	
horizontal velocity at bed	m/s	u_x	4.38E-04	6.34E-02	
	mm/s		0.4	63.4	

BED SHEAR STRESS

parameter	unit	symbol	value		source
horizontal velocity at bed	m/s	u_x	4.38E-04	6.34E-02	
gravitational acceleration	m/s²		9.806		
density of water	kg/m³	ρ_w	1000		canonical
specific gravity of sediment		SG	2.65		canonical for typical quartz sediment
density of sediment	kg/m3	ρ_s	2650		
bed friction factor		f	0.032		typical
bed shear stress	Pa	τ_b	3.08E-06	6.42E-02	
kinematic viscosity of water	m²/s	ν	1.00E-06		canonical
shear velocity	m/s	u_*	5.55E-05	8.01E-03	
minimum sediment diameter	mm	D	0.075	0.075	design parameter
	m		0.000075	0.000075	
boundary Reynolds number		R_{e*}	0.004	0.6	
critical Shields stress		$\Theta_c=\tau_*$	> 0.5	= 0.2	Shields relationship (see below)
critical shear stress	Pa	τ_c	0.6	0.2	
			t_c > t_b	*t_c > t_b*	
			no motion	no motion	larger sediment diameters also satisfy a qualitative no motion conclusion
					smaller sediment diameters also satisfy a qualitative motion conclusion





Type A Sand

SIEVE SIZE	PERCENT FINER BY WEIGHT
No. 8	100
No. 10	68-88
No. 20	6-26
No. 200	0-10

Type B Gravel

SIEVE SIZE	PERCENT FINER BY WEIGHT
1 inch	100
3/8 inch	68-88
No. 4	6-26
No. 200	0-10

Type C

SIEVE SIZE	PERCENT FINER BY WEIGHT
No. 4	95-100
No. 10	90-95
No. 40	75-90
No. 60	60-75
No. 200	50-60

Design Sheet 2. Central channel Critical Shield's stress analysis, breaking on tidal flat.

input
calculation
linked cell
Note
Output

CONVERSION

1	ft	0.3048	m
1	mile	5280	ft
1	m	1000	mm
1	hour	60	min
1	min	60	sec
1	mph	0.44704	m/s

SIGNIFICANT WAVE HEIGHT

parameter	unit	symbol	value	source
gravitational acceleration	m/s^2	g	9.806	canonical
fetch	m	F	536	Google Earth (see figure below)
water surface elevation	ft NAVD88		-5.54	Amec Foster Wheeler figure 3-1, dated 1/25/2017
	m NAVD88		-1.689	
bed elevation	ft NAVD88	z_b; $z=-z_b$	-15	Amec Foster Wheeler figure 3-1, dated 1/25/2017
	m NAVD88		-4.572	
depth	m	d	2.883	
wind speed @ 10m above surface	mph	u_{10}	74	Category 1 hurricane
wind speed @ 10m above surface	m/s		33.081	
wind stress factor	m/s	U_A	52.522	
		Grouped terms		
		gF/U_A^2	1.907	see below
		gd/U_A^2	0.010	see below
		A	0.017	see below
		B	0.008	see below
		C	0.150	see below
		D	0.047	see below
		gH/U_A^2	0.00207	see below
		gT/U_A	0.343	see below
significant wave height	m	H_s	0.581	Shore Protection Manual equations 3-39 and 3-40
wave period for significant wave	s	T	1.84	Shore Protection Manual equations 3-39 and 3-40

CHECK

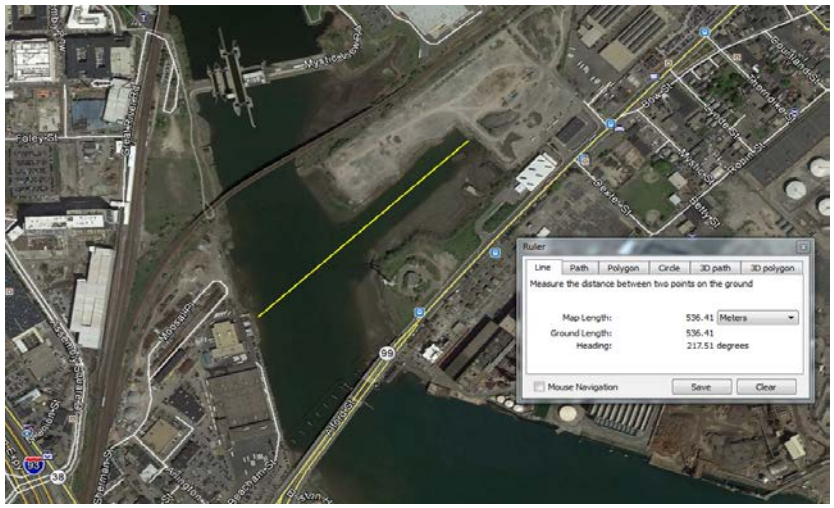
significant wave height	m	H_s	0.581	online calculator for same model: https://woodshole.er.usgs.gov/project-pages/coastal_model/Tools/fetch_limited.html
			0.0%	OK
wave period for significant wave	s	T	1.84	online calculator for same model: https://woodshole.er.usgs.gov/project-pages/coastal_model/Tools/fetch_limited.html
			0.1%	OK

Shore Protection Manual

$$\frac{gH}{U_A^2} = 0.283 \tanh\left[0.530\left(\frac{gd}{U_A^2}\right)^{3/4}\right] \tanh\left\{\frac{0.00565\left(\frac{gF}{U_A^2}\right)^{1/2}}{\tanh\left[0.530\left(\frac{gd}{U_A^2}\right)^{3/4}\right]}\right\} \quad (3\text{-}39)$$

$$\frac{gT}{U_A} = 7.54 \tanh\left[0.833\left(\frac{gd}{U_A^2}\right)^{3/8}\right] \tanh\left\{\frac{0.0379\left(\frac{gF}{U_A^2}\right)^{1/3}}{\tanh\left[0.833\left(\frac{gd}{U_A^2}\right)^{3/8}\right]}\right\} \quad (3\text{-}40)$$

A, B, C, D

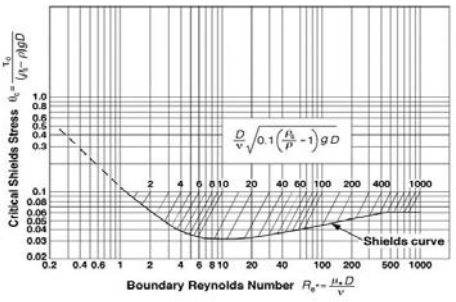


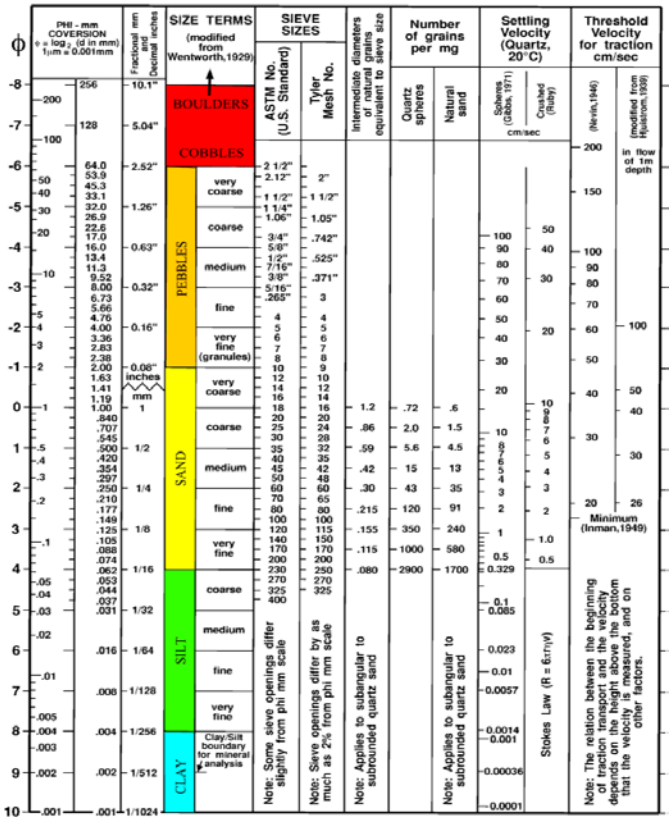
WAVE ORBITAL VELOCITY

parameter	unit	symbol	value	source
wave period for significant wave	s	T	1.84	
wave angular velocity	s	σ	3.420	2π/T
gravitational acceleration	m/s^2	g	9.806	
significant wave height	m	H_s	0.581	
wave breaking parameter		K_b	0.78	H_s/d
depth	m	d	0.745	
wave amplitude	m	a	0.291	
iteration parameter	1/m	k_{guess}	1.486	iteration parameter to solve dispersion equation
wave number	1/m	k	1.486	dispersion equation
iteration check		σ_{check}	3.420	check
percent difference			0%	OK
wave length	m	λ	4.230	2π/k
wave condition			intermediate depth	
		kd	1.107	
		sinh(kd)	1.3	
		x	0.000	
		t	0.00	
		θ	0.00	kx-σt
		cosθ	1.00	
horizontal velocity at bed	m/s	u_x	7.38E-01	
	mm/s		737.8	

BED SHEAR STRESS

parameter	unit	symbol	value		source
horizontal velocity at bed	m/s	u_x	7.38E-01		
gravitational acceleration	m/s^2		9.806		
density of water	kg/m^3	ρ_w	1000		canonical
specific gravity of sediment		SG	2.65		canonical for typical quartz sediment
density of sediment	kg/m3	ρ_s	2650		
bed friction factor		f	0.032		typical
bed shear stress	Pa	τ_b	8.71E+00		
kinematic viscosity of water	m^2/s	ν	1.00E-06		canonical
shear velocity	m/s	u_*	9.33E-02		
minimum sediment diameter	mm	D	16	8	design parameter
	m		0.016	0.008	
boundary Reynolds number		R_{e*}	1493.2	746.6	
critical Shields stress		$\Theta_c=\tau_c$	= 0.06	= 0.06	Shields relationship (see below)
critical shear stress	Pa	τ_c	15.5	7.8	
			$t_c > t_b$	$t_b > t_c$	
			no motion	motion	larger sediment diameters also satisfy a qualitative no motion conclusion
					smaller sediment diameters also satisfy a qualitative motion conclusion





Type A Sand

SIEVE SIZE	PERCENT FINER BY WEIGHT
No. 8	100
No. 10	68-88
No. 20	6-26
No. 200	0-10

Type B Gravel

SIEVE SIZE	PERCENT FINER BY WEIGHT
1 inch	100
3/8 inch	68-88
No. 4	6-26
No. 200	0-10

Type C

SIEVE SIZE	PERCENT FINER BY WEIGHT
No. 4	95-100
No. 10	90-95
No. 40	75-90
No. 60	60-75
No. 200	50-60

Design Sheet 3. South beach Critical Shield's stress analysis.

input
calculation
linked cell
Note
Output

CONVERSION

1	ft	0.3048	m
1	mile	5280	ft
1	m	1000	mm
1	hour	60	min
1	min	60	sec
1	mph	0.44704	m/s

SIGNIFICANT WAVE HEIGHT

parameter	unit	symbol	value	source
gravitational acceleration	m/s^2	g	9.806	canonical
fetch	m	F	265	Google Earth (see figure below)
water surface elevation	ft NAVD88		-5.54	Amec Foster Wheeler figure 3-1, dated 1/25/2017
	m NAVD88		-1.689	
bed elevation	ft NAVD88	z_b; z=-z_b	-15	Amec Foster Wheeler figure 3-1, dated 1/25/2017
	m NAVD88		-4.572	
depth	m	d	2.883	
wind speed @ 10m above surface	mph	u_{10}	74	Category 1 hurricane
wind speed @ 10m above surface	m/s		33.081	
wind stress factor	m/s	U_A	52.522	
	Grouped terms			
		gF/U_A^2	0.942	see below
		gd/U_A^2	0.010	see below
		A	0.017	see below
		B	0.005	see below
		C	0.150	see below
		D	0.037	see below
		gH/U_A^2	0.00150	see below
		gT/U_A	0.274	see below
significant wave height	m	H_s	0.422	Shore Protection Manual equations 3-39 and 3-40
wave period for significant wave	s	T	1.47	Shore Protection Manual equations 3-39 and 3-40

CHECK

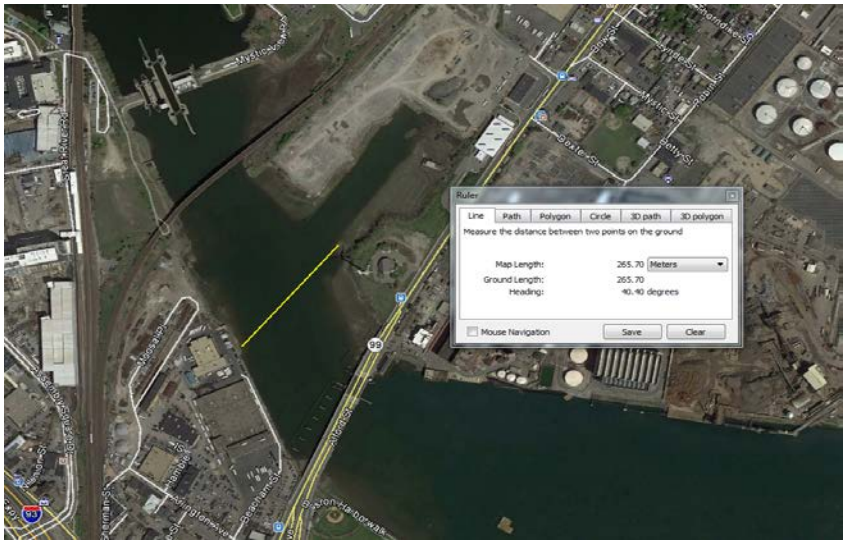
significant wave height	m	H_s	0.422	online calculator for same model: https://woodshole.er.usgs.gov/project-pages/coastal_model/Tools/fetch_limited.html
			0.0%	OK
wave period for significant wave	s	T	1.47	online calculator for same model: https://woodshole.er.usgs.gov/project-pages/coastal_model/Tools/fetch_limited.html
			0.1%	OK

Shore Protection Manual

$$\frac{gH}{U_A^2} = 0.283 \tanh\left[0.530\left(\frac{gd}{U_A^2}\right)^{3/4}\right] \tanh\left\{\frac{0.00565\left(\frac{gF}{U_A^2}\right)^{1/2}}{\tanh\left[0.530\left(\frac{gd}{U_A^2}\right)^{3/4}\right]}\right\} \quad (3\text{-}39)$$

$$\frac{gT}{U_A} = 7.54 \tanh\left[0.833\left(\frac{gd}{U_A^2}\right)^{3/8}\right] \tanh\left\{\frac{0.0379\left(\frac{gF}{U_A^2}\right)^{1/3}}{\tanh\left[0.833\left(\frac{gd}{U_A^2}\right)^{3/8}\right]}\right\} \quad (3\text{-}40)$$

A, B, C, D

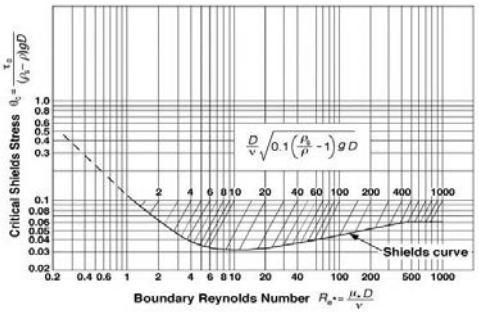


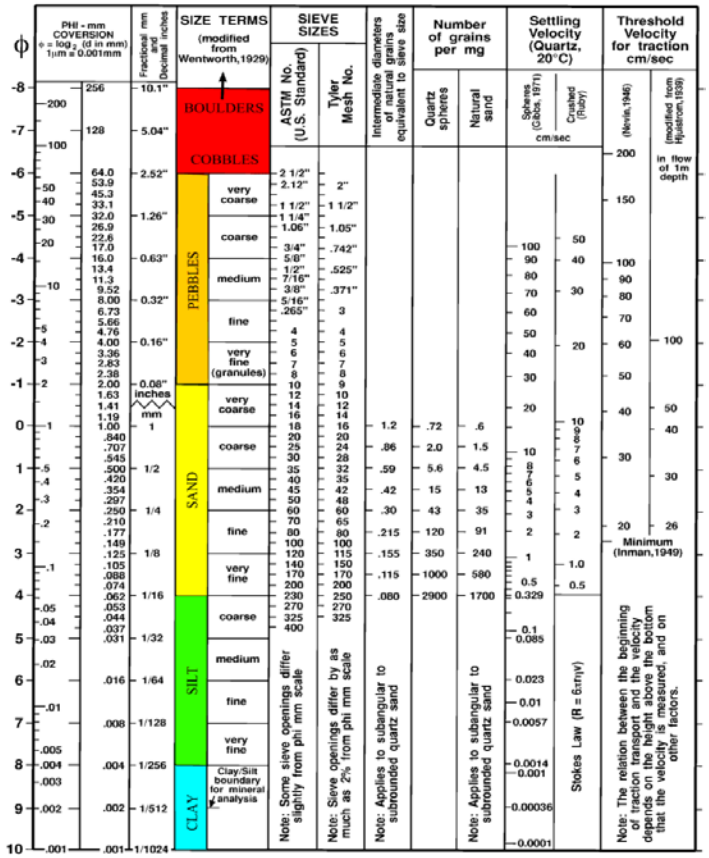
WAVE ORBITAL VELOCITY

parameter	unit	symbol	value	source
wave period for significant wave	s	T	1.47	
wave angular velocity	s	σ	4.275	2π/T
gravitational acceleration	m/s^2	g	9.806	
significant wave height	m	H_s	0.422	
wave breaking parameter		K_b	0.78	H_s/d
depth	m	d	0.541	breaking depth
wave amplitude	m	a	0.211	H_s/2
iteration parameter	1/m	k_{guess}	2.230	iteration parameter to solve dispersion equation
wave number	1/m	k	2.230	dispersion equation
iteration check		σ_{check}	4.275	check
percent difference			0%	OK
wave length	m	λ	2.818	2π/k
wave condition			intermediate depth	
		kd	1.207	
		sinh(kd)	1.5	
		x	0.000	
		t	0.00	
		θ	0.00	kx-σt
		cosθ	1.00	
horizontal velocity at bed	m/s	u_x	5.93E-01	
	mm/s		592.9	

BED SHEAR STRESS

parameter	unit	symbol	value		source
horizontal velocity at bed	m/s	u_x	5.93E-01		
gravitational acceleration	m/s^2		9.806		
density of water	kg/m^3	ρ_w	1000		canonical
specific gravity of sediment		SG	2.65		canonical for typical quartz sediment
density of sediment	kg/m3	ρ_s	2650		
bed friction factor		f	0.032		typical
bed shear stress	Pa	τ_b	5.62E+00		
kinematic viscosity of water	m^2/s	ν	1.00E-06		canonical
shear velocity	m/s	u_*	7.50E-02		
minimum sediment diameter	mm	D	8	4	design parameter
	m		0.008	0.004	
boundary Reynolds number		R_{e*}	600.00	300.00	
critical Shields stress		$\Theta_c=\tau_c$	= 0.06	= 0.058	Shields relationship (see below)
critical shear stress	Pa	τ_c	7.8	3.8	
			$t_c > t_b$	$t_b > t_c$	
			no motion	motion	larger sediment diameters also satisfy a qualitative no motion conclusion
					smaller sediment diameters also satisfy a qualitative motion conclusion





Type A Sand

SIEVE SIZE	PERCENT FINER BY WEIGHT
No. 8	100
No. 10	68-88
No. 20	6-26
No. 200	0-10

Type B Gravel

SIEVE SIZE	PERCENT FINER BY WEIGHT
1 inch	100
3/8 inch	68-88
No. 4	6-26
No. 200	0-10

Type C

SIEVE SIZE	PERCENT FINER BY WEIGHT
No. 4	95-100
No. 10	90-95
No. 40	75-90
No. 60	60-75
No. 200	50-60

Design Sheet 4. North beach Critical Shield's stress analysis.

input
calculation
linked cell
Note
Output

CONVERSION

1	ft	0.3048	m
1	mile	5280	ft
1	m	1000	mm
1	hour	60	min
1	min	60	sec
1	mph	0.44704	m/s

SIGNIFICANT WAVE HEIGHT

parameter	unit	symbol	value	source
gravitational acceleration	m/s^2	g	9.806	canonical
fetch	m	F	417	Google Earth (see figure below)
water surface elevation	ft NAVD88		-5.54	Amec Foster Wheeler figure 3-1, dated 1/25/2017
	m NAVD88		-1.689	
bed elevation	ft NAVD88	z_b; z=-z_b	-15	Amec Foster Wheeler figure 3-1, dated 1/25/2017
	m NAVD88		-4.572	
depth	m	d	2.883	
wind speed @ 10m above surface	mph	u_{10}	74	Category 1 hurricane
wind speed @ 10m above surface	m/s		33.081	
wind stress factor	m/s	U_A	52.522	
	Grouped terms			
		gF/U_A^2	1.482	see below
		gd/U_A^2	0.010	see below
		A	0.017	see below
		B	0.007	see below
		C	0.150	see below
		D	0.043	see below
		gH/U_A^2	0.00185	see below
		gT/U_A	0.317	see below
significant wave height	m	H_s	0.520	Shore Protection Manual equations 3-39 and 3-40
wave period for significant wave	s	T	1.70	Shore Protection Manual equations 3-39 and 3-40

CHECK

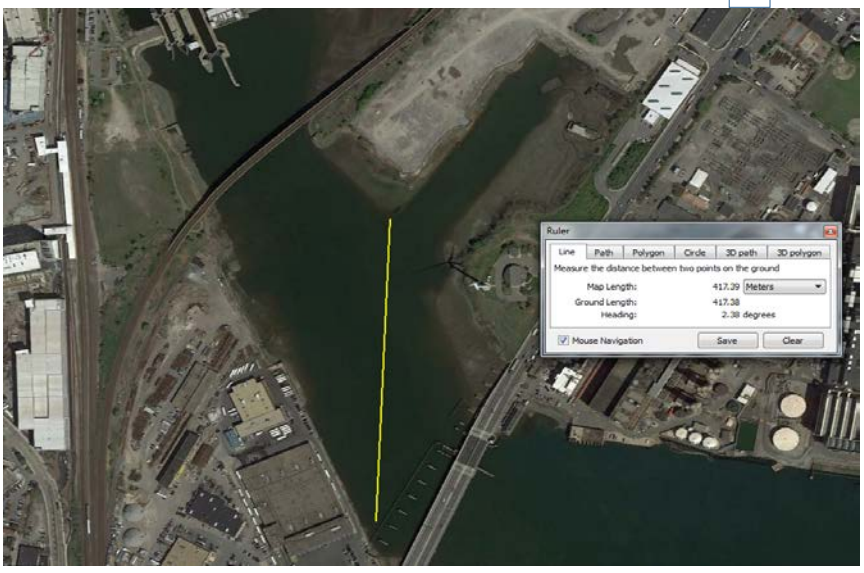
significant wave height	m	H_s	0.52	online calculator for same model: https://woodshole.er.usgs.gov/project-pages/coastal_model/Tools/fetch_limited.html
			0.0%	OK
wave period for significant wave	s	T	1.70	online calculator for same model: https://woodshole.er.usgs.gov/project-pages/coastal_model/Tools/fetch_limited.html
			0.0%	OK

Shore Protection Manual

$$\frac{gH}{U_A^2} = 0.283 \tanh\left[0.530\left(\frac{gd}{U_A^2}\right)^{3/4}\right] \tanh\left\{\frac{0.00565\left(\frac{gF}{U_A^2}\right)^{1/2}}{\tanh\left[0.530\left(\frac{gd}{U_A^2}\right)^{3/4}\right]}\right\} \quad (3\text{-}39)$$

$$\frac{gT}{U_A} = 7.54 \tanh\left[0.833\left(\frac{gd}{U_A^2}\right)^{3/8}\right] \tanh\left\{\frac{0.0379\left(\frac{gF}{U_A^2}\right)^{1/3}}{\tanh\left[0.833\left(\frac{gd}{U_A^2}\right)^{3/8}\right]}\right\} \quad (3\text{-}40)$$

A, B, C, D

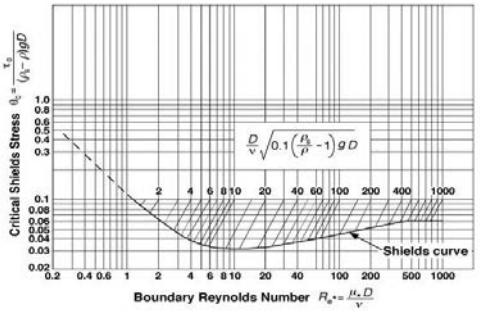


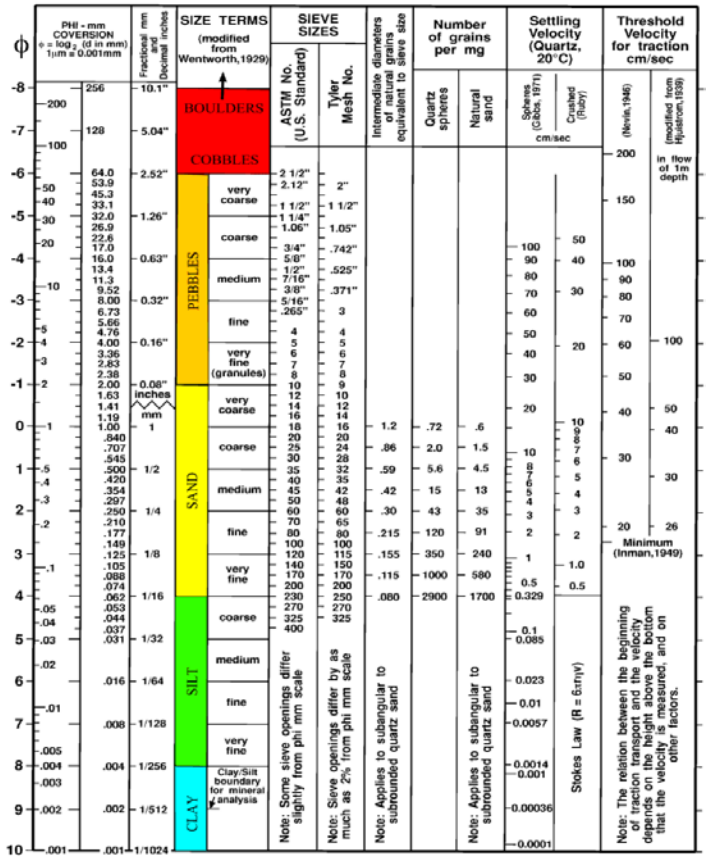
WAVE ORBITAL VELOCITY

parameter	unit	symbol	value	source
wave period for significant wave	s	T	1.70	
wave angular velocity	s	σ	3.701	2π/T
gravitational acceleration	m/s^2	g	9.806	
significant wave height	m	H_s	0.520	
wave breaking parameter		K_b	0.78	H_s/d
depth	m	d	0.666	breaking depth
wave amplitude	m	a	0.260	H_s/2
iteration parameter	1/m	k_{guess}	1.714	iteration parameter to solve dispersion equation
wave number	1/m	k	1.714	dispersion equation
iteration check		σ_{check}	3.701	check
percent difference			0%	OK
wave length	m	λ	3.666	2π/k
wave condition			intermediate depth	
		kd	1.142	
		sinh(kd)	1.4	
		x	0.000	
		t	0.00	
		θ	0.00	kx-σt
		cosθ	1.00	
horizontal velocity at bed	m/s	u_x	6.84E-01	
	mm/s		683.6	

BED SHEAR STRESS

parameter	unit	symbol	value		source
horizontal velocity at bed	m/s	u_x	6.84E-01		
gravitational acceleration	m/s^2		9.806		
density of water	kg/m^3	ρ_w	1000		canonical
specific gravity of sediment		SG	2.65		canonical for typical quartz sediment
density of sediment	kg/m3	ρ_s	2650		
bed friction factor		f	0.032		typical
bed shear stress	Pa	τ_b	7.48E+00		
kinematic viscosity of water	m^2/s	ν	1.00E-06		canonical
shear velocity	m/s	u_*	8.65E-02		
minimum sediment diameter	mm	D	8	4	design parameter
	m		0.008	0.004	
boundary Reynolds number		R_{e*}	691.73	345.86	
critical Shields stress		$\Theta_c=\tau_*$	= 0.06	= 0.0595	Shields relationship (see below)
critical shear stress	Pa	τ_c	7.8	3.9	
			$t_c > t_b$	$t_b > t_c$	
			no motion	motion	larger sediment diameters also satisfy a qualitative no motion conclusion
					smaller sediment diameters also satisfy a qualitative motion conclusion





Type A Sand

SIEVE SIZE	PERCENT FINER BY WEIGHT
No. 8	100
No. 10	68-88
No. 20	6-26
No. 200	0-10

Type B Gravel

SIEVE SIZE	PERCENT FINER BY WEIGHT
1 inch	100
3/8 inch	68-88
No. 4	6-26
No. 200	0-10

Type C

SIEVE SIZE	PERCENT FINER BY WEIGHT
No. 4	95-100
No. 10	90-95
No. 40	75-90
No. 60	60-75
No. 200	50-60

Design Sheet 5. Rubble mound breakwater

input
calculation
linked cell
Note
Output

CONVERSION

1	ft	0.3048	m
1	mile	5280	ft
1	ft	12	in
1	m	1000	mm
1	hour	60	min
1	min	60	sec
1	mph	0.44704	m/s

SIGNIFICANT WAVE HEIGHT

parameter	unit	symbol	value	source
gravitational acceleration	m/s^2	g	9.806	canonical
fetch	m	F	236	Google Earth (see figure below)
water surface elevation	ft NAVD88		-5.54	Amec Foster Wheeler figure 3-1, dated 1/25/2017
	m NAVD88		-1.689	
bed elevation	ft NAVD88	z_b; $z=-z_b$	-15	Amec Foster Wheeler figure 3-1, dated 1/25/2017
	m NAVD88		-4.572	
depth	m	d	2.883	
wind speed @ 10m above surface	mph	u_{10}	74	Category 1 hurricane
wind speed @ 10m above surface	m/s		33.081	
wind stress factor	m/s	U_A	52.522	
		Grouped terms		
		gF/U_A^2	0.839	see below
		gd/U_A^2	0.010	see below
		A	0.017	see below
		B	0.005	see below
		C	0.150	see below
		D	0.036	see below
		gH/U_A^2	0.00142	see below
		gT/U_A	0.264	see below
significant wave height	m	H_s	0.400	Shore Protection Manual equations 3-39 and 3-40
wave period for significant wave	s	T	1.42	Shore Protection Manual equations 3-39 and 3-40

CHECK

significant wave height	m	H_s	0.4	online calculator for same model: https://woodshole.er.usgs.gov/project-pages/coastal_model/Tools/fetch_limited.html
			0.0%	OK
wave period for significant wave	s	T	1.42	online calculator for same model: https://woodshole.er.usgs.gov/project-pages/coastal_model/Tools/fetch_limited.html
			0.0%	OK

Shore Protection Manual

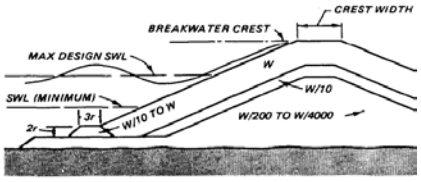
$$\frac{gH}{U_A^2} = 0.283 \tanh\left[0.530\left(\frac{gd}{U_A^2}\right)^{3/4}\right] \tanh\left\{\frac{0.00565\left(\frac{gF}{U_A^2}\right)^{1/2}}{\tanh\left[0.530\left(\frac{gd}{U_A^2}\right)^{3/4}\right]}\right\} \quad (3\text{-}39)$$

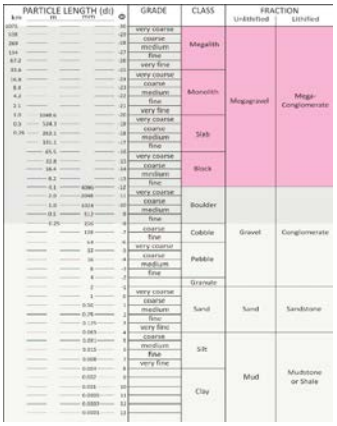
$$\frac{gT}{U_A} = 7.54 \tanh\left[0.833\left(\frac{gd}{U_A^2}\right)^{3/8}\right] \tanh\left\{\frac{0.0379\left(\frac{gF}{U_A^2}\right)^{1/3}}{\tanh\left[0.833\left(\frac{gd}{U_A^2}\right)^{3/8}\right]}\right\} \quad (3\text{-}40)$$

A, B, C, D

RUBBLE MOUND BREAKWATER

parameter	unit	symbol	value		source
unit weight of water	lb/ft^3	γ_w	62.4		canonical
specific gravity of armor unit		S_a	2.7		canonical
unit weight of armor unit	lb/ft^3	γ_a	168		
design wave height	m	H	0.400		
	ft		1.31		
stability coefficient		K_D	1.2		Table 4-2 USACE EM 1110-2-2904 DESIGN OF BREAKWATERS AND JETTIES
tan α			0.67		maxiumu slope 1.5(H):1(V)
angle of stucture slope	radians from horizontal	α	0.59		
	degrees		34		
cot α			1.5		
weight of individual armor unit	lb	W_a	15.9		Equation 4-1 USACE EM 1110-2-2904 DESIGN OF BREAKWATERS AND JETTIES Hudson stability equation
volume of individual armor unit	ft^3	V_a	9.5E-02		W_a/γ_a
equivalent spherical radius of armor unit	ft	r_a	0.28		$Va=(4/3)\,\pi\, r^3$
equivalent diameter of armor unit	ft		0.57		
	in		6.8		
calculated	mm		172		
use	mm		256	fine boulder	Extended Udden-Wentworth sediment classification system
second layer weight factor			10		
second layer weight	lb		1.59		
volume of individual armor unit	ft^3	V_a	9.5E-03		
equivalent spherical radius of armor unit	ft	r_a	0.13		
equivalent diameter of armor unit	ft		0.26		
	in		3.1		
calculated	mm		80		
use	mm		128	coarse cobble	
core weight factor			200		
core weight	lb		8.0E-02		
volume of individual armor unit	ft^3	V_a	4.7E-04		
equivalent spherical radius of armor unit	ft	r_a	0.05		
equivalent diameter of armor unit	ft		0.10		
	in		1.2		
calculated	mm		29		
use	mm		32	very coarse pebble	
number of stones thick		n	3		
		k_Δ	1		Table 4-3 USACE EM 1110-2-2904 DESIGN OF BREAKWATERS AND JETTIES
top layer thickness parameter	ft	r_1	1.4		
second layer thickness	ft	r_2	0.6		
core thickness	ft	r_3	0.2		
depth	ft below MLW	d	2.6		
side slope			1.5:1		
minimum creast width	ft	β	1.4		

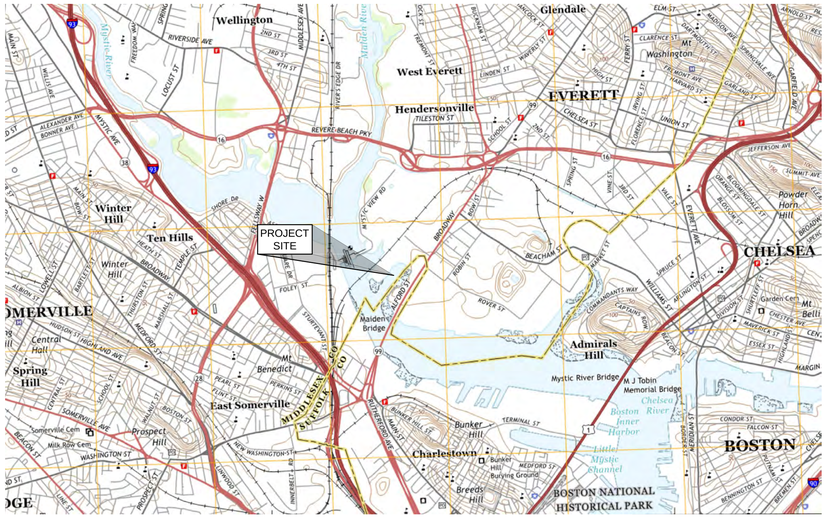




APPENDIX C

60% Design - Construction Drawings

FORMER EVERETT STAGING YARD
1 HORIZON WAY, EVERETT, MA
RTN 3-13341
APRIL, 2017
60% SUBMITTAL ISSUED FOR PERMITTING



LOCUS MAP

0' 1000' 2000' 3000'
1" = 2000'

KEY

0' 150' 300' 450'
1" = 300'

DRAWING INDEX

SHEET NUMBER	DRAWING TITLE	DISCIPLINE NUMBER
	COVER SHEET	
1	GENERAL NOTES AND LEGEND	G-001
2	EXISTING CONDITIONS SITE PLAN	V-101
3	DEMOLITION, EROSION AND SEDIMENTATION CONTROL SITE PLAN	C-101
4	PROPOSED DREDGE SITE PLAN	C-102
5	REMEDIATION CAP SITE PLAN	C-103
6	PROPOSED PROFILE A-A AND SECTION B-B	C-301
7	PROPOSED SECTIONS C-C AND D-D	C-302
8	TRANSITION DETAILS	C-501
9	DETAILS	C-502

PREPARED FOR:

Wynn BOSTON HARBOR

PREPARED BY:

amec foster wheeler

60% DRAFT - ISSUED FOR PERMITTING

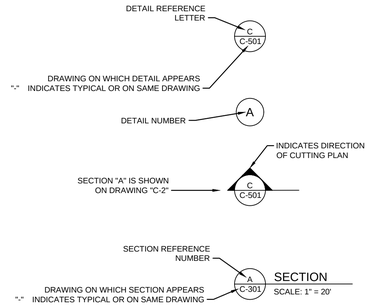
Lfn: CAD Projects\Wynn Everett Sediments - 3951160042\7.0 CAD\7.0 Bid Drawings\Sheets\0 - 3951160042 - G-000.DWG - G-001 - Apr. 27, 2017 10:54am - diana.dempsey

GENERAL NOTES:

1. ANY ON-SITE PERSONNEL HAS THE AUTHORITY TO STOP WORK ACTIVITIES IF QUESTIONABLE OR UNSAFE PRACTICES OR CONDITIONS ARE OBSERVED. CONTRACTOR SHALL TAKE PRECAUTIONS TO ADDRESS THE PRACTICES OR CONDITIONS TO SATISFACTION OF CONSTRUCTION MANAGER PRIOR TO RESTARTING WORK. FAILURE TO STOP WORK WILL NOT BE TOLERATED AND MAY RESULT IN PERSONNEL BEING BANNED FROM THE SITE AND REPLACED BY CONTRACTOR OR TERMINATION OF CONTRACTOR ENTIRELY.
2. DRAWINGS HAVE BEEN COMPILED FROM ON-SITE INVESTIGATIONS, GIS, LIDAR, AND SURVEY. SEE DRAWING REFERENCE FOR FURTHER INFORMATION.
3. CONTRACTOR SHALL VERIFY ALL DIMENSIONS, ELEVATIONS, AND EXISTING FEATURES WITHIN THE LIMITS OF WORK PRIOR TO THE START OF ANY WORK AND DETERMINE THE APPROPRIATE QUANTITIES AND REQUIRED MATERIALS TO COMPLETE THE WORK IN ACCORDANCE WITH THE DRAWINGS AND SPECIFICATIONS. ANY DISCREPANCIES SHALL BE REPORTED TO CONSTRUCTION MANAGER. CONTRACTOR SHALL VERIFY ACTUAL FIELD CONDITIONS PRIOR TO CONSTRUCTION.
4. LOCATIONS OF UTILITIES SHALL BE VERIFIED BY CONTRACTOR. NOT ALL UTILITIES MAY BE SHOWN. CONTRACTOR SHALL VERIFY THE PRESENCE OF UTILITIES BELOW THE SEDIMENT SURFACE, UNDERGROUND, AND OVERHEAD.
5. UNLESS OTHERWISE NOTED, ALL EXISTING FEATURES DESIGNATED ON THE DRAWINGS ARE TO REMAIN. INCLUDING, BUT NOT LIMITED TO, LIVING SHORELINE, WHARF, STORMWATER FEATURES, ETC. FEATURES SHALL BE VERIFIED, LOCATED AND PROTECTED DURING ALL PHASES OF CONSTRUCTION.
6. PORTIONS OF THE WORK ARE WITHIN THE VICINITY OF AND ADJACENT TO A BOSTON WATER AND SEWER COMMISSION (BWSC) STORMWATER OUTFALL. THERE IS NO ACCESS TO THE BWSC PROPERTY ALLOWED.
7. ALL ACTIVITIES SHALL BE CONDUCTED IN ACCORDANCE WITH THE MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION (MASS DEP) CONTINGENCY PLAN (MCP) UNDER RELEASE TRACKING NUMBER (RTN) 3-13341 AND THE MASS DEP EROSION AND SEDIMENT CONTROL GUIDELINES.
8. PROFILES, SECTIONS, AND DETAILS ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY AND ARE PROVIDED ONLY TO ILLUSTRATE THE INTENT OF THE DESIGN. ACTUAL SITE CONDITIONS MAY VARY FROM THE INFORMATION SHOWN ON THE PROFILES AND SECTIONS AND SHALL BE VERIFIED BY CONTRACTOR.
9. CONTRACTOR TO DISABLE AND SECURE ALL EQUIPMENT PRIOR TO DAILY SHUTDOWN. CLIENT IS NOT RESPONSIBLE FOR VANDALISM, OR LOSS DUE TO TRESPASSING.
10. ALL BASE MAP INFORMATION CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS EXISTING AT THE TIME OF THE SURVEYS. USE OF THIS INFORMATION BY CONTRACTORS OR OTHERS SHALL BE AT THE SOLE RISK OF CONTRACTOR.
11. TURBIDITY CONTROL MEASURES SHALL BE MAINTAINED IN ACCORDANCE WITH THE SPECIFICATIONS AND REGULATORY REQUIREMENTS.
12. IN THE EVENT CONTRACTOR DISCOVERS ANY HAZARDOUS MATERIAL, THE REMOVAL OF WHICH IS NOT ADDRESSED IN THE PROJECT PLANS AND SPECIFICATIONS, CONTRACTOR MUST IMMEDIATELY CEASE ALL WORK AND IMMEDIATELY NOTIFY CONSTRUCTION MANAGER OF THE DISCOVERY OF SUCH MATERIALS.
13. CONTRACTOR IS RESPONSIBLE FOR SITE JOB SAFETY, INCLUDING BUT NOT LIMITED TO, INSTALLATION AND MAINTENANCE OF BARRIERS, FENCING AND OTHER APPROPRIATE SAFETY ITEMS NECESSARY TO PROTECT THE PUBLIC FROM AREAS OF CONSTRUCTION AND CONSTRUCTION ACTIVITY.
14. NO VEGETATION SHALL BE DISTURBED UNLESS APPROVED BY CONSTRUCTION MANAGER IN WRITING.
15. CONSTRUCT TEMPORARY EROSION CONTROLS AS SHOWN ON THE DRAWINGS PRIOR TO STARTING WORK. THE SMALLEST PRACTICAL AREA OF LAND SHOULD BE DISTURBED AT ANY ONE TIME DURING CONSTRUCTION.
16. ALL LOCATIONS OF TEMPORARY EROSION CONTROL DEVICES SHALL BE SUBJECT TO ADJUSTMENT AS DIRECTED BY CONSTRUCTION MANAGER, AND SHALL BE REPLACED IN ACCORDANCE WITH THE CONTRACT DOCUMENTS.
17. THE EROSION CONTROL DEVICES SHOWN ON THE DRAWINGS AND AS SPECIFIED IN THE CONTRACT DOCUMENTS REPRESENT THE MINIMUM REQUIRED FOR EROSION CONTROL. CONTRACTOR SHALL ADD TO THESE DEVICES ANY AND ALL MEASURES AS REQUIRED BY CONSTRUCTION MANAGER TO EFFECTIVELY PREVENT EROSION AND MIGRATION OF SEDIMENT FROM THE WORK AREA.
18. ALL WORK SHALL BE IN ACCORDANCE WITH THE DRAWINGS, SPECIFICATIONS, PERMITS, AND ALL LOCAL, STATE, AND FEDERAL LAWS, CODES, RULES, REGULATIONS, AND ORDINANCES BEARING ON THE PERFORMANCE OF THE WORK.

DRAWING REFERENCE:

1. VERTICAL DATUM BASED ON NOAA STATION 8443662, AMELIA EARHART DAM, MYSTIC RIVER, MA AND REFER TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88): NAVD88=0.0,MLLW=-5.54, MLW=-5.21, MHW=+4.35, FEMA 100 YR FLOOD ELEVATION (ZONE AE)=+9.0.
2. EXISTING SURVEY FROM DRAWING TITLED "EXISTING CONDITIONS PLAN, BROADWAY (ROUTE 99), EVERETT, MASS." BY FELDMAN LAND SURVEYORS, DATED APRIL 4, 2016.
3. DEMOLITION PLAN DOCUMENTS AND INFORMATION BY: EXISTING CONDITIONS PLAN BROADWAY (ROUTE 99) EVERETT, MASS. PREPARED BY: FELDMAN LAND SURVEYORS BOSTON, MA DATED: 03/20/15.



TYPICAL
DETAIL AND SECTION REFERENCE
NTS

GENERAL LEGEND:

CITY/PROPERTY LINE	
5	EXISTING MAJOR CONTOUR
7	EXISTING MINOR CONTOUR
HTL	HIGH TIDE (HTL) ELEVATION +7.30' (NAVD88)
MHW	MEAN HIGH WATER (MHW) ELEVATION +4.35' (NAVD88)
MLW	MEAN LOW WATER (MLW) ELEVATION -5.21' (NAVD88)
WETLANDS LINE	
LOW	LIMITS OF WORK
TC	PROPOSED STAND-ALONE PERMEABLE TURBIDITY CURTAIN
-10.0	PROPOSED MAJOR CONTOUR
-8.0	PROPOSED MINOR CONTOUR
-16.5	PROPOSED HALF CONTOUR

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amec foster wheeler
AMEC MASSACHUSETTS, INC.
271 MILL ROAD
CHELMSFORD MASSACHUSETTS 01824
TELEPHONE: (978) 692-9090
FAX: (978) 692-6633
WEB: WWW.AMECFW.COM

REVISION	DATE	ISSUE / REVISION DESCRIPTION	ISSUED BY	APPROVED
0	04/26/2017	60% SUBMITTAL ISSUED FOR CLIENT REVIEW		

PROJECT:
FORMER EVERETT STAGING YARD
1 HORIZON WAY, EVERETT, MA

TITLE:
GENERAL NOTES, CONSTRUCTION SEQUENCING, AND LEGEND

CLIENT:
BOSTON HARBOR wynn

SEAL:
DRAFT

DESIGNED BY:	DRAWN BY:
DAA	DED
CHECKED BY:	SCALE:
TD	AS SHOWN

PROJECT NUMBER: 3651160042

DRAWING NUMBER: **G-001**

SHEET NUMBER: **1 OF 9**

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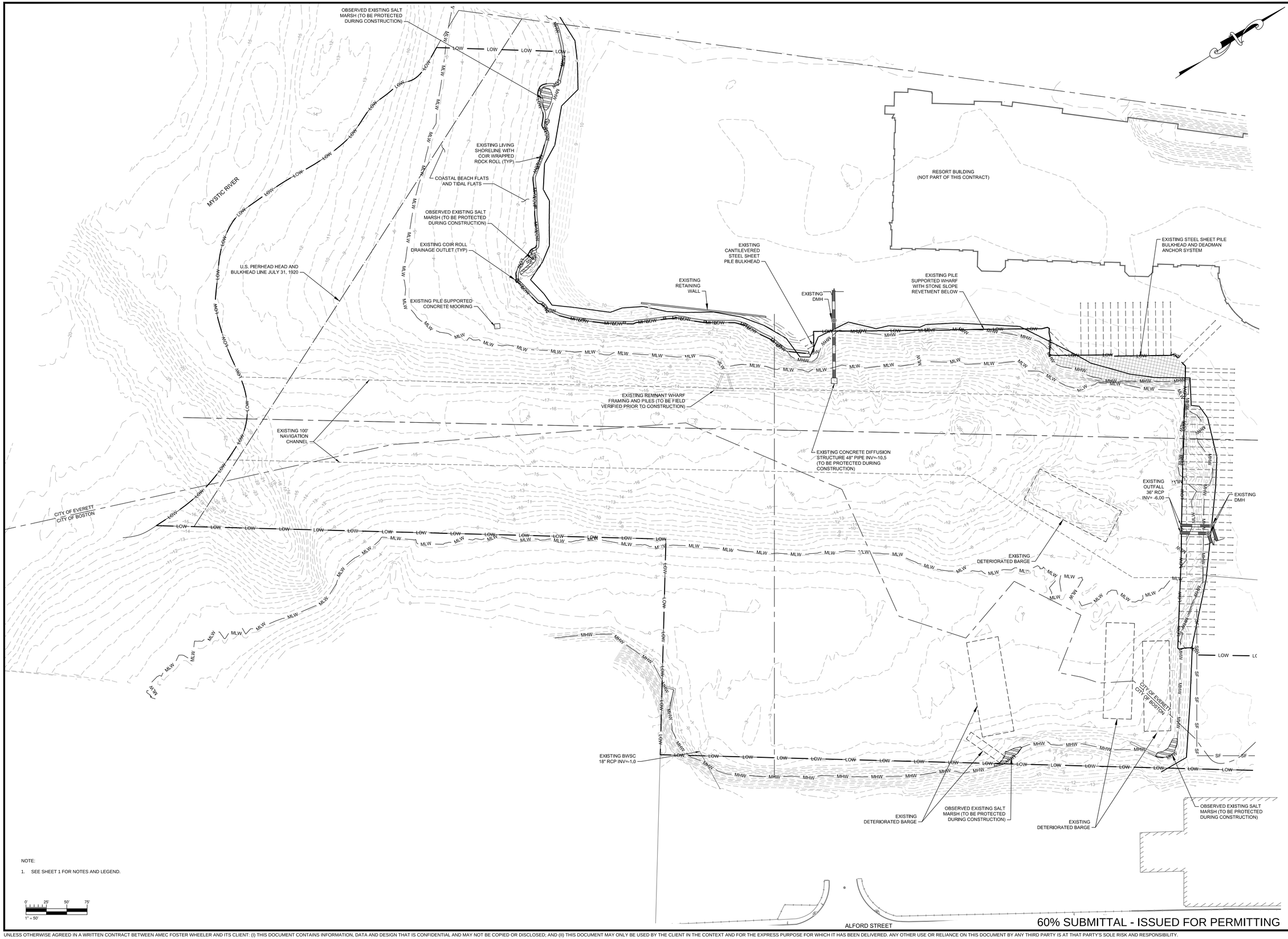

NOTE:

1. SEE SHEET 1 FOR NOTES AND LEGEND.

0' 25' 50' 75'
1" = 50'

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REVISION	DATE	ISSUE / REVISION DESCRIPTION	ISSUED BY	APPROVED
0	04/26/2017	60% SUBMITTAL ISSUED FOR CLIENT REVIEW		

PROJECT:
FORMER EVERETT STAGING YARD
1 HORIZON WAY, EVERETT, MA

TITLE:
EXISTING CONDITIONS SITE PLAN

CLIENT:
BOSTON HARBOR wynn

SEAL:
DRAFT

DESIGNED BY: DAA	DRAWN BY: DED
CHECKED BY: TD	SCALE: AS SHOWN
PROJECT NUMBER: 3651160042	
DRAWING NUMBER: V-101	
SHEET NUMBER: 2 OF 9	

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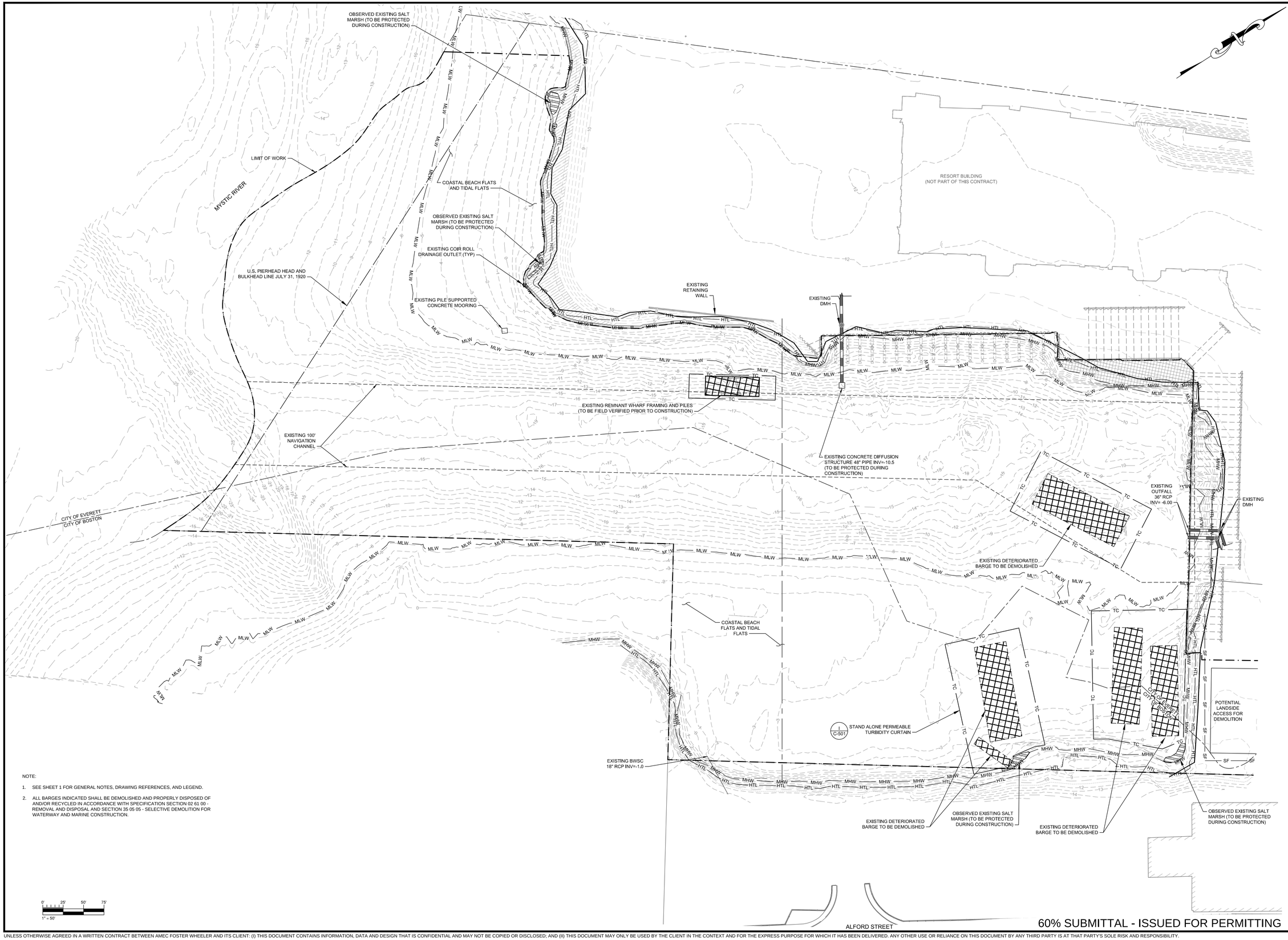

NOTE:

1. SEE SHEET 1 FOR GENERAL NOTES, DRAWING REFERENCES, AND LEGEND.
2. ALL BARGES INDICATED SHALL BE DEMOLISHED AND PROPERLY DISPOSED OF AND/OR RECYCLED IN ACCORDANCE WITH SPECIFICATION SECTION 02 61 00 - REMOVAL AND DISPOSAL AND SECTION 35 05 05 - SELECTIVE DEMOLITION FOR WATERWAY AND MARINE CONSTRUCTION.

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REVISION	DATE	ISSUE / REVISION DESCRIPTION	ISSUED BY	APPROVED
0	04/26/2017	60% SUBMITTAL ISSUED FOR CLIENT REVIEW		

PROJECT: FORMER EVERETT STAGING YARD
1 HORIZON WAY, EVERETT, MA

TITLE: DEMOLITION, EROSION AND SEDIMENTATION CONTROL SITE PLAN

CLIENT: BOSTON HARBOR wynn

SEAL: DRAFT

DESIGNED BY: DAA	DRAWN BY: DED
CHECKED BY: TD	SCALE: AS SHOWN
PROJECT NUMBER: 3651160042	
DRAWING NUMBER: C-101	
SHEET NUMBER: 3 OF 9	

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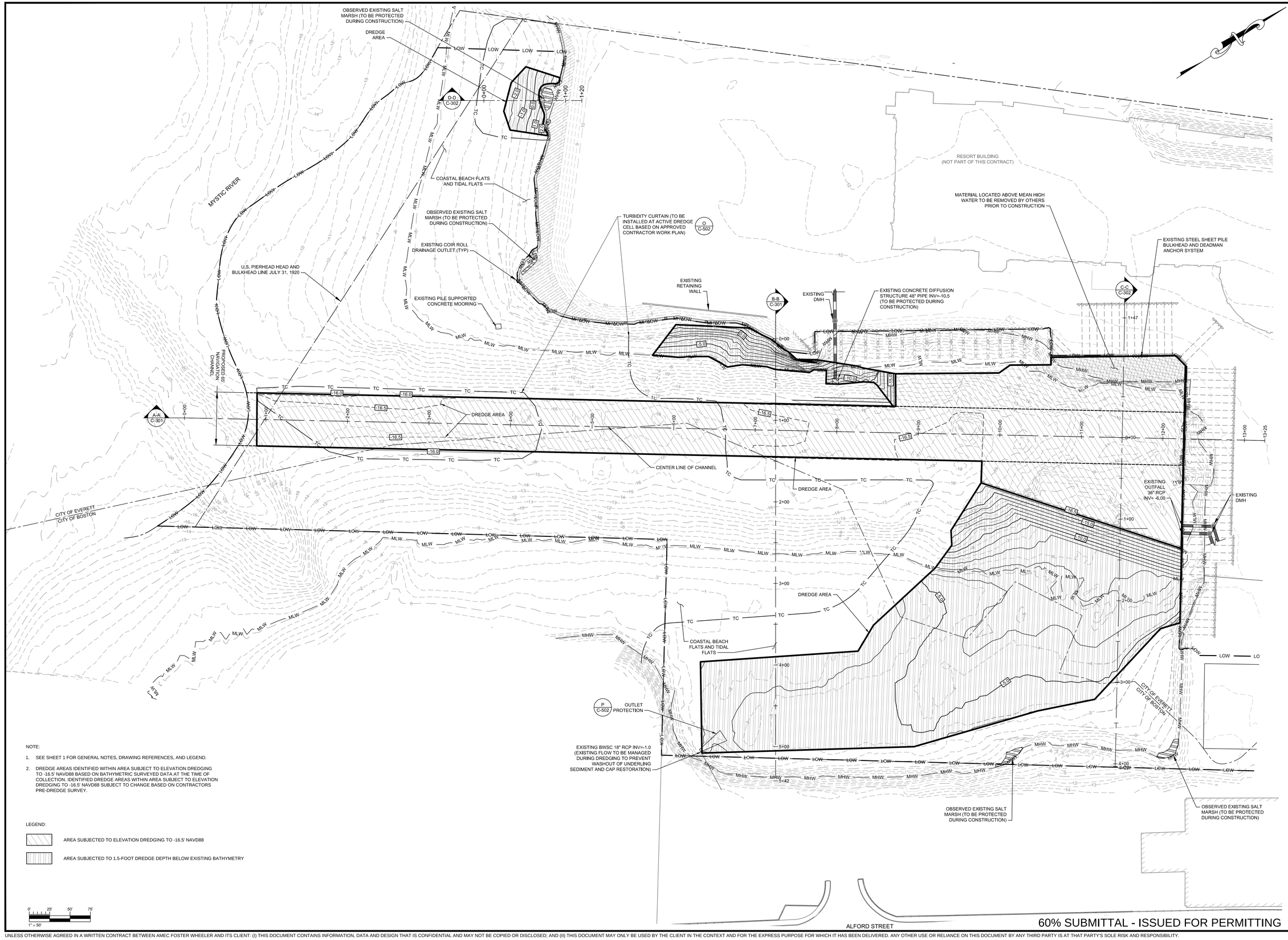

NOTE:

1. SEE SHEET 1 FOR GENERAL NOTES, DRAWING REFERENCES, AND LEGEND.
2. DREDGE AREAS IDENTIFIED WITHIN AREA SUBJECT TO ELEVATION DREDGING TO -16.5' NAVD88 BASED ON BATHYMETRIC SURVEYED DATA AT THE TIME OF COLLECTION. IDENTIFIED DREDGE AREAS WITHIN AREA SUBJECT TO ELEVATION DREDGING TO -16.5' NAVD88 SUBJECT TO CHANGE BASED ON CONTRACTORS PRE-DREDGE SURVEY.

LEGEND:

AREA SUBJECTED TO ELEVATION DREDGING TO -16.5' NAVD88

AREA SUBJECTED TO 1.5-FOOT DREDGE DEPTH BELOW EXISTING BATHYMETRY

0' 25' 50' 75'
1" = 50'

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REVISION	DATE	ISSUE / REVISION DESCRIPTION	ISSUED BY	APPROVED
0	04/26/2017	60% SUBMITTAL ISSUED FOR CLIENT REVIEW		

PROJECT: FORMER EVERETT STAGING YARD
1 HORIZON WAY, EVERETT, MA

TITLE: PROPOSED DREDGE SITE PLAN

CLIENT: BOSTON HARBOR wynn

SEAL: DRAFT

DESIGNED BY:	DRAWN BY:
DAA	DED
CHECKED BY: TD	SCALE: AS SHOWN

PROJECT NUMBER: 3651160042

DRAWING NUMBER: C-102

SHEET NUMBER: 4 OF 9

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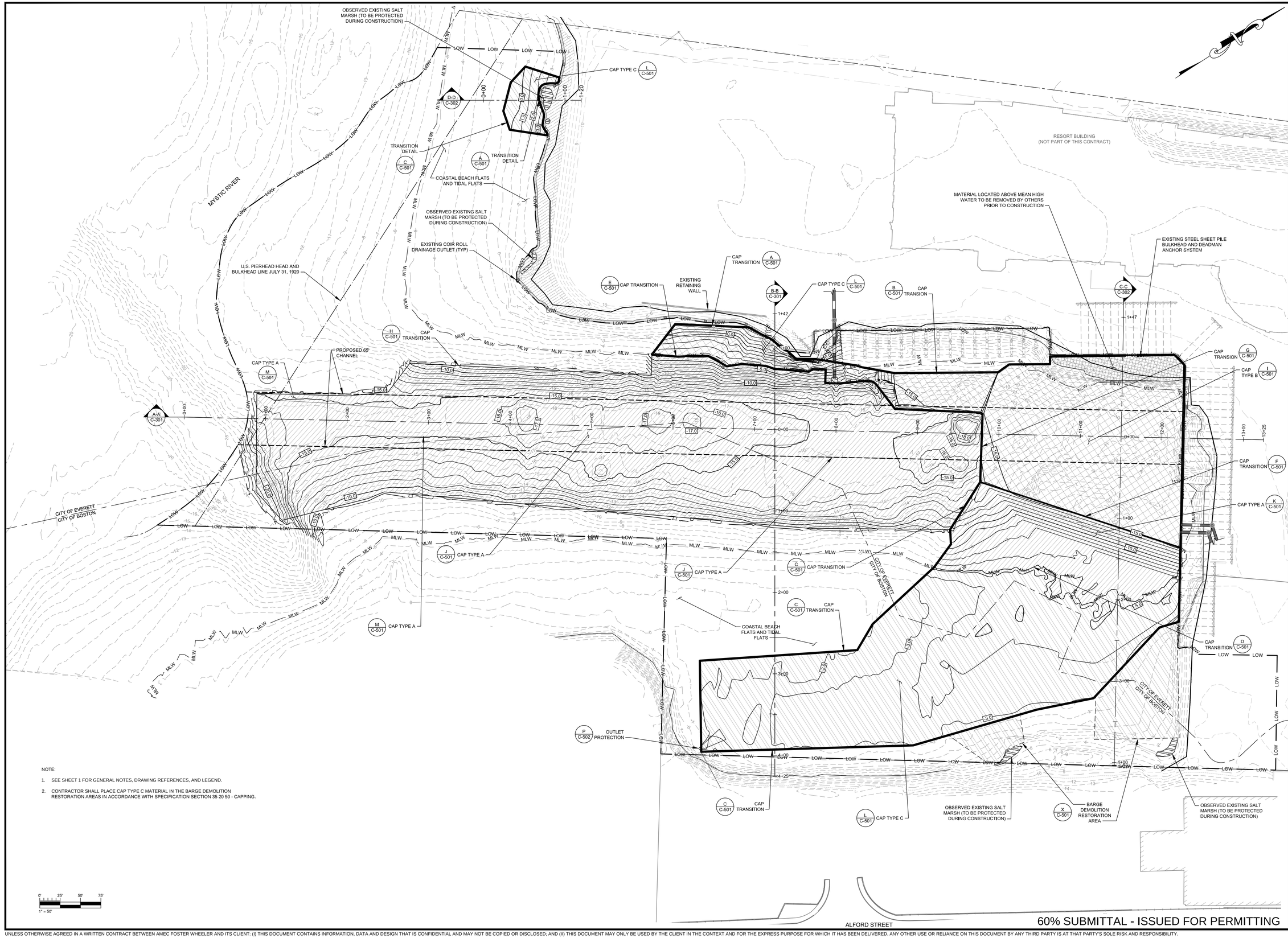

NOTE:

1. SEE SHEET 1 FOR GENERAL NOTES, DRAWING REFERENCES, AND LEGEND.
2. CONTRACTOR SHALL PLACE CAP TYPE C MATERIAL IN THE BARGE DEMOLITION RESTORATION AREAS IN ACCORDANCE WITH SPECIFICATION SECTION 35 20 50 - CAPPING.

60% SUBMITTAL - ISSUED FOR PERMITTING

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REVISION	DATE	ISSUE / REVISION DESCRIPTION	ISSUED BY	APPROVED
0	04/26/2017	60% SUBMITTAL ISSUED FOR CLIENT REVIEW		

PROJECT: FORMER EVERETT STAGING YARD
1 HORIZON WAY, EVERETT, MA

TITLE: REMEDIATION CAP SITE PLAN

CLIENT: BOSTON HARBOR wynn

SEAL: DRAFT

DESIGNED BY: DAA	DRAWN BY: DED
CHECKED BY: TD	SCALE: AS SHOWN
PROJECT NUMBER: 3651160042	
DRAWING NUMBER: C-103	
SHEET NUMBER: 5 OF 9	

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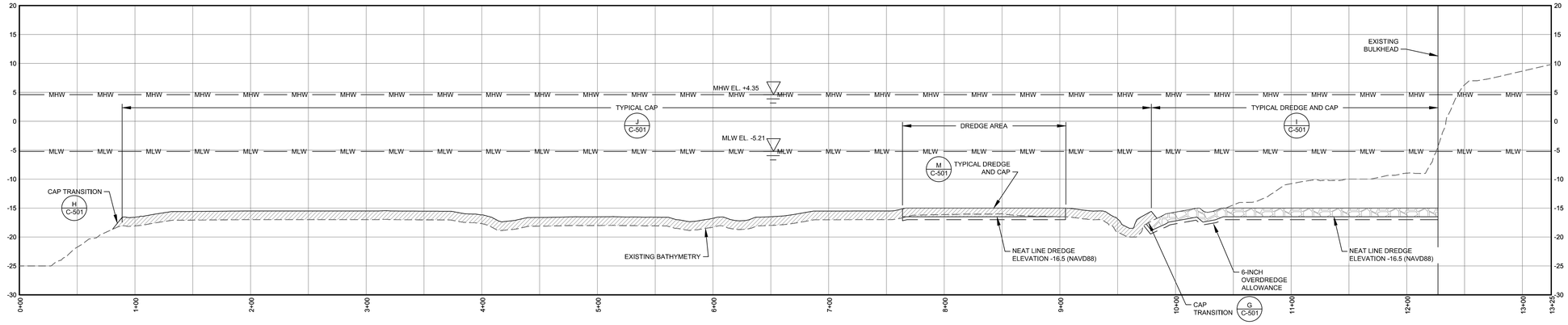
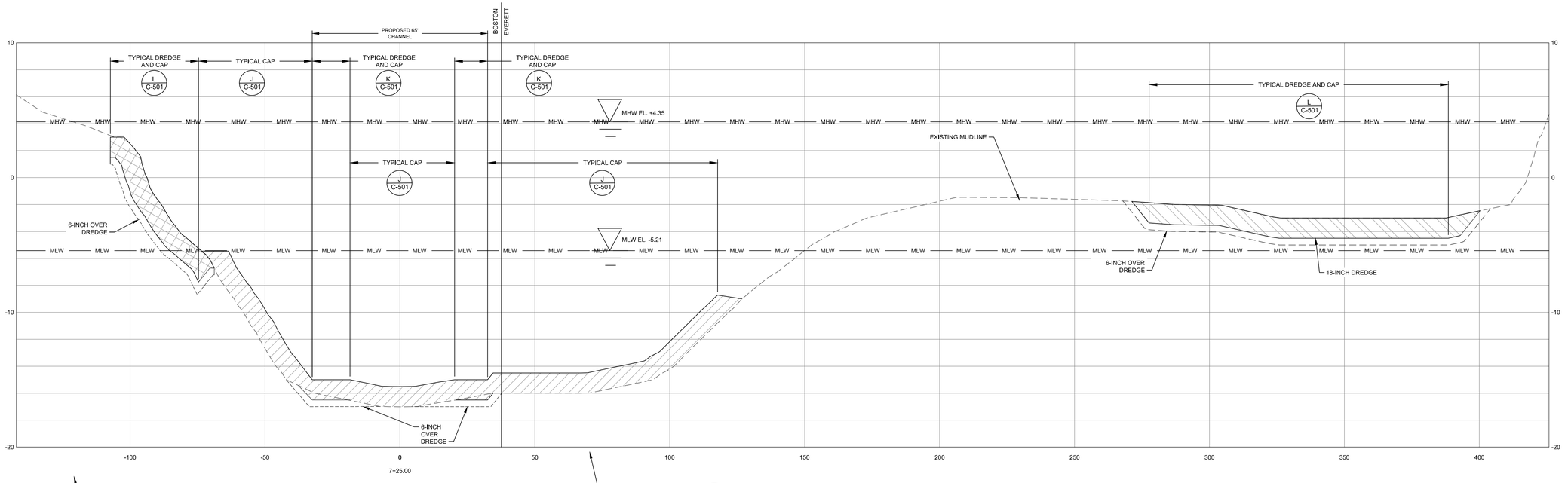


A-A C-102 PROFILE
SCALE: V: 1"=10' / H:1" = 20'



B-B C-102 SECTION
SCALE: V: 1"=4' / H:1" = 20'

NOTES:
1. APPROXIMATE LIMIT INDICATED REFLECTS POTENTIAL AREA OF HISTORIC SHORELINE STRUCTURES. THE LIMIT SHOWN IS BASED ON BEST AVAILABLE INFORMATION AND DOES NOT PRECLUDE ENCOUNTERING STRUCTURES IN OTHER AREAS.

VERTICAL SCALE IN FEET
0 10 20 40
0 50 100 200
HORIZONTAL SCALE IN FEET

VERTICAL SCALE IN FEET
0 2 4 8
0 10 20 40
HORIZONTAL SCALE IN FEET

amec foster wheeler
AMEC MASSACHUSETTS, INC.
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CHELMSFORD MASSACHUSETTS 01824
TELEPHONE: (978) 692-9090
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REVISION	DATE	ISSUE / REVISION DESCRIPTION	ISSUED BY	APPROVED
0	04/26/2017	60% SUBMITTAL ISSUED FOR CLIENT REVIEW		

PROJECT: FORMER EVERETT STAGING YARD
1 HORIZON WAY, EVERETT, MA

TITLE: PROPOSED PROFILE A-A AND SECTION B-B

CLIENT: BOSTON HARBOR Wynn

SEAL: DRAFT

DESIGNED BY: DAA	DRAWN BY: DED
CHECKED BY: TD	SCALE: AS SHOWN
PROJECT NUMBER: 3651160042	
DRAWING NUMBER: C-301	
SHEET NUMBER: 6 OF 9	

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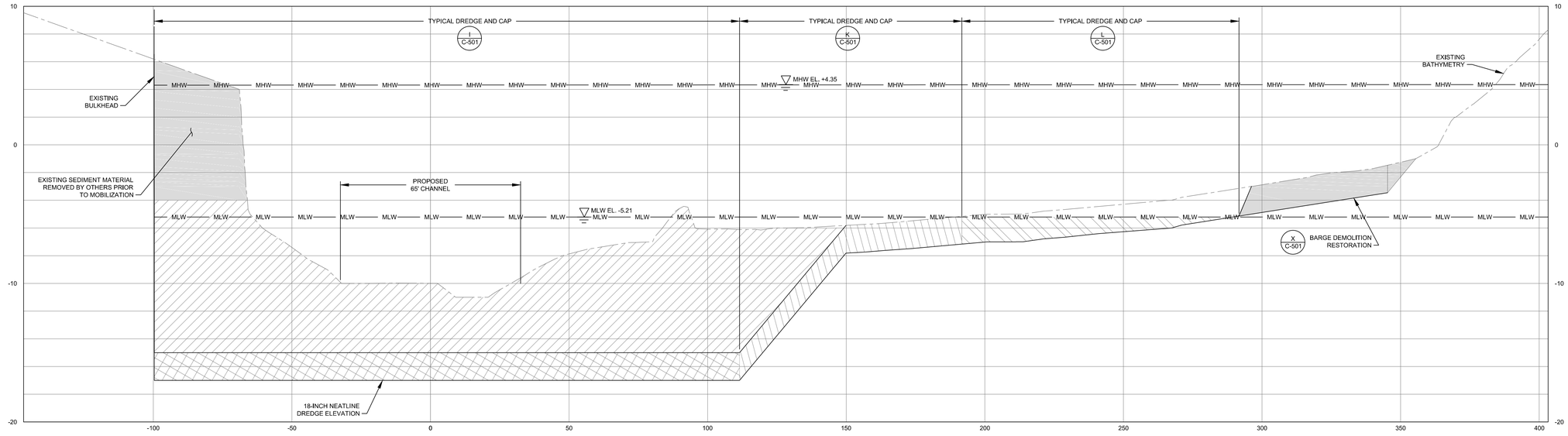
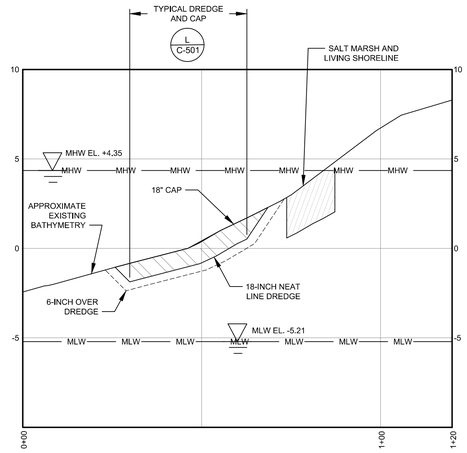


C-C / C-302 SECTION
SCALE: V: 1"=4' / H:1" = 20'



D / C-302 SECTION
SCALE: V: 1"=4' / H:1" = 20'

VERTICAL SCALE IN FEET
0 2 4 8
HORIZONTAL SCALE IN FEET
0 10 20 40

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REVISION	DATE	ISSUE / REVISION DESCRIPTION	ISSUED BY	APPROVED
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PROJECT: FORMER EVERETT STAGING YARD
1 HORIZON WAY, EVERETT, MA

TITLE: PROPOSED DREDGE SECTIONS
C-C AND D-D

CLIENT: BOSTON HARBOR wynn

SEAL: DRAFT

DESIGNED BY: DAA	DRAWN BY: DED
CHECKED BY: TD	SCALE: AS SHOWN
PROJECT NUMBER: 3651160042	
DRAWING NUMBER: C-302	
SHEET NUMBER: 7 OF 9	

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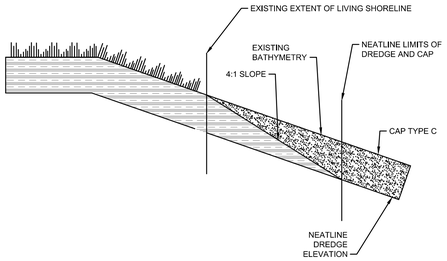
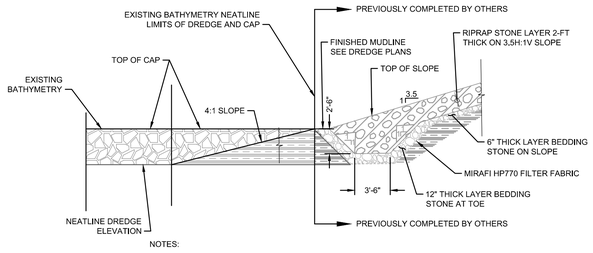
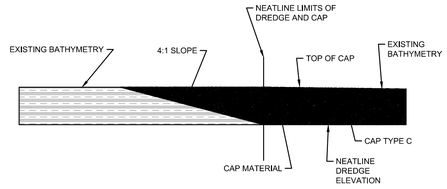
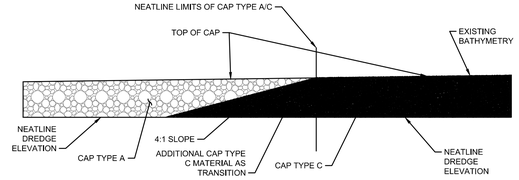




NOTES:

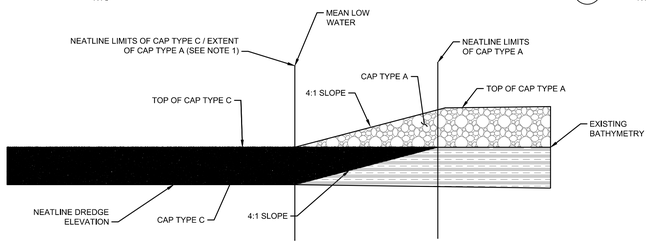
1. CONTRACTOR TO CONFIRM EXISTING CONDITIONS PRIOR TO START OF WORK.





TYPICAL TRANSITION DETAIL: LIVING SHORELINE TO DREDGE AND CAP TYPE C — A

NTS

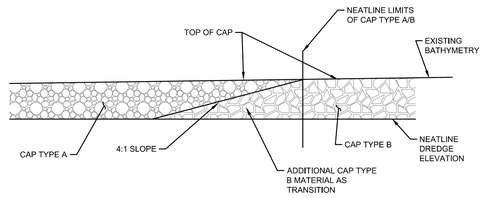


NOTES:

1. CONTRACTOR SHALL TRANSITION CAP TYPE A AND CAP TYPE C SO THE EXTENT OF 4 : 1 SLOPE OF CAP TYPE A IS EQUAL TO THE NEATLINE LIMITS OF CAP TYPE C.

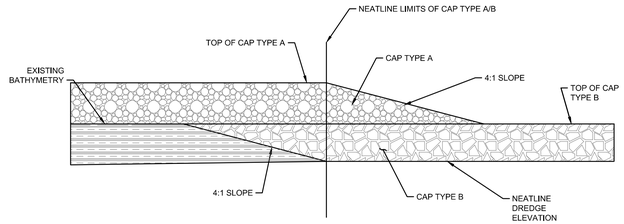
TYPICAL TRANSITION DETAIL: DREDGING AND CAPPING AT TOE OF EXISTING SLOPE — B

NTS



TYPICAL TRANSITION DETAIL: TRANSITION FROM DREDGE AND CAP TO EXISTING MUDLINE — C

NTS

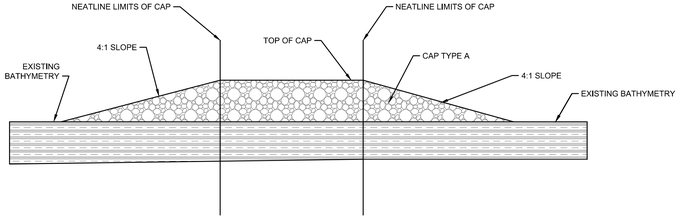


TYPICAL TRANSITION DETAIL: TRANSITION BETWEEN CAP TYPE A AND CAP TYPE C IN ARE SUBJECT TO DEPTH BASED DREDGING — D

NTS

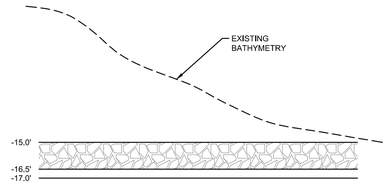
TYPICAL TRANSITION DETAIL: TRANSITION BETWEEN CAP TYPE A AND CAP TYPE C — E

NTS



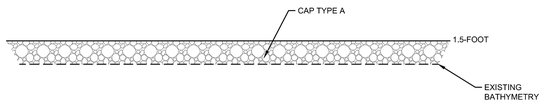
TYPICAL TRANSITION DETAIL: TRANSITION BETWEEN CAP TYPE A AND CAP TYPE B — F

NTS



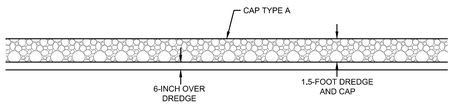
TYPICAL TRANSITION DETAIL: TRANSITION BETWEEN CAP TYPE A AND CAP TYPE B — G

NTS



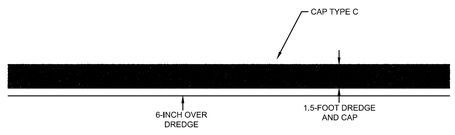
TYPICAL TRANSITION DETAIL: TRANSITION BETWEEN CAP AND EXISTING BATHYMETRY — H

NTS



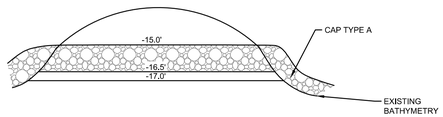
TYPICAL DREDGE AND CAP (SUBTIDAL TURNING NAVIGATION) — I

NTS



TYPICAL CAP (SUBTIDAL) — J

NTS



TYPICAL DREDGE AND CAP (SUBTIDAL) — K

NTS

TYPICAL DREDGE AND CAP (INTERTIDAL) — L

NTS

TYPICAL DREDGE AND CAP (SUBTIDAL CHANNEL NAVIGATION) — M

NTS

LEGEND:

AREA SUBJECT TO CAP TYPE A

AREA SUBJECT TO CAP TYPE B

AREA SUBJECT TO CAP TYPE C

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REVISION	DATE	ISSUE / REVISION DESCRIPTION	ISSUED BY	APPROVED
0	04/26/2017	60% SUBMITTAL ISSUED FOR CLIENT REVIEW		

PROJECT: FORMER EVERETT STAGING YARD
1 HORIZON WAY, EVERETT, MA

TITLE: TRANSITION DETAILS

CLIENT: BOSTON HARBOR wynn

SEAL: DRAFT

DESIGNED BY: DAA	DRAWN BY: DED
CHECKED BY: TD	SCALE: AS SHOWN
PROJECT NUMBER: 3651160042	
DRAWING NUMBER: C-501	
SHEET NUMBER: 8 OF 9	

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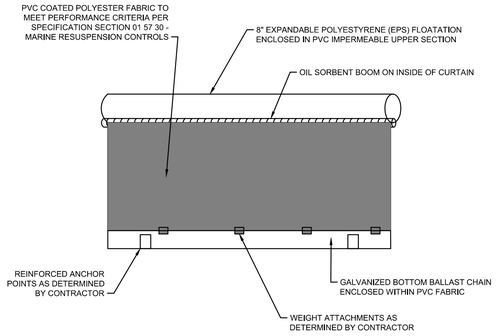
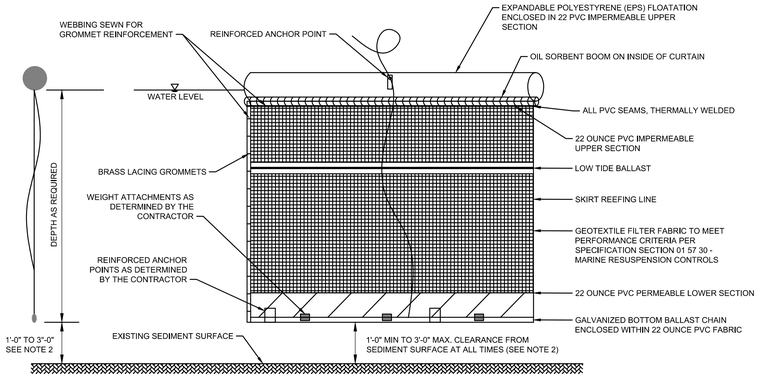


NOTES:

1. SECONDARY OIL CONTAINMENT BOOM SHALL BE PLACED IN ACCORDANCE WITH SPECIFICATION SECTION 01 57 30 - MARINE RESUSPENSION CONTROLS.

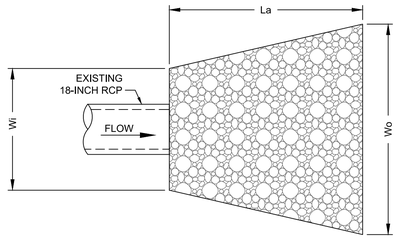
SECONDARY OIL CONTAINMENT BOOM DETAIL — N
NTS



NOTES:

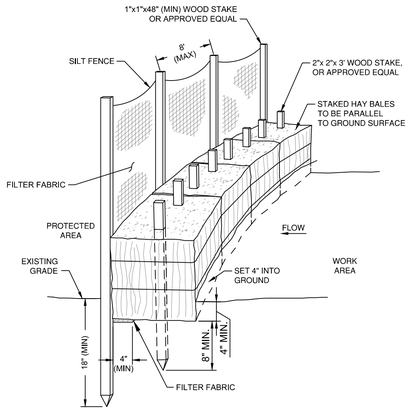
1. STAND ALONE PERMEABLE TURBIDITY CURTAIN TO BE PLACED AS DETAILED HEREIN AND IN ACCORDANCE WITH SPECIFICATION 01 57 30 - MARINE RESUSPENSION CONTROLS
2. CONTRACTOR SHALL MAINTAIN THE BOTTOM OF THE TURBIDITY CURTAIN GREATER THAN 12 INCHES BUT NO MORE THAN 36 INCHES ABOVE THE SEDIMENT SURFACE ALONG THE LENGTH OF THE CURTAIN TO AVOID THE CURTAIN RESTING ON THE SEDIMENT SURFACE.

STAND-ALONE PERMEABLE TURBIDITY CURTAIN DETAIL — O
NTS



PIPE SIZE	La	Wo	Wi	Dstone
18-INCH	34-FEET	15-FEET	3-FEET	8-INCH

PIPE OUTLET PROTECTION — P
NTS



HAY BALE BARRIER W/ SILT FENCE

CONSTRUCTION SPECIFICATIONS :

1. HAY BALES SHALL BE PLACED AT THE TOE OF DISTURBED SLOPES PARALLEL TO THE CONTOURS AND IN A ROW WITH ENDS TIGHTLY ABUTTING THE ADJACENT HAY BALES.
2. EACH HAY BALE SHALL BE EMBEDDED IN THE SOIL A MINIMUM OF (4) INCHES, AND PLACED SO THE BINDINGS ARE HORIZONTAL.
3. HAY BALES SHALL BE SECURELY ANCHORED IN PLACE BY TWO STAKES DRIVEN THROUGH THE BALE. THE FIRST STAKE IN EACH BALE SHALL BE DRIVEN TOWARD THE PREVIOUSLY LAID BALE AT AN ANGLE TO FORCE THE BALES TOGETHER.
4. WHERE SILT FENCE OVERLAP, OVERLAP DISTANCE SHALL BE 36".
5. INSPECTION SHALL BE DAILY AND REPAIR/REPLACEMENT SHALL BE MADE PROMPTLY AS NEEDED, ACCUMULATED SEDIMENT SHALL BE REMOVED AND APPROPRIATELY DISPOSED OF BY CONTRACTOR.
6. HAY BALES SHALL BE REMOVED ONLY AS DIRECTED BY CONSTRUCTION MANAGER.

HAY BALE BARRIER WITH SILT FENCE — Q
NTS

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REVISION	DATE	ISSUE / REVISION DESCRIPTION	ISSUED BY	APPROVED
0	04/26/2017	60% SUBMITTAL ISSUED FOR CLIENT REVIEW		

PROJECT:
FORMER EVERETT STAGING YARD
1 HORIZON WAY, EVERETT, MA

TITLE:
DETAILS

CLIENT:
BOSTON HARBOR wynn

SEAL:
DRAFT

DESIGNED BY:	DRAWN BY:
DAA	DED
CHECKED BY:	SCALE:
TD	AS SHOWN

PROJECT NUMBER: 3651160042

DRAWING NUMBER: **C-502**

SHEET NUMBER: **9 OF 9**

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APPENDIX D

60% Design - Technical Specifications

SECTION 00 01 10 – TABLE OF CONTENTS

END OF SECTION

SECTION 00 31 00 – AVAILABLE PROJECT INFORMATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Referenced Sections

B. Available Project Information

C. Reference Information

D. Permits/Regulatory Authorizations

1.2 REFERENCED SECTIONS

A. Section 01 41 00 – Regulatory Requirements

1.3 AVAILABLE PROJECT INFORMATION

A. Certain reference information relating to Site conditions and data are available to Contractor, but will not be part of the Contract Documents. Information that is available from Owner is referenced herein. Contractor is responsible for reviewing the available reference information prior to submitting a Bid and executing the Contract.

B. Owner-supplied information is provided to Contractor only for information and convenience, and is not a warranty of existing conditions. Owner-supplied information is intended to supplement rather than serve in lieu of Contractor's own investigations. Owner, Construction Manager, and Engineer disclaim responsibility for accuracy of information that has been prepared by others. Owner, Construction Manager, and Engineer further disclaim responsibility for interpretation of that information by Contractor.

C. Owner will not consider requests for additional compensation for extra Work due to conditions that reasonably could have been anticipated from the available reference information.

D. The Drawings and Specifications require Contractor to conduct surveys and investigations and collect certain additional data and information prior to or as part of construction. Contractor is responsible for obtaining additional information if the Contractor desires or as needed to complete the Work.

1.4 REFERENCE INFORMATION

A. The following information is available to Contractor. This information is for reference only and is not part of the Contract.

TO BE COMPLETED PRIOR TO BID

1.5 PERMITS/REGULATORY AUTHORIZATIONS

A. Permits and regulatory authorizations that have been or will be obtained by Owner, and permits and regulatory authorizations that Contractor is required to obtain are identified in Section 01 41 00 – Regulatory Requirements.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 00 31 19 – EXISTING CONDITION INFORMATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Referenced Sections

B. Site Conditions

C. Environmental Conditions

D. Existing Conditions

1.2 REFERENCED SECTIONS

A. Section 00 31 00 – Available Project Information

B. Section 01 14 00 – Work Restrictions

1.3 SITE CONDITIONS

A. Location of Work

1. The Work under this Contract is to be performed within the sediment portion of the Former Everett Staging Yard Disposal Site (the Site) as shown on the Drawings and described below.

2. Contractor access to and use of the properties within the Limits of Work shall be in accordance with the Drawings and Section 01 14 00 – Work Restrictions. Contractor's Work will be strictly monitored by Construction Manager for compliance with these requirements. No access or activities by Contractor other than offsite sediment loading/unloading described in Section 35 20 30 – Dredged Material Management will be allowed outside the Limits of Work shown on the Drawings unless pre-approved by Construction Manager.

B. Site Description

1. The Wynn property encompasses approximately 35 acres, which includes an upland portion (approximately 22 acres) and a portion of the adjacent Mystic River to the southwest (approximately 13 acres). The approximate latitude and longitude for the Site are 42.39 degrees north and 71.07 degrees west, respectively. The Universal Transverse Mercator (UTM) coordinates are approximately 4,695,650 meters north and 329,600 meters east.

2. The sediment portion of the property in the Mystic River consists of an approximately 13-acre embayment of the Mystic River which is bounded to the northwest and north by the upland portion of the property and to the northeast and

east by the Boston Water and Sewer Commission's Material Handling Facility (180-220 Alford Street).

1.4 ENVIRONMENTAL CONDITIONS

A. Environmental investigations have been undertaken from the 1990s to the present. The environmental investigations included field sampling and laboratory testing to characterize physicochemical and biological conditions in environmental media samples.

B. Contaminants of concern (COC)s consist of metals, polycyclic aromatic hydrocarbons (PAHs), phthalates, and polychlorinated biphenyls (PCBs). Sediment COC concentrations vary with location and depth based on testing of sediment chemical and physical properties. Localized areas of relatively high COC concentrations have been identified in certain areas.

C. Previous environmental investigations and results are referenced in Section 00 31 00 – Available Project Information.

1.5 EXISTING CONDITIONS

A. The results of prior surveys and investigations are indicative of general conditions at their respective locations considering the sampling and survey equipment employed. Variations in the properties of the materials are to be expected. Information regarding the physical and chemical properties of materials to be removed or otherwise associated with the Work is provided in the supplemental reference information identified in Section 00 31 00 – Available Project Information. The information is based on field investigation and laboratory testing of the materials. The data and results of prior surveys and investigations reflect available information at the time of data collection, are approximate, and may have changed since the time of data collection. Although the results of such investigations are considered generally representative of conditions at their respective locations at the time of the investigation, local variations in the materials are to be expected and, if encountered, shall not be considered materially different within the purview of the Contract.

B. Debris is present in the areas targeted for dredging. Contractor shall examine the Work Area and the reference materials and conduct their own surveys and become thoroughly familiar with field conditions, and types and quantities of debris that may be encountered and generated during Contractor's dredging operations. Contractor's plan for dredging, dredged material transport, and sediment processing shall incorporate measures to manage vegetation and debris in a manner that does not adversely impact the dredging, dredged material transport, or sediment unloading/processing operations.

C. Subsurface investigation data provide information regarding conditions below the sediment surface. The data were collected and compiled primarily for use by Engineer to determine dredging limits and other design items. These data, by their nature, cannot reveal all conditions existing on the Site and are provided to Contractor for information purposes only. Contractor shall understand that subsurface conditions may differ from those depicted on the available logs.

D. Geotechnical information has been collected within the Work Area. Copies of logs and geotechnical results are included in accordance with Section 00 31 00 – Available Project Information.

E. Contractor is responsible for reviewing the information contained in the referenced documentation. The information is made available to Contractor for information on factual data only and shall not be interpreted as a warranty of subsurface conditions whether interpreted from written text, logs, or other data.

F. If, during the course of construction, conditions differing substantially from those indicated in the above-referenced information and/or Drawings are encountered, Contractor shall promptly notify Construction Manager in writing, and shall not disturb such conditions until directed. Should subsurface conditions be found to vary substantially from the existing information, Construction Manager and Engineer will determine whether changes to the Drawings or Specifications are required.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01 11 00 – SUMMARY OF WORK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Referenced Sections

B. Project Description

C. Drawings

D. Specifications

E. Dredge Prism Files

1.2 REFERENCED SECTIONS

A. Section 35 20 50 – Capping

1.3 PROJECT DESCRIPTION

A. The Sediment Remediation Project (referred to as the Project) will include the remediation of the sediment portion of the Former Everett Staging Yard Disposal Site in Boston and Everett, Massachusetts (referred to as the Site). The sediment remediation program is being implemented to address environmental risk associated with sediment in an embayment of the Mystic River that contains metals, polycyclic aromatic hydrocarbons (PAHs), phthalates, and polychlorinated biphenyls (PCBs).

B. The proposed work will be completed to comply with the requirements of the Massachusetts Contingency Plan (MCP, 310 CMR 40.0000). The Disposal Site, identified by the Massachusetts Department of Environmental Protection (MassDEP) as Release Tracking Number 3-13341, includes the entire upland portion of the property in and a portion of the sediment in an embayment of the Mystic River.

C. In general, the main components of the Project include the following:

1. Performing demolition and removal of five abandoned barges located as shown on the Drawings.

2. Dredging contaminated sediment in subtidal and intertidal portions of the Site, transporting the dredged material for unloading, processing and offsite disposal, and treating and discharging water generated during the dredging and dredged material handling operations. The area that will be dredged is approximately 3.76 acres. Approximately 24,200 in situ cubic yards of sediment are targeted for dredging and the allowable total dredging volume (including an overdredge allowance of six inches) is approximately 27,600 cubic yards. Both elevation

based and depth based dredging are proposed. Landside access is not available at the site for offloading or processing of sediments, or for import and loading of fill materials onto material barges for placement.

3. Capping dredged and non-dredged portions of the Site with three different single layer caps. The estimated volume of cap material is approximately 19,200 cubic yards and the allowable total cap volume (including overplacement allowance in accordance with Section 35 20 50 – Capping) is approximately 21,200 cubic yards.

D. Contractor shall furnish all labor, materials, services, insurance, tools, equipment, temporary facilities, decontamination facilities, and incidentals to perform the Work in accordance with the Drawings and Specifications, including applicable laws, permits, regulations, codes, Owner requirements, access agreements, ordinances, and applicable standards.

E. Existing conditions at the Site are summarized in Section 00 31 19 – Existing Conditions Information and shown on the Drawings.

F. Certain reference information relating to Site conditions and data are available to Contractor, but will not be part of the Contract Documents. This reference information is listed in Section 00 31 00 – Available Project Information. Contractor is responsible for reviewing the available reference information prior to submitting a Bid and executing the Contract.

G. Potential constraints that may affect Project implementation include, but are not limited to, the following:

1. Semidiurnal tides with an approximate 10-foot tidal swing.

2. The potential for water quality monitoring data to exceed regulatory compliance requirements. Monitoring for compliance with the water quality requirements will be conducted by Contractor. Contractor shall implement best management practices, engineering controls, operational controls, corrective measures, and other mitigation measures necessary to maintain compliance with the water quality requirements.

3. Limited use of upland access at the Site. Contractor must identify and use an off-site property for usage, including but not limited to, dredge material processing and offloading, the loading of construction materials including cap materials onto barges prior to transporting the materials to the Site, and daily personnel access and egress.

4. Dredging adjacent to sensitive shoreline habitat and structures.

5. Time-of-year restrictions.

H. Contractor shall develop and implement a Construction Quality Control Plan (CQCP) in accordance with Section 01 40 00 – Quality Requirements. Contractor shall perform quality control surveys, testing, and inspections in the field to verify compliance of the Work and materials with the Drawings and Specifications. Construction Manager will

review Contractor's quality control surveys, testing, and inspection results and may perform independent quality assurance surveys, testing, and inspections as needed.

I. It is expected that Contractor will implement the Work on an expedited schedule. Owner's objective is to complete demolition, dredging, and capping in a single construction season. Accordingly, Contractor is expected to implement an appropriate work schedule to accomplish this objective.

1.4 DRAWINGS

A. The Contract Drawings (referred to as the Drawings) are listed on the Drawing Index in Table A attached to this Specification Section.

1.5 SPECIFICATIONS

A. General and Technical Specifications (collectively referred to as the Specifications) are listed in Section 00 01 10 – Table of Contents.

1.6 DREDGE PRISM FILES

A. Dredge Prism Files are electronic files that will be used to verify that dredging has achieved the required elevations as described in Section 35 20 23 – Dredging. The following Dredge Prism Files are provided with the Bid documents:

1. Dredge Prism XYZ File, which is an electronic data point file that specifies the horizontal (X and Y) and vertical (Z) extent of design cut material to be removed as part of the dredging. The electronic data file contains X, Y, and Z values on a 1-foot by 1-foot basis within the footprint of the dredge areas and the adjoining side slope areas.

2. Overdredge Prism XYZ File, which is an electronic data point file that specifies the horizontal (X and Y) and vertical (Z) extent of the allowable overdredge material that may be removed as part of the dredging. The electronic data file contains X, Y, and Z values on a 1-foot by 1-foot basis within the footprint of the Dredge Area and the adjoining side slope areas.

3. Dredge Prism Boundary File, which shows the lateral extent of the Dredge Prism XYZ File where the dredge cut intersects the existing pre-dredge sediment surface. The Dredge Prism Boundary file is an AutoCAD DXF data file.

4. Overdredge Prism Boundary File, which shows the lateral extent of the Overdredge Prism XYZ File where the allowable overdredge cut intersects the existing pre-dredge sediment surface.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

TABLE A
DRAWING INDEX

TO BE COMPLETED PRIOR TO BID

Sheet	Drawing Number	Drawing Title

END OF SECTION

SECTION 01 12 19 – CONTRACT INTERFACE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Referenced Sections

B. Responsibilities of Parties

C. Interpretation of Drawings and Specifications

1.2 REFERENCED SECTIONS

A. This Section contains information that applies to all Work performed under the Contract between Owner and Contractor.

1.3 RESPONSIBILITIES OF PARTIES

A. Owner

1. Wynn MA, LLC and Everett Property, LLC (collectively Wynn) is the Owner responsible for implementation of the Project, including contracting, accounting, purchasing, etc. Owner has final approval authority over modifications to the Contract and will provide overall direction to Construction Manager and Engineer. Construction Manager and Engineer will report to Owner.

B. Construction Manager

1. Construction Manager reports to Owner. Construction Manager is authorized to represent Owner and act on Owner's behalf to administer the Project.

2. Construction Manager, on behalf of Owner, is responsible for overall management related to the Project, overseeing implementation of the Work, communications with the Contractor, and administration of the Drawings and Specifications.

3. Construction Manager will communicate directly with Contractor to coordinate activities.

4. Construction Manager will communicate and coordinate with Owner and Engineer, as necessary, during the course of the Work. Construction Manager will receive information directly from Contractor and convey information, as appropriate, to Owner and Engineer. Certain submittals prepared by Contractor will require approval by Owner or Engineer. Construction Manager will coordinate submittal reviews by Owner and Engineer.

C. Engineer

1. Engineer will serve as representative for the Licensed Site Professional for the project and is responsible for overseeing implementation of the design in accordance with the Massachusetts Contingency Plan (MCP).

2. Engineer has prepared the Drawings and Specifications and is responsible for the interpretation of the Drawings and Specifications. Engineer will report to Owner. Engineer, under Owner management, will review proposed alterations or modifications to the project design as formally requested by Contractor and provide the results of that review to Construction Manager.

3. Engineer, Owner, and Construction Manager will answer questions that arise regarding the interpretation of the Drawings and Specifications. During construction, Engineer will review certain submittals prepared by Contractor and may provide on-site observation services during the project implementation by Contractor. Engineer will communicate directly with Construction Manager, who will communicate with Contractor.

D. Contractor

1. Contractor is responsible for implementing and ensuring the completion of the Work, producing Record Drawings, and documenting the Work performed and the as-built conditions. Contractor is responsible for procuring permits and approvals within Contractor's scope, completing notifications other than those described in Section 01 41 00 – Regulatory Requirements, and procuring the services of subcontractors as necessary to complete the Work as needed. Contractor is also responsible for the Work of Contractor's subcontractors, including inspections to verify that Work performed by subcontractors is in compliance with the requirements of the Contract.

2. Contractor is subject to requirements of local, state, and federal agencies for implementation of the Work. Details pertaining to jurisdictional requirements governing the Work that are not specifically mentioned in the Contract or the Specifications shall not relieve Contractor's obligation to be in compliance with applicable requirements.

3. Contractor shall conduct certain monitoring activities throughout the Work. Data collected from monitoring by Contractor shall be provided to Construction Manager and used to provide documentation of conditions at the Site. Owner and Construction Manager reserve the right to suspend or modify Work at the Site if monitoring data indicate that threshold levels, as identified in the Specifications, applicable plans, or permits, are exceeded. In the event these threshold levels are exceeded, resulting suspensions and/or modifications of Work shall be performed by Contractor at no additional cost to Owner.

1.4 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS

A. Should it appear that the Work to be done or any matters relative thereto are not sufficiently detailed or explained in the Drawings or Specifications, Contractor shall submit a Request for Information (RFI) to Construction Manager in accordance with Section 01 31 13 – Project Coordination.

B. Drawings are intended to be illustrative and may not be an exact or a complete representation of actual field conditions or the actual finished Work. For the finished Work, Contractor shall include all necessary extra material required to make each installation satisfactory and operable for its intended purpose, even though some items may not be specifically depicted on the Drawings.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01 14 00 – WORK RESTRICTIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Referenced Sections

B. General Requirements and Restrictions

C. Contract Work Area

D. Work Hours and Days

E. Access to Site

F. Equipment and Vehicle Operation and Maintenance

G. In-water Work Requirements and Restrictions

H. Weather and Water Conditions

I. Protection of Structures, Equipment, and Services

1.2 REFERENCED SECTIONS

A. Section 01 32 16 – Construction Progress Schedule

B. Section 01 35 53 – Security Procedures

C. Section 01 52 00 – Construction Facilities

D. Section 02 51 00 – Equipment Decontamination

1.3 GENERAL REQUIREMENTS AND RESTRICTIONS

A. Contractor is responsible for becoming familiar with all aspects of the Work and the Site prior to performing the Work in accordance with the Contract. Any discrepancies shall be brought to the attention of Construction Manager. If any discrepancies are encountered during construction, Contractor shall notify Construction Manager for resolution prior to proceeding with the Work.

B. Contractor shall cooperate with all other parties engaged in project-related activities, including but not limited to Owner's employees, representatives, and other contractors, to the greatest extent possible.

C. Contractor shall obtain authorization from Owner and/or Construction Manager to proceed with construction prior to starting work on any item not clearly defined by the Contract Documents.

D. Contractor shall execute Work with the least possible interference or disturbance to ongoing upland construction and the public. Contractor shall make appropriate accommodations and scheduling to prevent disrupting or impeding ongoing construction during implementation of the Work. Contractor shall not interfere with access or services to upland buildings, equipment, or other operational areas. Contractor shall make arrangements with Construction Manager to facilitate Work as stated.

E. Contractor shall comply with all local, state, and federal laws, regulations, and ordinances.

F. Contractor shall be solely responsible for all construction means, methods, techniques, sequences, and procedures and for coordinating all portions of the Work under the Contract.

G. Contractor shall comply with restrictions regarding Work hours and days, access, Contractor's use of Site, and coordination as specified herein and as directed by Owner and Construction Manager.

H. Contractor shall obtain Owner approval prior to bringing to the Site or using at the Site any hazardous products. Contractor shall maintain a register of hazardous products in storage areas and ensure that this area is maintained in accordance with laws and regulations.

I. Hot Work shall be minimized and shall not be performed without prior notification to and approval of Construction Manager. Any Hot Work shall be in accordance with local, state, and federal requirements.

J. Use of explosives at the Site is not permitted.

K. Burning of any materials at the Site is not permitted.

L. Contractor shall inform its employees, employees of subcontractors, and distributors that any lewd, racial, or sexual comments or actions directed toward any individual on the Site is strictly prohibited. Incidents of this type may result in immediate and permanent dismissal of the employee(s) involved.

M. Smoking is not permitted in areas handling flammable liquids. All designated smoking areas must be delineated by flagging tape or other means and be equipped with a cigarette butt disposal can and a fire extinguisher.

N. Contractor must ensure Contractor's personnel employed on Site become familiar with and obey applicable rules and regulations that govern the project, including safety, fire, traffic, navigation, and security rules and regulations.

1.4 CONTRACT WORK AREA

A. The Limits of Work are shown on the Drawings and described in these Specifications. All Work shall be confined to the Limits of Work and completed to the lines, grades, and dimensions called for on the Drawings and Specifications unless directed otherwise by Construction Manager. All Work performed beyond designated limits without prior approval shall be corrected to Owner's satisfaction, at no additional cost to Owner.

B. Contractor is responsible for security within the Limits of Work throughout completion of Work activities in accordance with Section 01 35 53 – Security Procedures.

1.5 WORK HOURS AND DAYS

A. Work may be performed 24 hours per day, 6 days a week. Contractor is responsible for complying with all local, state, and federal laws, regulations, and ordinances that may apply to Contractors work hours and obtaining all related permits at no additional expense to Owner. Contractor shall include proposed work hours and days in the Construction Progress Schedule as described in Section 01 32 16 – Construction Progress Schedule. If modifications to initially proposed work hours and days are required, Contractor shall submit advance (minimum 72 hours) written request to Construction Manager. Contractor may alter Work hours only after receiving written approval from Construction Manager**.**

B. Perform noisiest Work between 7:00 a.m. and 7:00 p.m., avoiding weekends and statutory holidays. Noise-generating activities outside of this time period shall be limited to the extent practicable. Coordinate noise-generating activities outside of this time period with Construction Manager.

C. All Work conducted during non-daylight hours and periods of low visibility shall be performed in accordance with the lighting requirements described in Section 01 52 00 – Construction Facilities.

1.6 ACCESS TO SITE

A. Contractor shall have limited upland access to the Site as shown on the Drawings.

B. Contractor shall establish additional access and egress at a location outside of the project limits. Contractor shall secure all permits and approvals (including any associated fees) to access those location(s) and obtain approval by Construction Manager.

C. Contractor is responsible for transport of personnel to the Work Area, as required.

D. Contractor shall maintain and furnish a daily sign-in/sign-out log for all personnel and visitors to the Site.

E. Contractor shall design, construct, and maintain temporary access to and egress from the Work Area, as required to complete the Work. This includes, but is not limited to, stairs, runways, ramps, ladders, docks, platforms, and other means

independent of finished surfaces and in accordance with relevant local, state, federal, and other regulations.

1.7 EQUIPMENT AND VEHICLE OPERATION AND MAINTENANCE

A. Contractor shall maintain equipment and machinery used for the Work in good working order at all times. Machinery shall be free of any oil or fuel leaks.

B. Contractor shall inspect all equipment, machinery, vessels, and vehicles prior to being used on the project and daily during the course of Work for cleanliness and condition. Contractor shall submit a mechanical inspection certificate for each piece of applicable equipment 72 hours before equipment enters the Site. Contractor shall keep up to date the register of inspection activities, verification, machinery, and equipment maintenance and repair directly related to the Work.

C. Machinery shall be equipped with adequate exhaust and anti-pollution systems in order to limit atmospheric emissions and noise (mufflers).

D. Equipment and machinery used for Work on or near the water shall use vegetable oil-based lubricants in all oil-to-sea interfaces, unless the use of such lubricants is technically infeasible. Otherwise, use environmentally acceptable lubricants that are biodegradable, are non-toxic or minimally toxic, and are not bioaccumulative to the extent technically feasible.

E. Do not drive directly in the water with wheeled or rolling machinery or vehicles.

F. All Contractor equipment and vehicles that enter the Work Area shall be dedicated to the Work Area until decontaminated in accordance with Section 02 51 00 – Equipment Decontamination.

G. Contractor shall confine vehicle and equipment fueling, repairs, maintenance, and awaiting maintenance operations to areas approved by Construction Manager. Contractor shall prepare these areas with measures that prevent contamination of stormwater runoff and groundwater. Measures may include, but are not limited to, covered or roofed areas, drip pans, use of spill and overflow equipment, berming, cleaning surfaces to remove oil and grease from leaks, or draining all parts of fluids. Contractor shall perform any refueling activity of hydrocarbons under constant surveillance. Contractor shall handle oil products in such a way as to prevent and control leaks and spills.

H. Contractor shall perform light maintenance, washing, repairs on machinery and vehicles, fueling, and storage of maintenance products at a location more than 100 feet from any watercourse. Contractor shall perform major repairs in specialized garages located off Site or at an alternate location approved by Construction Manager.

I. Prior to maintenance, equipment shall be decontaminated in accordance with Section 02 51 00 – Equipment Decontamination.

J. Equipment operation shall be suspended during fueling.

1.8 IN-WATER WORK REQUIREMENTS AND RESTRICTIONS

A. Contractor shall plan and schedule silt-producing Work activities conducted below Mean High Water (MHW) to between September 15 and February 15, inclusive, as required in the permits. These Time-of-Year Restrictions shall be reflected in Contractor's Construction Progress Schedule.

B. Contractor may perform silt-producing Work activities outside the Time-of-Year Restrictions only after receiving written approval from Construction Manager. At least 21 days before the start of any planned silt-producing Work outside the specified period, Contractor shall develop and submit to Construction Manager a plan describing the nature of such activities, the dates during which the activities will be performed, the reason such activities cannot be completed in accordance with the specified Time-of-Year Restrictions, the mitigation measures that will be put in place to contain all such activities such that turbidity levels are not measurably increased, and the monitoring that will be implemented to document containment. If Construction Manager deems the reason and mitigation measures acceptable, Construction Manager will request an extension from the applicable permitting agencies; however, should such request be rejected by the permitting agencies, Contractor shall take necessary measures to complete Work in accordance with the specified restrictions at no additional cost to Owner.

C. Contractor shall perform Work in a manner that will not disrupt normal activities within the Federal Navigation Channel and/or neighboring properties. Contractor must ensure that neighboring operations or activities are not disturbed, interrupted, or prohibited as a result of Work.

D. Do not release debris, scrap, waste, or materials into the Work Area or the aquatic environment. All debris accidentally introduced into the aquatic environment shall be removed as soon as possible.

E. Should Contractor, during the execution of the Work, lose, dump, throw overboard, sink, or misplace any material, dredge, scow, machinery, equipment, or appliance, Contractor shall promptly notify Construction Manager. Contractor shall retrieve the material at the discretion of and to the satisfaction of Construction Manager at no additional cost to Owner.

1.9 WEATHER AND WATER CONDITIONS

A. Contractor shall evaluate the safety of vessel operations in all Work Areas proposed for vessel operations. Contractor shall conduct an evaluation for each vessel to determine the range of water conditions the equipment can safely operate in. This evaluation shall be performed by a naval architect, the vessel manufacturer, or other similar marine expert. Contractor shall also provide an assessment of the qualifications and experience of the crew operating the vessel and working in water conditions similar to those that will be encountered during the Work.

B. Monitor marine weather and marine forecasts and alerts at least twice daily to determine if forecasted conditions have the potential to impede the safe implementation of the Work.

C. Plan and schedule the Work to limit losses related to difficult working conditions (e.g., weather conditions) that impede the safe implementation of the Work.

D. Suspend or limit Work when difficult and unsafe conditions are anticipated or manifested (e.g., storms, violent winds, extreme wave events). Temporarily suspend or limit Work when weather conditions or wave height cause unsafe working conditions.

E. During periods of poor visibility (e.g., fog or rain), operation of moving vessels shall be slowed or halted, as necessary, to ensure the safety of project personnel, other vessels, structures, and the public.

1.10 PROTECTION OF STRUCTURES, EQUIPMENT, AND SERVICES

A. Contractor shall exercise care and provide protection to prevent disturbing or damaging structures, equipment, utilities, or other features within or adjacent to the Limits of Work. Any damage to structures, equipment, utilities, or other features shall be repaired or replaced by Contractor to the satisfaction of Construction Manager at no additional cost to Owner.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01 18 00 – PROJECT UTILITY SOURCES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Referenced Sections

B. Project Utility Sources

1.2 REFERENCED SECTIONS

A. Section 01 51 00 – Temporary Utilities

1.3 PROJECT UTILITY SOURCES

A. Any sizing or location of existing utilities noted on the Drawings is approximate and from available information provided by field observations or study of existing records. Information related to existing utilities provided in the Specifications or on the Drawings is for informational purposes only. Contractor shall be responsible for reviewing information and verifying the locations of all utilities whether or not shown on the Drawings and shall field verify the locations and sizing of any utilities shown on the Drawings that may affect the Work. Contractor shall repair any damage to utilities to the satisfaction of the utility owner and Construction Manager at no expense to Owner.

B. Contractors shall contact all relevant utilities and DigSafe at least 5 days prior to beginning intrusive Work

C. Contractor shall protect installed utilities from damage and shall be responsible for all replacement and lost production costs associated with damaged utilities. Contractor is responsible for identifying and obtaining buried on-site utility information.

D. Contractor shall conduct a pre-construction utilities location survey to field verify the location of all existing public and private utilities prior to starting any Work that may cause damage to such utilities. If the exact location or depth of existing underground utilities is unknown, Contractor, prior to beginning construction, shall perform all necessary explorations and studies to locate these utilities that may affect the Work.

E. Contractor shall notify Construction Manager immediately of any discrepancies in the utilities shown or referenced on the Drawings or in the Specifications and those observed in the field.

F. Contractor shall be liable for all damages to existing utilities in the performance of the Work. Contractor shall repair any damage to utilities to the satisfaction of the utility owner and Construction Manager at no expense to Owner.

G. Contractor is required to coordinate as needed with utility companies and Construction Manager during the Work. Contractor shall inform Construction Manager of existing utility installations that need relocation, if any, in order to complete the Work. Any such

utility relocation shall be considered incidental to the Work and no separate payment will be made. Any utility relocation operations shall be conducted only with prior coordination and approval of the applicable utility management.

H. Utility work shall adhere to all local, state, and federal utility codes and requirements.

I. Contractor shall exercise care and diligence to observe sustainable and conservational utility use practices throughout the Work.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 SECTION INCLUDES

A. Electric Utility Sources

B. Water Supply Sources

C. Sanitary Facilities

D. Communications/Internet

E. Removal

3.2 ELECTRIC UTILITY SOURCES

A. Existing electrical service is not available for Contractor use at the Site. Contractor shall make the necessary arrangements to provide and maintain temporary electric service, in accordance with local, state, and federal electrical codes. All costs associated with temporary electrical service, including but not limited to, permitting, inspections, fees, connection, modifications, energizing, fuel for generators, and usage charges, shall be borne by Contractor at no additional cost to Owner.

3.3 WATER SUPPLY SOURCES

A. Contractor shall provide their own potable water in sufficient quantity and of sufficient quality for all potable needs of all on-site project personnel (e.g., Owner, Construction Manager, Engineer, Agencies, and Contractor) during the Work.

B. Contractor shall provide their own non-potable water in sufficient quantity and of sufficient quality for all non-potable water needs of Contractor during the Work.

C. The quantity of water required for equipment and personnel decontamination and other Site activities shall be determined and provided by Contractor.

D. Contractor shall be responsible for removal of all installed temporary lines and equipment at the completion of the project.

E. Water used for the Work that is acquired by Contractor from off-site sources shall be at no additional cost to Owner.

3.4 SANITARY FACILITIES

A. Existing sanitary sewer facilities are not available for use by the Contractor. Contractor shall provide temporary sanitary facilities in accordance with Section 01 51 00 – Temporary Utilities.

3.5 COMMUNICATIONS/INTERNET

A. Existing communications/internet utilities are not available for use by Contractor. Contractor shall provide temporary communications/internet utilities in accordance with Section 01 51 00 – Temporary Utilities.

3.6 REMOVAL

A. Contractor shall remove temporary service connections and associated items upon completion of the Work or as directed by Construction Manager.

END OF SECTION

SECTION 01 20 00 – PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Referenced Sections

B. Description

C. Scope of Payment

D. Payment for Increased or Decreased Quantities

E. Omitted Items

F. Progress Payments

G. Payment for Material Delivered

H. Measurement of Quantities

I. Incidental Work

1.2 REFERENCED SECTIONS

A. Section 01 31 13 – Project Coordination

B. Section 01 33 00 – Submittal Procedures

C. Section 01 77 00 – Closeout Procedures

D. Section 02 21 00 – Surveys

E. Section 02 22 00 – Existing Conditions Assessment

F. Section 02 61 00 – Removal and Disposal

G. Section 02 72 00 – Water Decontamination

H. Section 31 05 13 – Soils and Aggregates

I. Section 35 05 05 – Selective Demolition for Waterway and Marine Construction

J. Section 35 20 23 – Dredging

K. Section 35 20 30 – Dredged Material Management and Processing

L. Section 35 20 50 – Capping

1.3 DESCRIPTION

A. All payment specifications set forth in Contract between Owner and Contractor and applicable provisions shall be complied with unless otherwise specified herein.

B. Unless otherwise specified herein, for lump sum items, payment will be made based on the actual percent of Work completed and agreed to by Construction Manager.

C. For unit price items, payment will be based on the actual amount of Work accepted by Construction Manager and for the actual quantity of materials removed or in place and accepted in conformance with the Contract, as shown by final measurement.

D. All units of measurement shall be United States convention as applied to the specific items of Work and as interpreted by Construction Manager. Payment units will be as indicated on the Bid Form.

E. At the end of each day's Work, Contractor shall meet with Construction Manager and determine the quantities of Work accomplished and/or completed during the Work day. Contractor shall then prepare a Daily Activity Report, which shall be signed by Contractor and provided to Construction Manager in accordance with Section 01 31 13 – Project Coordination. Quantities that are to be measured based on survey as specified herein may be approximated at the end of each day's Work by Contractor and Construction Manager, and this information shall be noted in the Daily Work Summary.

F. Once each month, Contractor shall prepare a Monthly Progress Summation form from the month's accumulation of Daily Activity Reports, which shall be signed by both Contractor and Construction Manager. The Monthly Progress Summation shall be prepared in accordance with Section 01 31 13 – Project Coordination.

G. Monthly Progress Summation forms, material delivery/disposal manifests, quality control test reports, and verified survey documentation performed in accordance with Section 02 21 00 – Surveys will provide the basis for Construction Manager's review and verification of monthly applications for payment submitted by Contractor.

1.4 SCOPE OF PAYMENT

A. Payments to Contractor will be made for the actual quantities of the Work performed and accepted by Construction Manager in accordance with the Contract. Upon completion of the Work, if these actual quantities show either an increase or decrease from the quantities given on the Bid Form, the Contract Unit Prices will still prevail, except as provided hereinafter and in the Contract.

B. Contractor shall accept compensation, as provided herein, in full payment for furnishing all labor, materials, services, insurance, tools, taxes, equipment, temporary facilities and utilities, decontamination facilities, and incidentals necessary to complete the Work and for performing all Work contemplated and embraced by the Contract.

C. The payment of any progress estimate or of any retained percentage except by and under the approved final invoice in no way shall affect the obligation of Contractor to repair or renew any defective parts of the Work or to be responsible for all damage due to such defects.

D. Unless otherwise approved by Owner, payment in excess of the lump sum prices will not be made.

1.5 PAYMENT FOR INCREASED OR DECREASED QUANTITIES

A. Payment for increased or decreased quantities will be in accordance with the Contract except as provided hereinafter.

B. Contractor shall accept payment in full at the Contract price for the actual quantities of Work completed.

1.6 OMITTED ITEMS

A. Should any items contained on the Bid Form be found unnecessary for the proper completion of the Work contracted, Construction Manager may eliminate such items from the Contract, and such action shall in no way invalidate the Contract, and no allowance will be made for items eliminated in making final payment to Contractor, unless specifically identified below.

1.7 PROGRESS PAYMENTS

A. Progress payments will be made monthly as the Work progresses in accordance with the Contract. All progress invoices and payments shall be subject to correction in the final quantity invoice and payment.

B. No monthly payment shall be required to be made when, in the judgment of Construction Manager, the Work is not proceeding in accordance with the provisions of the Contract Documents, or when, in his/her judgment, the total value of the Work performed since the last payment amounts to less than $1,000.00.

C. A retainage of 10% will be made on all progress payments to secure satisfactory performance of the contractual Work.

1.8 PAYMENT FOR MATERIAL DELIVERED

A. Payment will not be made for materials and equipment not incorporated into the Work.

B. No progress payment will be made related to fuels, supplies, lumber, falsework, or other materials, or on temporary structures of any kind that are not associated with the Work associated with the Contract.

1.9 MEASUREMENT OF QUANTITIES

A. Measurement by Weight. The payment quantity shall be computed based on actual weight in the hauling vehicle. For each load and each type of material delivered to or removed from the Site, Contractor shall furnish to Construction Manager a certified weight ticket from the supply or receiving facility. Certified weight tickets shall clearly and legibly indicate the date, material supplier or facility, project name, bid item number, material description (as defined in the Specifications), and weight of the material delivered. Payment will not be made on items measured by weight for which a certified weight ticket has not been submitted.

B. Measurement by Volume. Measurement shall be based on the in situ volume and final in-place dimensions as measured by survey measurements consistent with the Specifications.

C. Measurement by Area. Measurement shall be based on dimensions as measured by survey measurements consistent with the Specifications.

D. Measurement by Linear Measurement. Measurement shall be by linear dimension, at the item centerline or mean chord.

E. Measurement by Duration. Measurement shall be based on length of time (e.g., days or months) that a piece of equipment or system was in active operation as needed to complete the Work.

1.10 INCIDENTAL WORK

A. Incidental Work items for which separate payment is not measured include, but are not limited to, the following items:

1. Compliance with all local, state, and federal regulations and requirements.

2. Obtaining, maintaining, and compliance with all required permits and notifications.

3. Contractor's health and safety program.

4. Contractor's quality control and quality assurance program.

5. Contractor's project management, attendance at required project meetings, and project reporting.

6. Office and administration services necessary to support Contractor's activities for the duration of the project.

7. Contractor's insurance.

8. Cooperation and coordination with Owner, Construction Manager, Engineer, other contractors, abutting property owners, and others.

9. Procurement and coordination of subcontractors and equipment necessary to perform the Work.

10. Utility and service fees.

11. Work plans and submittals not specifically included or referenced in the Contract Pay Items.

12. Maintenance of equipment and all fuel, grease, oil, and other products necessary for equipment operation.

13. Removal or relocation of all obstructions encountered as necessary to complete the Work as described in the Specifications and shown on the Drawings, unless otherwise approved by Construction Manager.

14. Professional land surveyor services for controls.

15. Preparation of Record Drawings as described in the Specifications.

16. Sampling and testing of construction materials.

17. Materials handling, management, and stockpiling.

18. Site maintenance and cleanup.

19. Protecting and maintaining existing utilities and structures.

20. Protecting, as necessary, all equipment and materials from adverse weather effects.

21. Maintaining the safety of operations at the Site during Work.

22. Protecting sediment, soil, groundwater, air, and surface water resources during the implementation of the Work, including spill prevention, control, and cleanup and hazardous material storage.

23. Equipment decontamination.

24. Project closeout requirements as defined in Section 01 77 00 – Closeout Procedures.

25. Cleaning and waste management.

26. All other Work indicated in the Drawings and Specifications and not specifically listed among the Contract Pay Items described herein and included on the Bid Form.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 SECTION INCLUDES

A. Contract Pay Items

B. Items and Basis for Measurement and Payment

3.2 CONTRACT PAY ITEMS

A. The purpose of this Section is to define the method of measurement and payment for each of the items included on the Bid Form.

B. Contractor shall be carefully acquainted with all Work associated with each payment item and shall have no claim for any unfamiliarity with the requirement of various items.

3.3 ITEMS AND BASIS FOR MEASUREMENT AND PAYMENT

The items described below and presented on the Bid Form constitute all items to be specifically paid under this Contract.

ITEM NO. 1 – PERFORMANCE AND PAYMENT BONDS

1. Work Included

Contractor shall furnish performance and payment bonds, each in an amount at least equal to the Contract price as security for the faithful performance and payment of all Contractor's obligations to furnish, provide, and pay for the remediation and related materials according to the Contract. These bonds will remain in effect until at least 1 year after the date when final payment becomes due, except as provided otherwise by laws or regulations or by the Contract.

2. Measurement

The Work required for this item will be measured based on the receipt of the required performance and payment bonds.

3. Payment

Payment for this lump sum item will be made subsequent to receipt of the required performance and payment bond.

ITEM NO. 2 – WORK PLANS AND SUBMITTALS

1. Work Included

This item will provide for all Work, subcontracted or otherwise, necessary to complete the preparation of all submittals and Work Plans during the Work including but not limited to those listed in Table A of Section 01 33 00 – Submittal Procedures, and submission of Work Plans and submittals consistent with the timeframes listed in Table A of Section 01 33 00 – Submittal Procedures. All other submittals required by, but not specifically listed in, Section 01 33 00 – Submittal Procedures are considered incidental to this payment item.

2. Measurement

The Work required for this item will be measured on the basis of acceptance of Work Plans and submittals by Construction Manager as required by the Specifications.

3. Payment

Payment will be based on a percent complete basis as determined by Construction Manager using the number of approved Contractor submittals and the total number of submittals yet to be provided and approved.

ITEM NO. 3 – MOBILIZATION

1. Work Included

The Work required for this item shall include all labor, equipment, and materials required for the following:

a. Office-based Activities – This component of mobilization includes, but is not limited to, the following:

i. Insurance.

ii. Identification and acquisition of all construction-related permits and notifications that may be necessary for the completion of the project.

iii. Procurement and coordination of subcontractors and equipment necessary to perform the Work.

iv. Compliance with all local, state, and federal regulations and requirements.

v. All other office and administration services necessary to support Contractor's activities for the duration of the project.

b. Field-based Activities – This component also includes several support/operational/maintenance activities required of Contractor during execution of the Contract including, but not limited to, the following:

i. Mobilization of all personnel, equipment, and materials to the Site.

ii. Utility clearance, location, and protection.

2. Measurement

The Work required for this item will be measured on the basis of satisfactory evidence of mobilization of sufficient labor, equipment, and material to adequately advance the Work. Bid amount for mobilization shall not exceed 10% of the total base bid amount.

3. Payment

The lump sum price for mobilization shall be payment for all labor, equipment, material, and other incidentals mobilized to the Site and considered normal for

administration of the Work. Additional mobilization charges will not be allowed unless specifically authorized by Construction Manager. Payment will be made once Contractor has physically occupied the Site; a detailed Work schedule has been approved; permits and notifications have been obtained; and sufficient labor, equipment (including dredging equipment), and material to adequately progress the Work of this Contract are at the Site.

ITEM NO. 4 – TEMPORARY FACILITIES, CONTROLS, AND UTILITIES

1. Work Included

   The Work required for this item shall include all labor, equipment, and materials required for the following:

   a. Performance of all Work described in Section 01 31 13 – Project Coordination.

   b. Performance of all Work described in Section 01 51 00 – Temporary Utilities.

   c. Performance of all Work described in Section 01 52 00 – Construction Facilities.

   d. Performance of all Work described in Section 01 35 53 – Security Procedures.

2. Measurement

   The Work required for this item will be measured on the basis of satisfactory installation, maintenance, and removal of temporary construction facilities, utilities, and controls per the above-referenced Specifications and Drawings.

3. Payment

   30% of the lump sum price for this item will be paid with the first payment request following satisfactory evidence of temporary construction facilities, utilities, and controls installed. 50% of this lump sum payment item will be made incrementally on a monthly basis based on estimated total monthly project duration, consistent with Construction Manager-approved Construction Progress Schedule. The final 20% payment will be made upon removal of all temporary construction facilities, utilities, and controls to the satisfaction of Construction Manager.

ITEM NO. 5 – SURVEYS

ITEM NO. 5.1 – DEBRIS SURVEY

1. Work Included

   The Work required for this item shall include all labor, equipment, material, and other incidentals required to perform a debris survey consistent with Section 02 21 00 – Surveys.

2. Measurement

The Work required for this item will be measured on the basis of satisfactory performance of the required debris survey, including providing all required documentation to Construction Manager consistent with the requirements of Section 02 21 00 – Surveys.

3. Payment

Payment for this lump sum item will be made following Construction Manager approval of the required Contractor-submitted, debris survey results.

ITEM NO. 5.2 – TOPOGRAPHIC SURVEYS

1. Work Included

The Work required for this item shall include all labor, equipment, material, and other incidentals required to perform both pre- and post-construction topographical surveys consistent with Section 02 21 00 – Surveys and Section 02 22 00 – Pre- and Post-Construction Conditions Surveys, including but not limited to, pre- and post-dredging topographic surveys, cap placement surveys, interim surveys for progress payments, and all other topographic surveys required during the Work.

2. Measurement

The Work required for this item will be measured on the basis of satisfactory performance of the required pre- and post-construction surveys, including providing all required documentation to Construction Manager consistent with the requirements of Section 02 21 00 – Surveys and Section 02 22 00 – Pre- and Post-Construction Conditions Surveys.

3. Payment

Payment totaling 20% of the lump sum price will be made upon Construction Manager's approval of the Contractor-submitted, pre-condition topographic survey.

Payment totaling 40% of the lump sum price will be made upon Construction Manager's approval of the Contractor-submitted, topographic survey showing achievement of target dredge elevations.

Payment totaling 40% of the lump sum price will be made upon Construction Manager's approval of the Contractor-submitted, topographic survey showing successful placement of the cap material.

ITEM NO. 5.3 – BATHYMETRIC SURVEYS

1. Work Included

The Work required for this item shall include all labor, equipment, material, and other incidentals required to perform, record, document, and submit all bathymetric and hydrographic survey work described in Section 02 21 00 – Surveys, including but not limited to, pre- and post-dredging hydrographic

surveys, cap placement surveys, interim surveys for progress payments, and all other bathymetric/hydrographic surveys required during the Work.

2. Measurement

The Work required for this item will be measured on the basis of satisfactory performance of all bathymetric and hydrographic survey work as determined by Construction Manager consistent with the requirements of Section 02 21 00 – Surveys.

3. Payment

Payment totaling 20% of the lump sum price will be made upon Construction Manager's approval of the Contractor-submitted, pre-condition hydrographic survey.

Payment totaling 40% of the lump sum price will be made upon Construction Manager's approval of the Contractor-submitted, hydrographic survey showing achievement of target dredge elevations.

Payment totaling 40% of the lump sum price will be made upon Construction Manager's approval of the Contractor-submitted, hydrographic survey showing successful placement of the cap material.

ITEM NO. 6 – ENVIRONMENTAL PROTECTION AND MONITORING

1. Work Included

The Work required for this item shall include all labor, equipment, and materials associated with the following:

- Furnish, install, maintain, and remove all resuspension controls in accordance with Section 01 57 30 – Marine Resuspension Controls and all relevant permits and approvals, and as shown on the Drawings.

- Performance of all Work described in Section 01 35 43 – Environmental Procedures (e.g., water quality monitoring).

- Perform all Site cleaning and decontamination consistent with Sections 01 74 00 – Cleaning and Waste Management and 02 51 00 – Equipment Decontamination.

2. Measurement

The Work required for this item will be measured on the basis of installing, maintaining, and removing all required environmental controls and satisfying the criteria specified in the above-referenced Specifications and associated permits. ***Off-Site disposal of resuspension controls is covered under Payment Item No. 11 – Material Characterization, Transportation, and Disposal.***

3. Payment

20% of the lump sum price for this item will be paid with the first payment request following satisfactory evidence of mobilization and installation of required environmental protection and monitoring measures/equipment. 70% of this lump sum payment item will be made incrementally on a monthly basis based on estimated total monthly project duration, consistent with the approved Construction Progress Schedule. The final 10% payment will be made upon removal of all control measures.

ITEM NO. 7 – DEMOLITION

1. Work Included

The Work required for this item shall include all supervision, labor, tools, materials, equipment, services, and appurtenances necessary for, or incidental to, the demolition of the five sunken barges as shown on the Drawings and as described in Section 35 05 05 – Selective Demolition for Waterway and Marine Construction.

2. Measurement

The Work of this unit price item will be measured on the basis of the acceptance by Construction Manager of successful demolition and removal of the barges by means and methods described in the Specifications.

3. Payment

Payment totaling 20% of the lump sum price will be made upon completion and Construction Manager's approval for successful demolition of each of the five abandoned barges.

ITEM NO. 8 – DREDGING

ITEM NO. 8.1 – DREDGING

1. Work Included

The Work required for this item shall include all supervision, labor, tools, materials, equipment, services, and appurtenances necessary for, or incidental to, the dredging as shown on the Drawings and as described in Section 35 20 23 – Dredging.

2. Measurement

The Work of this unit price item will be measured on the basis of the acceptance by Construction Manager of dredging to the dredge limits as measured by the survey means and methods described in the Specifications and shown on the Drawings.

3. Payment

Payment for this unit price item will be made on the actual in-place cubic yards of dredging performed as measured based on the survey means and methods described in the Specifications. ***No payment will be made for dredging of materials removed beyond the over-dredge limits, unless instructed to do so by Construction Manager.***

ITEM NO. 8.2 – DREDGED MATERIAL PROCESSING

1. Work Included

The Work required for this item shall include all supervision, labor, tools, materials, equipment, services, and appurtenances associated with dredged material management and processing and as specified in Section 35 20 30 – Dredged Material Management and Processing.

2. Measurement

The Work of this unit price item will be measured consistent with the measurement for Payment Item No. 8.1 – Dredging, on the basis of the acceptance of dredging to the dredge limits as measured by the survey means and methods described in the Specifications and shown on the Drawings.

3. Payment

Consistent with Payment Item No. 8.1 – Dredging, payment for this unit price item will be made for the processing of dredged materials based on the actual in-place cubic yards of dredging performed as measured based on the survey means and methods described in the Specifications. ***No payment will be made for processing, management, and loading of materials removed beyond the over-dredge limits.***

ITEM NO. 9 – MATERIAL PROCUREMENT AND DELIVERY

ITEM NO. 9.1 – CAP TYPE A MATERIAL PROCUREMENT AND DELIVERY

1. Work Included

The Work required for this item shall include all supervision, labor, tools, materials, equipment, services, and appurtenances necessary to sample, purchase, deliver, and stockpile Cap Type A material; materials shall comply with the requirements of Section 31 05 13 – Soils and Aggregates.

2. Measurement

The Work required for this item will be measured on the basis of delivered weight and satisfactory stockpiling of the materials as described in the Specifications and shown on the Drawings.

3. Payment

Payment for this unit price item will be based on actual weight delivered by the hauling vehicles as recorded by certified weight tickets from the supply or

receiving facility. ***No payment will be made for materials for which a certified weight ticket has not been submitted to Construction Manager***

ITEM NO. 9.2 – CAP TYPE B MATERIAL PROCUREMENT AND DELIVERY

1. Work Included

   The Work required for this item shall include all supervision, labor, tools, materials, equipment, services, and appurtenances necessary to sample, purchase, deliver, and stockpile Cap Type B material; materials shall comply with the requirements of Section 31 05 13 – Soils and Aggregates.

2. Measurement

   The Work required for this item will be measured on the basis of delivered weight and satisfactory stockpiling of the materials as described in the Specifications and shown on the Drawings.

3. Payment

   Payment for this unit price item will be based on actual weight delivered by the hauling vehicles as recorded by certified weight tickets from the supply or receiving facility. ***No payment will be made for materials for which a certified weight ticket has not been submitted to Construction Manager***

ITEM NO. 9.3 – CAP TYPE C MATERIAL PROCUREMENT AND DELIVERY

1. Work Included

   The Work required for this item shall include all supervision, labor, tools, materials, equipment, services, and appurtenances necessary to sample, purchase, deliver, and stockpile Cap Type C material; materials shall comply with the requirements of Section 31 05 13 – Soils and Aggregates.

2. Measurement

   The Work required for this item will be measured on the basis of delivered weight and satisfactory stockpiling of the materials as described in the Specifications and shown on the Drawings.

3. Payment

   Payment for this unit price item will be based on actual weight delivered by the hauling vehicles as recorded by certified weight tickets from the supply or receiving facility. ***No payment will be made for materials for which a certified weight ticket has not been submitted to Construction Manager***

ITEM NO. 10 – CAP INSTALLATION

ITEM NO. 10.1 – CAP TYPE A INSTALLATION

1. Work Included

   The Work required for this item shall include all supervision, labor, tools, materials, equipment, services, and appurtenances necessary to remove material from the stockpile, load material onto the barge, and place capping material for Cap Type A consistent with Section 35 20 50 – Capping, as shown on the Drawings.

2. Measurement

   The Work required for this item will be measured based on achieving the required in-place thickness over the identified areas within overplacement tolerances as specified in Section 35 20 50 – Capping and as measured with surveying in accordance with Section 02 21 00 – Surveys, including providing all required documentation to Construction Manager.

3. Payment

   The Work of this unit price item will be measured on the basis of the acceptance of the placement of the cap materials based on actual in-place cubic yards determined by the survey means and methods described in the Specifications. ***No payment will be made for materials placed outside the limits described in the Specifications and shown on the Drawings unless specifically approved by Construction Manager.***

ITEM NO. 10.2 – CAP TYPE B INSTALLATION

1. Work Included

   The Work required for this item shall include all supervision, labor, tools, materials, equipment, services, and appurtenances necessary to remove material from the stockpile, load material onto the barge, and place capping material for Cap Type B consistent with Section 35 20 50 – Capping, as shown on the Drawings.

2. Measurement

   The Work required for this item will be measured based on achieving the required in-place thickness over the identified areas within overplacement tolerances as specified in Section 35 20 50 – Capping and as measured with surveying in accordance with Section 02 21 00 – Surveys, including providing all required documentation to Construction Manager.

3. Payment

   The Work of this unit price item will be measured on the basis of the acceptance of the placement of the cap materials based on actual in-place cubic yards determined by the survey means and methods described in the Specifications. ***No payment will be made for materials placed outside the limits described in the Specifications and shown on the Drawings unless specifically approved by Construction Manager.***

ITEM NO. 10.3 – CAP TYPE C INSTALLATION

1. Work Included

   The Work required for this item shall include all supervision, labor, tools, materials, equipment, services, and appurtenances necessary to remove material from the stockpile, load material onto the barge, and place capping material for Cap Type C consistent with Section 35 20 50 – Capping, as shown on the Drawings.

2. Measurement

   The Work required for this item will be measured based on achieving the required in-place thickness over the identified areas within overplacement tolerances as specified in Section 35 20 50 – Capping and as measured with surveying in accordance with Section 02 21 00 – Surveys, including providing all required documentation to Construction Manager.

3. Payment

   The Work of this unit price item will be measured on the basis of the acceptance of the placement of the cap materials based on actual in-place cubic yards determined by the survey means and methods described in the Specifications. ***No payment will be made for materials placed outside the limits described in the Specifications and shown on the Drawings unless specifically approved by Construction Manager.***

ITEM NO. 10.3 – CAP TYPE C MATERIAL INSTALLATION IN BARGE DEMOLITION RESTORATION AREA

1. Work Included

   The Work required for this item shall include all supervision, labor, tools, materials, equipment, services, and appurtenances necessary to remove material from the stockpile, load material onto the barge, and place Cap Type C material in the barge demolition restoration area consistent with Section 35 20 50 – Capping, as shown on the Drawings.

2. Measurement

   The Work required for this item will be measured based on achieving the required in-place thickness over the identified areas within overplacement tolerances as specified in Section 35 20 50 – Capping and as measured with surveying in accordance with Section 02 21 00 – Surveys, including providing all required documentation to Construction Manager.

3. Payment

   The Work of this unit price item will be measured on the basis of the acceptance of the placement of the cap materials based on actual in-place cubic yards determined by the survey means and methods described in the Specifications. ***No payment will be made for materials placed outside the limits described in the***

Specifications and shown on the Drawings unless specifically approved by Construction Manager.

ITEM NO. 11 – MATERIAL CHARACTERIZATION, TRANSPORTATION, AND DISPOSAL

The following applies to all Payment Item No. 11 categories:

1. Work Included

   The Work required for this item shall include all labor, equipment, and materials necessary to characterize, handle, manage, and transport all materials to approved disposal facility consistent with the requirements of Section 02 61 00 – Removal and Disposal.

2. Measurement

   Measurement for payment shall be the actual number of tons (or gallons, as appropriate) of each waste category, measured on the basis of satisfactory evidence of legal disposal at the approved disposal facility. Measurement of tons shall be based on certified weight receipts from the facility. Measurement of gallons shall be based on receipts from the facility.

3. Payment

   Payment shall be made for the actual number of tons (or gallons) of materials properly transported to and disposed of at the facility based on certified weight scale or volume-based receipts from the facility.

ITEM NO. 11.1 – NON-HAZARDOUS SEDIMENT

Non-hazardous dredged sediments (as determined based on the appropriate waste characterization), as defined in Section 02 61 00 – Removal and Disposal of Materials.

ITEM NO. 11.2 – NON-HAZARDOUS WASTE

Non-hazardous impacted debris (as determined based on the appropriate waste characterization), as defined in Section 02 61 00 – Removal and Disposal of Materials.

ITEM NO. 11.3 – RECYCLE MATERIAL (ASPHALT, BRICK, AND CONCRETE)

Non-impacted (as determined based on the appropriate waste characterization), unstained, uncoated, and unpainted Asphalt, Brick, and Concrete (ABC) shall be recycled at a facility approved by Construction Manager.

ITEM NO. 11.4 – SOLID WASTE

Non-impacted debris including general refuse and trash generated during the Work shall be transported and disposed of at a solid waste facility approved by Construction Manager.

ITEM NO. 11.5 – METALS RECYCLING

Non-impacted metal debris (as determined based on the appropriate waste characterization) generated during the Work shall be recycled at a facility approved by Construction Manager.

ITEM 12 NO. – DEMOBILIZATION

1. Work Included

   The Work required for this item shall include all labor, equipment, and materials necessary for the performance of demobilization.

2. Measurement

   The Work required for this item will be measured on the basis of satisfactory demobilization from the Site. Bid amount for demobilization shall not exceed 5% of the total base bid amount.

3. Payment

   The lump sum price for this item will be made following satisfactory evidence of final demobilization of the Site as determined by Construction Manager.

END OF SECTION

SECTION 01 31 13 – PROJECT COORDINATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Referenced Sections

B. Project Coordination

C. Pre-construction Meeting/Initial Conference

D. Daily Quality Control Meetings

E. Construction Progress Reporting

F. Weekly Construction Period Meetings

G. Additional Meetings

H. Closeout Meeting

I. Contact Information

1.2 REFERENCED SECTIONS

A. Section 01 77 00 – Closeout Procedures

B. Section 01 32 16 – Construction Progress Schedule

1.3 PROJECT COORDINATION

A. Contractor shall coordinate scheduling, submittals, and Work of various sections of Contract Documents to ensure efficient and orderly sequence of installation of interdependent construction elements.

B. In the event Contractor has questions or requires clarifications related to the Work or Contract, Contractor shall submit a written Request for Information (RFI) to Construction Manager in a timely fashion as to not impact project schedule and at no additional cost to Owner. Responses to RFIs will be provided to Contractor within 5 business days.

C. Contractor shall coordinate space requirements, sequencing, permit compliance and monitoring, chain of communications, vessel traffic, and roles and responsibilities. This includes, but is not limited to, physical or mechanical installation or removal of materials and equipment in accordance with the Drawings and Specifications.

D. Contractor shall coordinate the Work of all subcontractors and is responsible for such work performed.

E. Contractor shall establish on-site lines of authority and communications, and shall comply with procedures for communications and submittals as described in the Specifications.

F. Before the beginning of the Work, Contractor shall organize a Site meeting with the personnel assigned to the project to inform them of the contractual requirements in environmental and safety matters.

G. During the performance of the Work, Contractor shall comply with the contractual requirements regarding environmental protection.

1.4 PRE-CONSTRUCTION MEETING/INITIAL CONFERENCE

A. Construction Manager will schedule and conduct one pre-construction meeting prior to the commencement of any Work at the Site. The meeting will be held at the Site. Construction Manager will prepare and distribute an agenda for this Pre-construction Meeting and will also prepare the meeting summary/minutes.

B. Contractor's key management staff and management staff for all key subcontractors shall attend the Pre-construction Meeting. Other Pre-construction Meeting attendees will include Owner, Construction Manager, and Engineer.

C. The anticipated agenda includes:

1. Personnel introduction.

2. Submission of executed bonds and insurance certificates.

3. Communications procedures and lines of authority.

4. Distribution of the Contract.

5. Submission of list of subcontractors, list of products, schedule of values, progress schedule, example of weekly progress meeting agenda and minutes, and example of daily reports.

6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, change orders, and Contract closeout procedures.

7. Permits and approval status.

8. Sequence of Work and schedule.

9. Health and safety requirements.

10. Environmental protection requirements.

11. Procedures for weather management, emergency notifications, and schedule modifications.

12. Identification of on-site and off-site Work Area(s).

13. Use of premises by Owner and Contractor.

14. Owner's requirements and occupancy.

15. Construction facilities and controls.

16. Temporary utilities.

17. Survey and inspections.

18. Application for payment procedures.

19. Procedures for testing.

20. Procedures for maintaining record documents.

21. Interactions with media, regulators, and the public.

22. Procedures for vessel communication.

D. Construction Manager will record minutes and distribute copies to participants within 5 business days after meeting.

1.5 DAILY QUALITY CONTROL MEETINGS

A. Contractor shall conduct a daily construction meeting at the beginning of each Work day to update attendees on the previous day's activities and discuss the Work plan for the day and future concerns or plans.

B. Meeting attendance is required for Construction Manager, Engineer, Contractor, on-site Contractor personnel, on-site subcontractor personnel, and others as appropriate. Representatives of Owner may also attend daily construction meetings.

C. At a minimum, the anticipated agenda includes:

1. Health and safety-related issues and observations, and planned corrective actions.

2. Environmental protection issues and observations, and planned corrective actions.

3. The previous day's activities including: locations where Work was performed; the Work performed; health and safety issues, incidents, or concerns; environmental issues, incidents, or concerns; operational or maintenance issues or concerns; quality control/quality assurance monitoring, testing, and results; approximate areas/volumes dredged, capped; estimated quantity of material removed from the Site; approximate tonnage and type of material brought to the Site; approximate volume of treated water discharged; and any delays or downtime that occurred.

4. The current day's planned activities including: Work planned for the day; locations where Work will be performed; health and safety activities; environmental control measures; quality control/quality assurance monitoring and testing; an estimation

of the areas/volumes to be constructed, dredged, capped; and the amount of material expected to be delivered to the Site.

5. Future plans and any troubleshooting.

1.6 CONSTRUCTION PROGRESS REPORTING

A. Contractor shall review the progress and quality of the Work on a daily basis and shall prepare and submit to Construction Manager each day a Daily Activity Report described herein. The Daily Activities Report shall be submitted to Construction Manager by 5:00 p.m. of the following Work day.

B. At a minimum, the Daily Activity Reports shall include the following information:

1. Project name.

2. Date, time, location, and type of construction activity and Work hours.

3. Personnel, visitors, and equipment on Site.

4. Author of report.

5. Weather conditions including wind, precipitation, and temperature.

6. Personnel and equipment on Site including a listing of all subcontractors and suppliers, and sign-in logs for employees, subcontractors, and visitors, including regulatory agencies and/or testing and inspection entities.

7. Documentation of daily health and safety briefings, daily health and safety topics, and applicable Job Site Analyses.

8. Materials and equipment delivered, used, and/or stored on Site, and demobilized.

9. Summary of Work performed.

10. Any health and safety issues, incidents, or concerns.

11. Any environmental issues, incidents, or concerns.

12. Any identified operational or maintenance issues.

13. All quantities of Work performed. For those requiring subsequent measurement or survey, these quantities shall be estimated for the purposes of these reports.

14. Upland and marine equipment operating, and for all equipment, the following information:

a. Location of operation.

b. Hours of operating time.

c. Name of operator.

d. Total areas and volumes dredged, offloaded, disposed of, backfilled, and capped.

e. Daily production rates.

f. Equipment performance, maintenance, and hours of downtime due to equipment breakdowns.

15. Total estimated tonnage and volume of material staged, if applicable.

16. Description and details of the daily quality control check of all dredging equipment and positioning system sensors.

17. Cumulative area and volume dredged, capped to date for the project.

18. Cumulative area and volume of each type of soil or aggregate material placed to date for the project.

19. Cumulative and daily waste shipment log of all materials exported to disposal facilities.

20. Tests performed inclusive of results.

21. Monitoring and inspections performed inclusive of results.

22. Any notification from the Construction Manager of non-conformance.

23. Delays encountered and relevant details of the delay, such as the cause, resolution, and measures implemented to avoid similar delays in the future.

24. Construction photographs.

25. Information required by other Specification Sections.

C. Within 3 days following the end of each month, Contractor shall prepare and submit to Construction Manager a Monthly Progress Summation Form prepared based on the Daily Activity Reports.

D. Within 3 days following the end of each month, Contractor shall prepare and submit to Construction Manager an updated Construction Progress Schedule, including a comparison to the project baseline schedule, as described in Section 01 32 16 – Construction Progress Schedule.

1.7 WEEKLY CONSTRUCTION PERIOD MEETINGS

A. Construction Manager shall schedule and lead meetings throughout progress of the Work at weekly intervals.

B. Contractor shall make arrangements for meetings, prepare agenda with copies for participants, and preside at meetings.

C. Meeting attendance is required for Contractor's superintendent, major subcontractors and suppliers, representative responsible for the management of safety, Construction Manager, and others as appropriate according to the agenda topics for each meeting. Representatives of Owner and Engineer may also attend weekly meetings.

D. Contractor shall be responsible for developing the weekly meeting agenda, which, at a minimum, shall include:

1. Review minutes of previous meetings.

2. Health and safety issues.

3. Review of Work progress.

4. Review of Contractor's 3-week look-ahead schedule for planned activities, required equipment, required materials, and manpower requirements. Contractor shall provide copies of the 3-week look-ahead schedule to Construction Manager during each weekly meeting.

5. Review of monitoring results.

6. Field observations, problems, and decisions.

7. Identification of problems impeding planned progress.

8. Review of submittals schedule and status of submittals.

9. Review of off-site fabrication and delivery schedules.

10. Review of the Construction Progress Schedule.

11. Corrective measures to regain projected schedules, if necessary.

12. Planned progress during succeeding work period.

13. Identification of potential impacts to ongoing operations during succeeding work period, and means and methods to reduce said impact.

14. Coordination of projected progress.

15. Maintenance of quality and Work standards.

16. Proposed changes and corresponding effects on progress schedule and coordination.

17. Financial status and projections.

18. Action items.

19. Other business relating to Work.

E. Contractor shall record minutes and distribute copies by the end of the following workday to all meeting participants as a draft for comment. Construction Manager will review the draft and provide comments/edits to Contractor. Contractor shall modify and distribute a final version of the meeting minutes to all attendees prior to the subsequent weekly meeting.

F. The weekly meetings shall be conducted at (LOCATION TO BE DETERMINED PRIOR TO BID).

1.8 ADDITIONAL MEETINGS

A. Contractor shall attend additional on-site meetings requested by Owner, Construction Manager, regulatory agencies, and/or local officials at no additional cost to Owner.

B. Construction Manager will prepare agenda and minutes for such meetings.

1.9 CLOSEOUT MEETING

A. Construction Manager will schedule and conduct a post-construction closeout meeting after reviewing closeout submittals provided by Contractor in accordance with Section 01 77 00 – Closeout Procedures. The meeting will be held at (LOCATION TO BE DETERMINED PRIOR TO BID). Construction Manager will prepare and distribute an agenda for the Closeout Meeting and prepare the meeting summary/minutes.

B. Attendance Required: Construction Manager, Contractor, Contractor's superintendent, and all key subcontractors (if applicable). Representatives of Owner and Engineer may also attend the post-construction closeout meeting.

C. Anticipated Agenda:

1. Punch list.

2. Closeout submittals as described in Section 01 77 00 – Closeout Procedures.

1.10 CONTACT INFORMATION

A. Contractor shall establish and maintain contact information including e-mail addresses and cellular telephone numbers for Contractor's project manager, superintendent, and representative responsible for the management of safety. Contractor's project manager, superintendent, and representative responsible for the management of safety shall have available and maintain telephone, e-mail, and internet access at the Site.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01 32 16 – CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Referenced Sections

B. Submittals

C. Schedule Revisions

D. Project Schedule Update

E. Work Sequencing

1.2 REFERENCED SECTIONS

A. Section 01 11 00 – Summary of Work

B. Section 01 14 00 – Work Restrictions

C. Section 01 31 13 – Project Coordination

D. Section 01 33 00 – Submittal Procedures

E. Section 01 41 00 – Regulatory Requirements

1.3 SUBMITTALS

A. Contractor shall submit a detailed Construction Progress Schedule not later than 1 week after award as specified in Section 01 33 00 – Submittal Procedures. The Construction Progress Schedule shall present a progress plan and schedule outlining all major Work activities associated with the Contract, described in Section 01 11 00 – Summary of Work, and associated Drawings and Specifications. The schedule shall identify all task items in sufficient detail to demonstrate how Contractor will execute and sequence the Work. The Construction Progress Schedule shall be consistent with the requirements of the Contract and the milestones, sequencing and completion dates, and restrictions described in the Specifications. The schedule shall address all major Site activities from the submission of project submittals through Site demobilization. The schedule shall describe Contractor's sequence and schedule for each component of the Work, the length of time required to complete each component of the Work, the necessary equipment that Contractor shall provide to meet schedule constraints, and a critical path analysis, and shall take into account the sequencing, property use and access limitations, and permitting restrictions described in this Section and shown on the Drawings. The Construction Progress Schedule shall include a Gantt chart consisting of horizontal lines, or bars, plotted along a daily time scale. The schedule shall have a separate line for each section of the Work, and shall identify the first Work day of each week. It shall show the complete sequence of construction by activity, identifying the Work of separate stages and other logically

grouped activities, and shall indicate early and late start, early and late finish, float dates, task dependencies between tasks, and duration. The time scale shall indicate all required milestone and completion dates as set forth in the Contract. The horizontal bar(s) shall indicate the start and finish dates, as well as the total time period of performance for each activity. Contractor shall arrange the chart so as to show the activities that are necessary to fulfill each and every milestone and completion date requirement. The Construction Progress Schedule shall identify any ramp-up, peak, and ramp-down of each Work task and a rating of importance for each activity. The Construction Progress Schedule shall factor in allowances for estimated downtime related to known or expected conditions that affect schedule (e.g., weather, water conditions). The Construction Progress Schedule shall include a Gantt chart and supporting narrative describing, at a minimum, the following:

1. Mobilization.

2. Submittals with a separate sub-heading for work plan submittals.

3. Initial surveys including a pre-construction conditions survey, debris survey, and pre-construction topographic and hydrographic surveys.

4. Site preparation activities, including, but not limited to, installation of temporary access ways, water access, barge loading areas, support facilities, and temporary utilities.

5. Demolition activities.

6. Debris removal activities.

7. Dredging activities.

8. Dredged material offloading, processing, and disposal.

9. Water treatment.

10. Soil and aggregate material procurement and delivery to the Site.

11. Capping activities

12. Post-dredging capping activities.

13. Waste material management, processing, and disposal.

14. Post-construction surveys and inspections.

15. Demobilization.

B. Contractor shall submit weekly updates to the Construction Progress Schedule.

C. Contractor shall submit a 3-week look-ahead schedule for planned activities, required equipment, required materials, and manpower requirements. Contractor shall provide copies of the 3-week look-ahead schedule to Construction Manager prior to each weekly meeting. The 3-week look-ahead schedule shall include sufficient detail to indicate the

current and near-term (at a minimum of 3 weeks) Work to be performed, and be reconcilable to the activities within the latest approved Construction Progress Schedule. At a minimum, the 3-week look-ahead schedule shall include the following information:

1. Activity identification number, description, and original duration and planned Work days.

2. Additional detail beyond the Construction Progress Schedule to depict the specific daily activities and coordinate the Work required by others.

3. Actual activity commencement dates and planned completion dates for progress to date, updated completion dates (as necessary), remaining duration in Work days, and percent complete.

4. A list of all subcontractors that will perform Work in the upcoming 3 weeks, including subcontractors' names, work activities, duration, percent complete, and planned/actual completion date.

5. A labor forecast summary of workers sorted by subcontractor and trade and a total of all workers planned to be at the Site for each week.

D. If Construction Manager finds that a submitted schedule does not comply with project requirements, the corrective revisions will be noted on the submittal copy and returned to Contractor. Contractor shall resubmit a revised schedule within 5 days.

1.4 SCHEDULE REVISIONS

A. Revisions to the accepted Construction Progress Schedule may be made only with the written approval of Construction Manager. A change affecting the Contract value of any activity including the Contract time may be made only in accordance with applicable provisions of the Contract.

1.5 PROJECT SCHEDULE UPDATE

A. Contractor shall update the Construction Progress Schedule on at least a weekly basis to the satisfaction of Construction Manager for review during Weekly Construction Period Meetings described in Section 01 31 13 – Project Coordination. Failure to provide these updates may result in Work shutdown and/or delays in payment until such updates are received. Contractor shall prepare updates to the Construction Progress Schedule in such a way that the baseline schedule is maintained for each task so that progress can be tracked.

B. At a minimum, updates to the Construction Progress Schedule shall include the following:

1. Up-to-date and accurate progress of the Work for each activity presented in the previously accepted Construction Progress Schedule.

2. Actual activity commencement and complete dates, the actual remaining duration in Work days, and physical percent complete for each activity commenced and not complete.

3. Updates, as appropriate, to activity durations, changes in logic connections between activities, changes in constraints, changes to activities commencement or completion dates, changes to activities descriptions, and/or activity additions and deletions.

4. Updates to forecasted completion dates for each activity presented in the previously accepted Construction Progress Schedule.

5. Updates based on coordination with subcontractors and suppliers.

1.6 WORK SEQUENCING

A. The Work of the Contract shall be sequenced in accordance with Contractor's approved Construction Progress Schedule.

B. Work sequencing and scheduling shall be performed consistent with the requirements of this Section, including but not limited to all permit-required restrictions provided in Section 01 41 00 – Regulatory Requirements and Work restrictions as described in Section 01 14 00 – Work Restrictions.

C. Contractor shall perform Work in a manner that will not disrupt or interfere with vessel traffic or neighboring properties. Contractor must ensure that neighboring operations or activities are not disturbed, interrupted, or prohibited as a result of Work.

D. Work sequencing shall be conducted to coordinate each Work component in a manner to minimize downtime and achieve the schedule milestones identified in the Contract.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01 33 00 – SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Referenced Sections

B. Summary

C. Submittal Requirements

D. Submittal Review

E. Work Plans

F. Product Data

G. Shop Drawings

H. Samples

I. Design Data

J. Test Reports

K. Certificates

L. Manufacturer's Instructions

M. Manufacturer's Field Reports

1.2 REFERENCED SECTIONS

A. Section 01 78 39 – Project Record Documents

1.3 SUMMARY

A. This Section includes requirements for submittals such as work plans, Shop Drawings, test results, operation and maintenance data, surveys, Construction Progress Schedules, construction photographs, and other submittals required by the Drawings and Specifications.

B. Contractor shall submit required materials and documents to Construction Manager for review in accordance with the Contract. Construction Manager will administer and control the review and processing of the submittals. Certain submittals will be reviewed by Engineer. Construction Manager will coordinate reviews by Engineer. Any reviews performed by Engineer will be transmitted by Construction Manager to Contractor.

References in this Section to submittal reviews by Construction Manager are inclusive of reviews by Engineer.

C. Table A of this Section includes a list of submittals that are specified in the Specifications and Drawings, and identifies the required submittal timeframes.

1.4 SUBMITTAL REQUIREMENTS

A. Table A at the end of this Section lists the submittals specified in the Specifications and Drawings and will serve as the preliminary Schedule of Submittals. Contractor shall review Table A for accuracy and completeness. In the event of a discrepancy between Table A and the Specifications or Drawings, Contractor shall notify Construction Manager of the inconsistency in writing. In addition, Contractor shall submit any proposed revisions to Construction Manager for review and approval. Construction Manager has final approval authority over any modifications to the Schedule of Submittals.

B. Construction Manager may request submittals in addition to those listed when deemed necessary to adequately describe the Work covered in the respective sections. Contractor shall provide these requested submittals at no additional cost to Owner.

C. Contractor shall submit a Submittal Tracking Register that includes, at a minimum, a complete listing of all required and proposed submittals (see Table A), including the subject matter of each submittal (submittal name), corresponding Specification name and number(s), preparer, applicable unique tracking numbers, and planned dates of submission. The Submittal Tracking Register shall identify which submittals are associated with time-critical or long-lead items and indicate the dates by which Construction Manager's review will be needed in order to meet delivery dates. Contractor shall be responsible for maintaining and updating the Submittal Tracking Register weekly to document the actual dates of submissions, listing any subsequent resubmissions, and Construction Manager's review/approval action.

D. Contractor shall submit required submittals to Construction Manager as follows:

1. Include with each submittal a transmittal form that clearly identifies the submittal name, Specification section name and number, preparer, and date submitted. Each submittal form shall also include a unique tracking number that references the applicable Specification section number.

2. Sequentially number transmittal forms. Mark revised submittals with original number and sequential alphabetic suffix.

3. Identify on each submittal the project, Contractor, subcontractor, and supplier; pertinent Drawing and detail number; pertinent Specification section name and number; and date submitted.

4. Provide a separate submittal for each Specification requiring submittals. Where multiple Specifications relate to the same system or element and are being provided from the same source, a single combined submittal is acceptable.

5. Apply Contractor's certification, signed or initialed, certifying that review, approval, verification of product selections and designations, compatibility with

field conditions and dimensions, adjacent construction Work, and coordination of information are in accordance with requirements of the Drawings and Specifications. If submittal requires an engineer's stamp, Contractor shall ensure that the submittal has been prepared and signed by an engineer licensed in Massachusetts. Contractor shall verify compatibility of submittal with requirements of the Drawings and Specifications and shall return non-conforming submittals to prepare for revision rather than submitting for review by Construction Manager. Incomplete or improperly packaged submittals and submittals from sources other than Contractor will not be accepted.

6. Coordinate submission of related items and group submittals of related products in a single transmission. Coordinate submittals to avoid conflicts between various items of Work, and provide submittals so as to not interfere with project schedule.

7. Include all submittal material requested for each Specification.

8. Clearly identify variations from requirements of Drawings and Specifications in all submittals. Failure to identify variations from the Drawings and Specifications does not relieve Contractor of responsibilities to comply with Drawings and Specifications and will result in the submittal being marked "Revise and Resubmit."

9. Clearly identify any proposed substitutions for materials or modifications to the procedures specified in the Drawings and Specifications in each submittal. State product or system limitations that may be detrimental to successful performance of completed Work. Failure to do so will result in the submittal being marked "Revise and Resubmit."

10. Mark or show dimensions and values in same units as specified.

E. Submittals requiring Construction Manager approval shall be scheduled and approved prior to acquisition of the material or equipment covered thereby and before any Work described is initiated. Contractor shall begin no fabrication or Work requiring the submittals until return of the submittals with Construction Manager approval/comments. No delays, damages, or time extensions will be allowed for time lost in late submittals.

F. Construction Manager may elect to stop Work activities at the Site in the event that submittals have not been submitted or are not of acceptable quality (as determined by Construction Manager) and per the schedules specified herein. Any delays related to submittal approvals shall not allow the construction schedule to be extended and shall not be reason to increase the Contract price.

G. For Work that does not have a submittal specified in the Drawings and Specifications, Contractor shall document any proposed variation from the Drawings and Specifications in the form of a submittal consistent with this Section. Such submittal shall be submitted to Construction Manager for review at least 15 days prior to the planned start date of the activity affected by the proposed variation.

H. Contractor must adhere to approved submittals; deviation from the approved submittals must be pre-approved by Construction Manager in writing.

I. Where possible, transmit all submittals electronically via electronic mail. Where electronic submittal is not possible, submit three paper copies for Construction Manager review.

1.5 SUBMITTAL REVIEW

A. Construction Manager review will only involve checking for compliance with the design concept of the project and for compliance with the information given in the Drawings and Specifications, not extending to means, methods, techniques, sequences, or procedures of construction (except where a specific means, method, technique, sequence, or procedure of construction is indicated in or required by the Drawings and Specifications), and not extending to standards, codes, or regulations, or to safety precautions or programs incident thereto. Approval of submittal by Construction Manager does not relieve Contractor of responsibility for correcting errors that may exist in a submittal or from meeting the requirements of the Drawings and Specifications.

B. Construction Manager will have at least 5 working days for initial review of each submittal, not including delivery time to and from Contractor.

C. Construction Manager reserves the right to withhold action on a submittal that requires review of related submittals before the submittal can be approved until related submittals are received. Additional time will be required if processing must be delayed to permit review of related subsequent submittals.

D. After review, Construction Manager will return submittals marked as follows to indicate action taken:

1. Approved: Part of Work covered by submittal may proceed provided it complies with requirements of Drawings and Specifications. Final acceptance will depend upon that compliance. The term “Approved” shall only indicate that there is no exception taken to the submittal.

2. Approved Except as Noted: Part of Work covered by submittal may proceed provided it complies with notations and corrections on submittal and requirements of Drawings and Specifications. Final acceptance will depend upon that compliance.

3. Revise and Resubmit: Do not proceed with part of Work covered by submittal including purchasing, fabricating, and delivering. Revise or prepare new submittal in accordance with notations and resubmit.

E. Resubmission of Submittals

1. When revised for resubmission, changes made since previous submission shall be submitted in redline/strikeout and/or other means to track changes made to previous submittal, unless otherwise approved by Construction Manager in writing.

2. Resubmissions shall be required within 5 working days of return from Construction Manager review unless otherwise approved by Construction Manager in writing.

3. Revised submittals shall be submitted following the procedures specified for initial submittals.

4. Resubmittals shall include the original tracking number with an alphabetic designation (i.e., "A" for the first resubmission or "B" for the second resubmission, and so on).

5. Resubmittals are required until all comments by Construction Manager are addressed. All changes made in the resubmittal must be documented and must also indicate any changes made other than those requested by Construction Manager.

6. Final approved submittals shall be provided without redline/strikeout.

F. Contractor shall, as appropriate, distribute copies of reviewed submittals to the personnel implementing the Work, and shall instruct those parties to promptly report inability to comply with submittal requirements. Deviations from approved submittals must be pre-approved by Construction Manager in writing. After submittals have been approved by Construction Manager, no resubmittal for the purpose of substituting materials or equipment will be given consideration unless accompanied by an explanation regarding why a substitution is necessary.

G. Contractor shall store paper copies of submittals that have been accepted by Construction Manager in a file at the Site.

H. Submittals processed by Construction Manager do not become Drawings and Specifications and are not considered Change Orders; the purpose of a submittal review is to establish a reporting procedure and is intended for Contractor's convenience in organizing the Work and to permit Construction Manager to monitor Contractor's progress and understanding of the design. Review, acceptance, or approval of submittals shall not add to the Contract amount. Any additional costs that may result shall be solely the obligation of Contractor.

I. Contractor shall direct inquiries to Construction Manager regarding the procedure, purpose, or extent of any submittal if clarifications are required prior to submittal to avoid delays in approval.

1.6 WORK PLANS

A. Contractor shall prepare and submit the required work plans, as listed in Table A, to Construction Manager for review within the timeframe indicated on Table A.

B. Work plan requirements are included in individual Specifications or on Drawings.

C. Work relevant to the individual work plans shall not be performed until the work plan has been approved by Construction Manager.

D. Each work plan shall be indexed and referenced by a Table of Contents and all pages shall be numbered.

1.7 PRODUCT DATA

A. Submit product data to Construction Manager for review for limited purpose of checking for conformance with information given in Drawings and Specifications.

B. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

C. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances, as applicable.

D. After review, produce copies and distribute in accordance with this Specification and Section 01 78 39 – Project Record Documents.

1.8 SHOP DRAWINGS

A. Submit Shop Drawings to Construction Manager for review for conformance with information given in Drawings and Specifications.

B. Where required by Specifications or otherwise needed, Contractor shall prepare Shop Drawings illustrating the portion of Work for use in fabricating, interfacing with other work, and installing products. The Contract Drawings shall not be reproduced and submitted as Shop Drawings.

C. When required by individual Specification sections, Contractor shall provide Shop Drawings signed and sealed by an engineer licensed in Massachusetts who is responsible for designing components shown on Shop Drawings.

1. Include signed and sealed calculations to support design.

2. Submit Shop Drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.

3. Make revisions and provide additional information when required by authorities having jurisdiction.

D. Electronic Format

1. Size printable to: 8.5 by 11 inches minimum and 22 by 34 inches maximum

2. Present in a clear and thorough manner. Title each Shop Drawing with project name. Identify each element of Shop Drawings with reference number.

E. After review, produce copies and distribute in accordance with this Section and Section 01 78 39 – Project Record Documents.

1.9 SAMPLES

A. Submit samples to Construction Manager for review for limited purpose of checking for conformance with information given in Drawings and Specifications.

B. Submit samples to illustrate functional and aesthetic characteristics of products, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

C. Include identification on each sample, with full project information.

D. Submit number of samples at frequencies specified in individual Specification sections; Construction Manager will retain one sample.

E. Reviewed samples shall not be used in the Work, unless specifically stated in individual Specification sections.

F. Samples will not be used for testing purposes unless specifically stated in individual Specification sections.

G. After review, produce duplicates and distribute in accordance with this Section.

1.10 DESIGN DATA

A. Submit design data for Construction Manager knowledge as Contract Administrator or for Owner.

B. Submit information for limited purpose of assessing conformance with information given in Drawings and Specifications.

1.11 TEST REPORTS

A. Submit test reports for Construction Manager knowledge as Contract Administrator or for Owner.

B. Submit test reports for information for limited purpose of assessing conformance with information given in Drawings and Specifications.

1.12 CERTIFICATES

A. When specified, submit to Construction Manager certifications by manufacturer, installation/application subcontractor, or Contractor.

B. Certifications shall document that the applicable material or installation meets the specified requirements.

C. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

D. Certificates may be recent or previous test results on material or product, but must be acceptable to Construction Manager.

1.13 MANUFACTURER'S INSTRUCTIONS

A. When specified, submit to Construction Manager printed instructions for delivery, storage, assembly, installation, startup, adjusting, and finishing for delivery to Owner.

B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

C. Note that manufacturer installation instructions are submitted for Owner information. Review or retention by Construction Manager does not imply approval of the instructions or procedures.

1.14 MANUFACTURER'S FIELD REPORTS

A. Submit reports for Construction Manager's and Owner's benefit.

B. Submit reports in duplicate within 24 hours of field observation to Construction Manager for information.

C. Submit for information for limited purpose of assessing conformance with information given in Drawings and Specifications.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

TABLE A
SUBMITTAL LIST/SCHEDULE

The following represents the list of submittals specified in the Drawings and Specifications. Contractor shall notify Construction Manager in writing in the event of a discrepancy between Table A and the Specifications or Drawings.

Submittal	Submittal Timeframe

TABLE TO BE COMPLETED PRIOR TO BID

END OF SECTION

SECTION 01 35 29 – HEALTH, SAFETY, AND EMERGENCY RESPONSE PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Referenced Sections

B. Description of Section

C. References and Standards

D. Health and Safety Requirements

E. Submittals

F. Responsibilities of Contractor and Subcontractors

G. Stop Work Authority

H. Employee Training

I. Hazard Communication

J. Site Access and Controls

K. Work Zone Air Monitoring

1.2 REFERENCED SECTIONS

A. Section 00 31 00 – Available Project Information

B. Section 01 33 00 – Submittal Procedures

C. Section 01 35 43 – Environmental Procedures

D. Section 01 35 53 – Security Procedures

1.3 DESCRIPTION OF SECTION

A. Contractor shall provide all labor, materials, equipment, and services necessary for Contractor to protect health, safety, and public welfare of Site workers, on-site personnel, Site visitors, trespassers, and the environment during the performance of all Work.

B. Contractor shall develop, implement, and adhere to the requirements of a Site-specific Health and Safety Plan (HASP) during execution of the Work as shown on the Drawings and as specified herein.

C. Contractor shall conduct Work Zone air monitoring and respond to threshold exceedances during air monitoring as specified herein.

1.4 REFERENCES AND STANDARDS

A. Contract Documents

B. Federal Occupational Health and Safety Administration (OSHA) Standards.

C. Health and Safety Procedures outlined in CMR 40.0018 of the Massachusetts Contingency Plan (MCP).

D. Wynn, LLC., Safety Procedures.

1.5 HEALTH AND SAFETY REQUIREMENTS

A. Contractor shall at all times be solely responsible for exercising reasonable precaution to protect the health, safety, and welfare of Site workers, on-site personnel, Site visitors, trespassers, and the environment during performance of the Work.

B. Contractor shall comply with all applicable provisions of federal, provincial, and local health and safety and occupational health and safety statutes and codes.

C. Contractor shall also comply with conditions contained in Site-specific permits or licenses. Contractor shall make every effort to comply with requests from Construction Manager related to health and safety.

D. Contractor shall be responsible for full compliance with the regulations established under the federal OSHA of 1970, including agreements with the U.S. Department of Labor and the State of Massachusetts and any applicable amendments or revisions thereof, whether associated with the furnishing of equipment and or systems, the furnishing and installation of equipment and/or systems, the construction of facilities, the performance of services or any other similar contractual relation.

1. Contractor shall be responsible for any violations of the regulations including payment of costs involved with correction of violations, hearing or appeal procedures, and claims and/or fines associated with said violations at no additional cost to Owner.

2. Contractor shall comply with applicable requirements of labor laws and regulations of the State of Massachusetts applicable to safety and the authorities having jurisdiction over same.

3. Contractor shall maintain adequate protection against damage to life and property involved in the Work and shall provide all necessary, protective devices until completion and final acceptance of the project by Construction Manager.

4. In any emergency threatening life or property, not considered by Contractor as coming under the preceding provisions, Contractor may act at its own discretion without authorization by Construction Manager. In the case of such an event, Contractor shall notify Construction Manager as soon as possible.

E. Contractor shall be responsible for all notifications to utility companies or other parties regarding any intrusive Site work in compliance with OSHA 29 CFR 1926.650-652 and all applicable local and state requirements.

F. Contractor shall develop, implement, administer, and supervise a Site-specific HASP and associated procedures in accordance with these Specifications.

G. Contractor shall be responsible for the development and implementation of a Site-specific HASP consistent with the requirements described herein and specifying Contractor's policies and procedures to adequately protect Site workers, on-Site personnel, Site visitors, and trespassers. Contractor shall review the available chemical and analytical data, the specified scope of work, and Site conditions in the development of the HASP. The HASP shall be written in compliance with applicable sections of OSHA 29 CFR 1926 and 1910. The HASP must establish in detail the protocols necessary for protecting workers, on-Site personnel, visitors, and trespassers from potential physical and chemical hazards encountered during the work.

H. Daily health and safety briefings shall be conducted prior to each day's Work or shift change, if applicable, and documented in the Daily Activity Reports. Contractor is required to notify all workers of the history of the Site and source materials that are present, and to be alert for evidence of impacted materials. Workers who are potentially in direct contact with impacted and/or potentially impacted materials shall, at a minimum, be trained in health and safety procedures according to the OSHA requirements and be current in their OSHA 8-hour refresher training. Site workers that are not in compliance with health and safety training requirements and medical monitoring will not be allowed to conduct Work at this Site.

I. Contractor shall designate Site Safety and Health Officers (SSHOs) approved by Construction Manager, who shall oversee the continuous, day-to-day, implementation and enforcement of the HASP. The SSHOs shall be present on Site whenever Work is occurring and shall report matters pertaining to Site safety, health, and environmental concerns. At least one SSHO shall be present at all times that any Work is occurring. The SSHOs shall be responsible for preparing and maintaining all daily health and safety Site logs and reports. The qualifications and prior relevant project experience of the SSHOs shall be submitted to Construction Manager for approval prior to their engagement on the project. Substitution of the project-assigned SSHOs shall not be allowed unless there has been a Construction Manager-approved and qualified substitute.

J. Contractor shall conduct the Work in a manner that prevents fugitive dust that may impact public health or result in nuisance conditions. Contractor will be required to carefully cover and monitor the integrity of all material stockpiles.

K. Opinions of Construction Manager regarding expected Site conditions do not relieve Contractor of his responsibility to protect the health and safety of his employees, all subcontractor employees, the public welfare, and the environment. In the event Contractor discovers unknown, unforeseen, sudden, or potentially hazardous conditions, or environmental conditions inconsistent with known existing conditions, Contractor shall notify Construction Manager immediately. The verbal notification of any environmental releases, injuries, near misses, or OSHA-reportable events shall be reported to Construction Manager immediately following the incident. At that time, Site actions may include a

safety stand-down or safety Work stoppage depending on the severity of the event, which shall be followed by a written description of the conditions. The written description shall be submitted to Construction Manager within 24 hours of the discovery. Contractor shall cooperate with any follow-up investigations conducted by Construction Manager of a reportable condition or other incident.

1.6 SUBMITTALS

A. Contractor shall submit qualifications of the assigned SSHOs to Construction Manager in accordance with Section 01 33 00 – Submittal Procedures.

B. Contractor shall submit a Site-specific HASP in accordance with Section 01 33 00 – Submittal Procedures. The HASP shall be submitted to Construction Manager within 30 days of Notice to Proceed, but no later than 14 days before the start of Work.

1. The HASP shall address all applicable requirements under OSHA 29 CFR 1910.120. The plan shall be written to avoid misinterpretation, ambiguity, and mistakes that verbal orders cause.

2. The HASP shall be prepared and implemented by Contractor's SSHO and shall address all Work-specific activities and hazards. The Contractor's HASP shall also address employee hazard control procedures for all potential contaminated material management.

3. At a minimum, the HASP shall include:

a. A Site Control Plan to establish Work Zones.

b. Specific provisions for Stop Work authority consistent with this Section.

c. Specific provisions for stopping Work and re-evaluating safety procedures and equipment in the event an unanticipated work scope is required.

d. Site Description and Hazard Evaluation.

e. Safety Data Sheets (SDSs) for products to be used at the Site.

f. Names of key personnel and alternate responsible for Site safety and health (responsibilities and chain of command).

g. Safety and health hazard assessment and risk analysis for each Site task and operation, including physical, chemical, and biological hazards.

h. Identification of the SSHO(s) as well as additional key personnel and alternates responsible for Site safety.

i. Requirements for training in accordance with applicable federal, state, and local regulations for each work task, and a record or schedule for training of Contractor's and subcontractors' workers in the use of personal protective equipment (PPE).

j. Work task-specific levels of protection and a description of health and safety equipment including protective clothing, respiratory equipment, and monitoring instruments.

k. Medical surveillance in accordance with applicable federal, state, and local regulations.

l. Requirements for identifying and working within confined spaces.

m. As part of the HASP, Contractor shall include a Site-specific Work Zone Air Monitoring Plan. No work shall be performed until Construction Manager has determined that the Work Zone Air Monitoring Plan is acceptable. The plan shall include, but not be limited to, the following information:

    i. Contractor work area monitoring locations, procedures, personnel, equipment, and documentation.

    ii. Corrective action trigger levels for Work Zone volatile organic compounds (VOCs), dust and odors (monitoring to be conducted by Contractor) in accordance with applicable federal, state, and local regulations.

    iii. Corrective actions to be completed for on-Site dust, VOC and odor action level exceedances (monitoring to be conducted by Contractor).

    iv. Equipment and materials to be used during corrective actions for personnel and Work Zone exceedances.

    v. Standard Operating Procedures for engineering controls for VOC, dust, odors, and Work practices.

n. Site control measures (Work Zones, Communications, and Security) including a map indicating route to hospital for emergency medical care.

o. Personnel hygiene and decontamination.

p. Equipment decontamination.

q. Logs, reports, and recordkeeping.

r. Emergency Response Plan.

s. Emergency procedures for occurrences such as personal injury, fire, and exposure to toxic substances.

t. Emergency contact information.

u. Contingency measures.

v. Task-specific Job Safety Analysis (JSA) for each component for the Work anticipated for the project, including but not limited to:

i. Mobilization operations.

ii. Housekeeping.

iii. Fueling.

iv. General labor.

v. Utility clearance and identification.

vi. Unloading of equipment and materials.

vii. Material handling.

viii. Critical Lift Plans for cranes.

ix. Cold-weather Work.

x. Hot-weather Work.

xi. Night Work.

xii. On-water Work.

xiii. Work conducted by divers.

xiv. Heavy equipment operation.

xv. Resuspension control installation/removal.

xvi. Decontamination.

xvii. Dredged material handling and processing.

xviii. Cap material handling, loading, and placement.

xix. Truck loading/offloading and transport.

xx. Scow loading/offloading and transport.

xxi. Demolition activities

xxii. Asbestos containing material identification, management, and processing.

xxiii. Tank or vessel cleanout (confined space).

xxiv. Demobilization operations.

w. In the event a change in Work scope occurs (in the opinion of Construction Manager, Owner, or SSHO), a new or revised JSA shall be prepared. Such Work shall not be performed until Contractor submits the JSA for review and comment by Construction Manager.

x. In the event that Contactor elects to use a crane for any Site operations, Contractor shall submit a Crane Lift Plan for each proposed lifting or hoisting activity. The Crane Lift Plan shall be prepared and stamped by a Professional Engineer registered in the State of Massachusetts with a minimum of 5 years of relevant experience. At a minimum, each Crane Lift Plan shall include:

i. Cut sheets of crane equipment.

ii. Lift capacity.

iii. Weights of each proposed pick to be lifted.

iv. Swing radius.

v. Location plan of crane, picks, proximity to adjacent abutters, and restricted area where people are prohibited from entering during crane operations.

vi. Wind speed restrictions.

vii. Hoisting and associated supports.

viii. Description of how restricted area will be marked.

y. The HASP shall contain provisions for maintaining the health and safety of the public as it relates to the Work.

z. HASP approvals by appropriate and qualified Contractor personnel for review by Construction Manager.

C. No less than 7 days prior to worker's mobilization to Site, Contractor shall submit the following to Construction Manager:

1. Documentation of medical monitoring for all on-Site workers anticipated to start the project including:

a. Project Manager.

b. Project Site Superintendent.

c. Project SSHOs.

d. Project laborers and operators.

e. Subcontractors.

2. Documentation of 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training and applicable 8-hour annual HAZWOPER refresher training and other applicable training (e.g., supervisory; confined space entry) for personnel.

3. Documentation of personnel respirator qualification and fit testing for applicable personnel.

4. Documentation must be maintained on the Site at all times by Contractor and made available on request by Construction Manager.

D. Construction Activities

1. All required forms and OSHA records shall be maintained on the Site by Contractor as applicable.

1.7 RESPONSIBILITIES OF CONTRACTOR AND SUBCONTRACTORS

A. Minimum precautions noted in this Section shall in no way relieve Contractor from the responsibility to implement stricter health and safety precautions as warranted by the Work.

B. Contractor shall conduct a pre-construction health and safety coordination meeting prior to commencement of work at the Site to inform workers of the Site conditions, health and safety procedures, and contingency actions. The pre-construction health and safety coordination meeting shall be held at least 3 days prior to the commencement of the Work. Contractor shall also inform new workers of the Site conditions and proposed health and safety contingency actions. If changes in scope, materials, or methods used are selected after initial job brief or pre-construction health and safety coordination, then amendment to the HASP shall be made and documented and workers shall be notified of the changes.

C. Work Zone Air Monitoring

1. Contractor shall monitor air quality during all stages of the Work. The information collected shall be provided to Construction Manager on a daily basis in accordance with this Specification. Independent monitoring by Construction Manager may be performed using equivalent instruments.

2. Contractor shall monitor air quality in the “breathing zone” of Contractor employees for the constituents of concern (VOCs, particulates, or other constituents Contractor feels necessary) during those activities where exposure to impacted materials is possible, using instruments as described in Contractor’s HASP. The instruments shall be used in accordance with the procedures outlined in Contractor’s HASP for their employees and subcontractor’s employees.

3. Contractor will be required to comply with the action levels included in the air monitoring section of the HASP and take measures to prevent and control VOCs, dust, and odors.

4. Contractor shall conduct Work Zone air monitoring at all times during the duration of the project unless Contractor provides a written request to discontinue the Work

Zone air monitoring, including background readings and data, to Construction Manager for approval at Construction Manager's discretion.

D. Health and Safety Oversight

1. Overall responsibility for implementation of the HASP shall be the responsibility of Contractor's SSHO. The SSHO shall conduct an initial survey to determine the appropriate safety procedures and level of worker safety equipment, shall prepare the HASP, and shall oversee work activities. It shall be the SSHO's responsibility to notify Construction Manager of any deviations from the health and safety monitoring program.

2. The SSHO shall be assigned to the Site at all times during all stages of Site Work. The SSHOs shall maintain a continuous health and safety monitoring program throughout the performance of the Work. Contractor's SSHO responsibilities shall include, but not be limited to: attendance and participation in all weekly construction meetings; administering and documenting daily tailgate meetings; overseeing Site health and safety; protection of public health and safety as it relates to the Work; personnel and equipment decontamination; control of safety equipment checkout; Site traffic control; and emergency response. Other responsibilities shall include monitoring workers for weather-related exposures or stresses during their use of PPE.

3. Prior to commencement of any Site activities, Contractor's SSHOs shall review the HASP with, and provide appropriate training on required PPE use to, all on-Site employees who will be working in or near impacted material and on marine vessels. New employees during the course of the Site Work and visitors to the Site Work areas shall be informed of the Site conditions and safety requirements by Contractor's SSHOs.

4. Contractor's SSHOs shall also be responsible for signing visitors onto the Site and providing them with information regarding the day's activities and related safety issues. Contractor shall maintain a daily visitor's log, recording at a minimum the name and affiliation of each visitor and documentation of the safety orientation. If visitors enter restricted (impacted) areas, the same PPE and training requirements being met by Contractor's personnel shall be required of the visitors.

5. Contractor shall be responsible for implementation of the HASP by all other subcontractors.

6. Contractor shall provide all necessary health and safety equipment, including, but not limited to, PPE, respiratory equipment (if applicable), and monitoring instruments.

7. Contractor shall be responsible for determining the appropriate level of personal protection required based on the criteria outlined in Contractor's HASP. Work shall be suspended whenever Contractor personnel are not equipped with a sufficient level of protective clothing and equipment for the hazards encountered. In the event Contractor determines that a level of protection higher than Level D is required, Contractor shall immediately or pre-emptively notify Construction

Manager, and Contractor's personnel shall take the necessary steps outlined in the HASP.

E. It shall be Contractor's responsibility to notify Construction Manager verbally and in writing as quickly as possible should any unforeseen safety hazard or condition become evident during the performance of the Work. In the interim, Contractor shall take prudent action to establish and maintain safe working conditions and to safeguard workers, on-Site personnel, trespassers, and the environment in accordance with the established emergency response procedures detailed in Contractor's HASP.

1.8 STOP WORK AUTHORITY

A. Should any unforeseen safety-related factor, hazard, or condition that poses a potential threat of physical injury or harm to Site personnel or the environment become evident during the performance of the Work, all Site personnel shall have authority as granted by OSHA regulations to issue a Stop Work directive. In addition, Construction Manager shall also have authority to issue a Stop Work directive upon observation of a safety-related factor, hazard, or condition of potential injury or harm to the environment.

B. If a Stop Work directive is issued, Contractor must immediately take prudent corrective action to secure the Work and provide safe conditions for Site personnel and the environment. This corrective action shall be followed by an immediate written incident report to Construction Manager. The incident report shall be provided as soon as possible but, at a minimum, within 2 hours of the incident. Contractor shall conduct an investigation and provide a written report incorporating results of the investigation if directed to do so by Construction Manager.

C. Contractor shall not charge standby time during Stop Work directives initiated by Construction Manager, in response to Contractor's near miss, unsafe action, or reportable safety incident.

D. Should Contractor refuse to obey a Stop Work directive, Contractor shall immediately be excused from the Site.

1.9 EMPLOYEE TRAINING

A. Prior to the initiation of the Work, Contractor and all subcontractors shall certify that all personnel assigned to perform or supervise Work at the Site have received, and that new hires will receive prior to being allowed on the Site, appropriate training as described in the approved HASP.

B. Annual medical monitoring in compliance with OSHA 29 CFR 1926.65(f)/1910.120(f) is also required for personnel working in the vicinity of environmentally impacted Site material.

C. Contractor shall be responsible for training its employees and to ensure that Contractor's subcontractors are trained. Contractor shall be responsible for ensuring that only personnel having successfully completed the required training are permitted to enter the Site. Documentation of training for all Site employees shall be maintained on the Site by Contractor at all times.

1.10 HAZARD COMMUNICATION

A. Contractor and each Subcontractor must have a written Hazard Communication Program. This program must be available on the Site at all times for review by Construction Manager.

B. Contractor shall ensure that SDSs for chemicals brought onto the Site by Contractor and subcontractors shall be maintained within a current and comprehensive Chemical Inventory located at the Site and must be made available to Construction Manager upon request.

1.11 SITE ACCESS AND CONTROLS

A. Contractor's HASP shall include Site access provisions, which effectively limit access to active Work areas to only those persons in full compliance with the requirements of the HASP. Additionally, access into each specific Work Zone shall be restricted to those employees assigned to complete the specified tasks.

B. Contractor shall prepare Site control procedures to define and establish Work Zones, based on the proposed work locations and the requirements specified in this Part. The HASP shall include operational procedures in order to properly implement the Site access and control provisions of the plan. Work Zones shall include but not be limited to the following:

1. Exclusion Zone.

2. Contaminant Reduction Zone.

3. Support Zone.

C. Contractor shall change Work zones as necessary to support the specific Work being performed.

D. No eating or drinking will be allowed within Work zones located in the vicinity of environmentally impacted Site materials.

E. No smoking is allowed on Site except in the designated smoking areas.

F. Contractor shall be required to make provisions for Site worker traffic control as necessary.

G. Contractor is responsible for securing the Site and individual Work areas at the end of each shift and ensuring that all Work areas are secured in such a way so as to prevent unauthorized or accidental access to Work areas or tampering with equipment or materials that may result in bodily injury or a release of hazardous materials consistent with the requirements of Section 01 35 53 – Security Procedures.

1.12 WORK ZONE AIR MONITORING

A. Contractor shall be responsible for establishing a Work Zone air monitoring program to monitor VOCs, odors, and dust levels within active Work Zones.

B. The air monitoring program shall establish the Work Zone and limits VOCs, odors, and dust designed to be protective of worker health and safety, compliant with the applicable federal, state, and local laws and regulations.

C. The air monitoring program shall include descriptions of VOC, odor, and dust suppression and control measures to be implemented if air monitoring results exceed the specified limits.

D. Information gathered during the air monitoring program shall be used by Contractor to determine appropriate safety and personnel protective measures to be implemented during Work, and to document on-Site employee exposures. Contractor shall use this information to implement appropriate employee hazard control measures, contingency plans, or both.

E. Action levels for the upgrading or downgrading of worker levels of protection shall be based upon information published by the American Conference of Governmental Industrial Hygienists (ACGIH) and OSHA. Action levels shall be based upon established OSHA Permissible Exposure Limits (PELs), ACGIH Threshold Limit Values (TLVs) and ACGIH and OSHA Short-Term Exposure Limits (STELs). Action levels shall be established for each Work activity and each contaminant present. A table summarizing each activity, the contaminant(s) to be monitored, monitoring instruments, frequency and duration of monitoring, action levels, and required response action shall be included in the HASP.

F. All required Work Zone air monitoring equipment shall be provided by Contractor and shall be maintained and calibrated according to the manufacturers' instructions. Calibration field checks using the appropriate reference standards shall be made on the Site at the minimum frequency of twice per shift (pre- and post-sampling). A daily log of all instrument readings, as well as field reference checks and calibration information, must be maintained in Contractor's record documents.

G. The SSHOs shall be responsible for operating all air monitoring equipment.

PART 2 PRODUCTS

2.1 SECTION INCLUDES

A. Materials

2.2 MATERIALS

A. Contractor and all Subcontractors shall provide on-Site personnel, when required by the Contractor's HASP, with the appropriate PPE and shall ensure that all PPE is kept clean and well maintained.

B. Minimum PPE to be worn in the Work area includes hard hats, steel-toed work boots, reflective safety vests, safety glasses, and standard work clothes. A USCG-approved personal flotation device shall be worn at all times when personnel are onboard a vessel or work platform or working within 10 feet of water where a drowning hazard exists.

C. All health and safety materials and equipment shall conform, at a minimum, to OSHA, NIOSH, and American National Standards Institute (ANSI), and ASTM International (ASTM) standards and requirements.

D. Contractor shall supply eyewash stations, first aid supplies, and fire extinguishers at each Work area in sufficient quantity and location throughout the Site to immediately address incidents that may arise for the period of the Work.

E. Contractor shall supply any additional PPE or safety equipment for the period of construction as required by Contractor's HASP or OSHA.

PART 3 EXECUTION

3.1 SECTION INCLUDES

A. Implementation and General Requirements

B. Emergency/Contingency Planning

C. Logs, Reports, And Recordkeeping

D. Decontamination

E. Incident Reporting Procedures

3.2 IMPLEMENTATION AND GENERAL REQUIREMENTS

A. Contractor shall take measures to protect all persons, on and off the Site, from exposure to oil and/or hazardous material as defined by Massachusetts Department of Environmental Protection (MassDEP), hazardous wastes as defined by U.S. Environmental Protection Agency, hazardous materials as defined by Massachusetts Department of Transportation, and/or hazardous substances as defined by OSHA, which may originate from or be present at the Site.

B. Contractor shall take measures to ensure that all construction activities are conducted in a safe manner.

C. Contractor shall establish and maintain Support, Contamination Reduction, and Exclusion Zones at the Site in accordance with OSHA 29 CFR 1910.120.

D. Contractor shall provide all required personnel decontamination equipment and materials in accordance with OSHA 29 CFR 1910.120.

E. Contractor shall dispose of all PPE used by Contractor's employees, subcontractors, Owner, Construction Manager, and/or any other Site visitors in accordance with all applicable regulations.

F. The HASP shall be implemented by Contractor and subcontractors under the direction of the SSHO. It is Contractor's responsibility to ensure compliance with the HASP by all on-

Site personnel. Modifications to Contractor's HASP shall be made by the SSHO after consultation with Construction Manager.

G. Construction Manager may conduct quality assurance inspections and will have access to all of Contractor's project-specific health and safety records.

H. The levels of protection are established in the referenced standards. It is anticipated that the majority of the Work will require personal protection provided by Level D. Upgrading the level of protection shall be the sole responsibility of Contractor. The SSHO shall notify Construction Manager immediately of the need to upgrade levels of protection.

3.3 EMERGENCY/CONTINGENCY PLANNING

A. At a minimum, Contractor's HASP shall include emergency procedures for occurrences such as personal injury, fire, and exposure to toxic substances. The SSHO shall instruct all personnel, including Subcontractor personnel, on the Site during the daily safety briefings concerning these safety procedures.

B. Emergency response procedures shall include employee training, alarm systems, escape routes and procedures, critical operations or equipment, rescue and medical duty assignments, designation of responsible parties, emergency reporting procedures, and methods to account for all employees after evacuation.

C. Emergency contact information shall be included in Contractor's HASP and shall be posted by Contractor in accessible areas near the Work.

D. In the event that on-Site Work results in the accidental spill or release of oil or hazardous materials, containment to the extent possible by on-Site personnel (in proper PPE as designated by the SSHO) shall be required of Contractor in accordance with Section 01 35 43 – Environmental Procedures. For any spill that cannot be controlled by on-Site personnel or are above the applicable reportable quantities, the SSHO or designee shall secure the area and notify the necessary personnel, including but not limited to Construction Manager, MassDEP, other relevant state environmental personnel, and a designated hazardous materials cleanup subcontractor trained in compliance with the emergency response training requirements of OSHA 29 CFR 1926.65 and 1910.120. All Contractor personnel who perform activities involving a response to a release of hazardous substances shall be trained in compliance with the emergency response training requirements of OSHA 29 CFR 1926.65 and 1910.120.

E. Should any unforeseen hazardous condition that may affect the completion of this Work become evident, it shall be the SSHO's responsibility to bring such to the attention of Construction Manager immediately both verbally and in writing. Resolution of the matter shall come through Construction Manager. In the interim, the SSHO shall take prudent action to establish and maintain safe working conditions and to safeguard all Site personnel, the public, and the environment.

3.4 LOGS, REPORTS, AND RECORDKEEPING

A. The SSHOs shall maintain daily logs and reports covering the implementation of the HASP including the air monitoring program and daily safety meetings. The format shall be

developed by the SSHO to include daily logs and weekly reports. The SSHO shall provide Construction Manager with copies of all logs and reports as requested.

B. The SSHOs shall provide Construction Manager with minutes of safety meetings, including topics discussed and attendance sheets, on a daily basis.

C. Contractor shall be solely responsible for compliance with all federal laws (such as OSHA 29 CFR 1926.33/1910.1020) that require that chemical exposure records and medical records be maintained by the employer for a specified length of time after the termination of the job.

3.5 DECONTAMINATION

A. Contractor's HASP shall specify personnel, equipment, and vehicle decontamination procedures to minimize the tracking of contaminants from the Site.

B. Contractor shall be responsible for the collection characterization, and containerization of PPE for removal by Owner's waste management contractor. Contractor shall prepare drummed and/or containerized material for collection to the east of the railroad tracks of the South Street Staging Area, in an area designated by the Construction Manager.

3.6 INCIDENT REPORTING PROCEDURES

A. Incident Response Steps: In the event of a safety incident, including injuries, "near misses," and vehicle accidents occurring during the performance of the Work, the SSHO shall provide details of the incident to Construction Manager as soon as possible but, at a minimum, within 2 hours of the incident and shall follow up with a written incident report by 10 a.m. the following day. The report shall include a root-cause analysis (i.e., identification of contributing factors relating to the incident), and describe the corrective actions that will be taken to prevent recurrence. The report shall provide details regarding the following:

1. What happened.
2. Names of people injured.
3. Treatment administered.
4. Nature and seriousness of the injury.
5. Location of the incident.
6. Date and time of the incident.
7. Names of witnesses, if applicable.
8. Root cause analysis.
9. Corrective action(s).

B. All injuries, accidents, and illnesses occurring as a result of or during on-Site Work must be recorded on Contractor's or affected subcontractor's OSHA 300 and 301 or equivalent forms. These forms shall be forwarded to Construction Manager. Contractor shall report all injuries to the appropriate authorities, including OSHA if necessary, and to Construction Manager immediately.

C. Contractor shall make arrangements with an ambulance service, medical professionals, and hospitals for the emergency treatment of its employees prior to commencing work on the Site. Construction Manager will not furnish any emergency medical treatment.

END OF SECTION

SECTION 01 35 43 – ENVIRONMENTAL PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Referenced Sections

B. References

C. Description of Work

D. Submittals

E. Environmental Requirements

1.2 REFERENCED SECTIONS

A. Section 01 14 00 – Work Restrictions

B. Section 01 33 00 – Submittal Procedures

C. Section 01 41 00 – Regulatory Requirements

D. Section 01 74 00 – Cleaning and Waste Management

E. Section 02 51 00 – Equipment Decontamination

F. Section 02 61 00 – Removal and Disposal

1.3 REFERENCES

A. Contract Documents

B. Code of Federal Regulation (CFR) Title 40 – Protection of Environment.

C. Code of Massachusetts Regulations 310 CMR 40.0000 - Massachusetts Contingency Plan.

1.4 DESCRIPTION OF WORK

A. Contractor shall provide all labor, materials, equipment, and services necessary and incidental to the following:

1. Protecting sediment, soil, air, and water resources during the implementation of the Work

2. Addressing spills and releases to the environment

3. Conducting water quality monitoring during in-water Work.

B. SUBMITTALS

C. Pre-construction

1. Contractor shall prepare and submit to Construction Manager a project-specific Environmental Procedures Plan in accordance with Section 01 33 00 – Submittal Procedures. Contractor's approved Environmental Procedures Plan shall address: protection of sediment, soil, groundwater, air, and surface water resources; protection of wildlife; odor control; dust control; noise control; and spill prevention and control. Environmental Procedures shall comply with all local, state, and federal laws and regulations; Site-specific permits/approvals obtained for the project; the Specifications; and the Drawings. At a minimum, Contractor's approved Environmental Procedures Plan shall include the following:

   a. A list of all potentially hazardous products and materials to be used at the Site including material specifications and Safety Data Sheets (SDSs).

   b. Spill prevention, control, and cleanup procedures, responses, and contingency plans. This shall include contamination prevention provisions to be taken to prevent accidental introduction of hazardous products, materials, and/or impacted sediments and liquids into any waterway, the air, or the ground. This shall also include a description of Contractor's secondary containment systems and a cleanup section that includes the procedures, instructions, and reports to be used in the event of an unforeseen incident requiring a contaminant release cleanup action. The cleanup section of the Environmental Procedures Plan shall include the procedures, instructions, and reports to be used in the event of an unforeseen incident requiring a contaminant release cleanup action. 0The plans shall include the following, at a minimum:

      i. Name of the individual on each shift who will be responsible for reporting spills, implementing and supervising the containment and cleanup, and following up with complete documentation of the incident.

      ii. Procedures for responding to spills or other environmental emergencies.

      iii. A description of contamination prevention provisions to be taken to prevent accidental introduction of hazardous products, materials, and/or impacted sediments and liquids into any waterway or the ground.

      iv. Methods and procedures to be used for expeditious spill response cleanup.

      v. Procedures, instructions, reports, and notifications in the event of an unforeseen incident requiring a spill cleanup action.

vi. A list of the materials, equipment, and devices that will be included in the emergency recovery kit that will be kept on Site for spill response.

vii. A list of spill control/containment-related equipment and materials that will be kept on board vessels for spill response.

viii. Names and locations of suppliers of containment materials and names and locations of additional oil recovery, cleanup, restoration, and disposal equipment available in case of an unforeseen spill emergency.

ix. A flow chart with names and telephone numbers for alerting Owner, Construction Manager, Contractor, and applicable agencies in case of an accidental spill of hydrocarbons or other contaminants or other environmental emergency.

x. Names and telephone numbers of Owner, Construction Manager, Agencies, and individuals, as well as 24-hour telephone contact numbers to be used in the event of an unforeseen incident requiring a contaminant release cleanup action.

xi. A description of where the plan will be kept so that it is easily accessible at all times and visible to all project personnel.

c. If the way in which Contractor stores fuel or refuels equipment triggers the requirements for a Spill Prevention, Control, and Countermeasure (SPCC) Plan consistent with 40 CFR 112, Contractor shall prepare, submit for review, and implement an appropriate SPCC Plan in accordance with 40 CFR 112 as part of the Environmental Procedures Plan.

d. A description of methods for continuously monitoring the Work Areas to ensure that no material or sediment is spilled outside these areas including during material transport, processing, and/or offloading. Any material contaminated by spilled material shall be promptly cleaned up and placed in the appropriate location at no additional cost to Owner.

e. Proposed locations and procedures for storing hazardous material, fuel, petroleum products, and waste material.

f. A description of the Contractor's water quality monitoring program, which shall include the following, at a minimum:

i. Number and location of monitoring stations.

ii. Details related to monitoring buoys, associated monitoring equipment, calibration procedures, anchoring methods, data transmission, and alarm/notification systems.

iii. Details associated with control measures and procedures to comply with the requirements herein.

iv. Water quality criteria in accordance with permits; local, state, and federal regulations; and information provided herein.

v. Details associated with the notification and response plan in the event that water quality criteria are exceeded.

vi. Surface water quality contingency items to be implemented in accordance with Section 01 57 30 – Marine Resuspension Controls..

g. A detailed description of the methods, equipment, and materials to be used to control noise during the implementation of the Work.

h. A detailed description of methods for conducting daily housekeeping activities in accordance with Section 01 74 00 – Cleaning and Waste Management.

i. Templates for logs, reports, and recordkeeping that will be used by Contractor.

2. Contractor shall submit a Weather Response Action Plan that, at a minimum, includes the following information:

a. Means and methods for monitoring and documenting weather conditions, incoming storms, and potentially hazardous conditions (e.g., wind and wave action) at least once per day, and coordination with Construction Manager.

b. Contractor-identified response levels and respective actions including, but not limited to, a timeline for initiation of actions associated with each identified action level in the event inclement weather, unsafe wave, or storm conditions are forecast.

c. Response action procedures and timelines for resuming Work activities.

3. Approval of Contractor's Environmental Procedures Plan or Weather Response Action Plan shall not relieve Contractor of any responsibility for control of potential environmental protection issues.

D. During Construction

1. In the event of a spill or release, Contractor shall immediately notify Construction Manager. Contractor shall also be responsible for the preparation of all release notification documentation in accordance with local, state, and federal requirements/regulations. All documentation shall be provided to Construction Manager for review prior to submittal to these agencies.

a. Within 48 hours of the completion of spill or discharge cleanup, Contractor shall document the cleanup in a Spill and Discharge Cleanup Report, which shall include the following, at a minimum:

i. Identification of the source of the spill.

ii. Nature and amount of material spilled.

iii. Estimated or actual date and time of the spill occurrence.

iv. Date and time notifications were made to the appropriate regulatory agencies.

v. Names of regulatory agency personnel contacted.

vi. Spill reference numbers assigned by regulatory agencies.

vii. A description of the spill location.

viii. The date and time cleanup was completed or terminated (if cleanup was delayed by emergency or adverse weather, the nature and duration of the delay).

ix. Sampling data taken prior to the cleanup and a description of the sampling methodology used to establish the spill boundaries.

x. Sampling data taken subsequent to the cleanup to confirm the removal of the spilled material.

xi. If release was to a solid surface, a description of the solid surface cleaned and the wash/rinse method used.

xii. If release was to surface water, approximate extent or transport and impact (including size and appearance [color, consistency] of sheen, if generated).

xiii. A certification statement signed by Contractor stating that the cleanup requirements have been met and that the information contained in the record is true to the best of his/her knowledge.

xiv. A description of corrective actions taken to prevent future releases.

xv. Copies of the documents and certifications that were submitted to Construction Manager for review and acceptance.

2. Provide results and data to Construction Manager on a daily basis for any water quality monitoring performed by Contractor. The submittal shall include the time, date, type, location, and results for any monitoring performed by Contractor. Provide hard copies of all laboratory analytical reports for samples collected and analyzed. Provide data in a form acceptable to Construction Manager.

3. Submit follow-up reports within 24 hours for any exceedances of water quality requirements. Include a description of the incident, causes of the exceedance, and actions taken to mitigate the exceedance and prevent the incident from recurring.

1.5 ENVIRONMENTAL REQUIREMENTS

A. All environmental pollution shall be prevented, abated, and controlled. Environmental degradation arising from construction activities shall be minimized by complying with all permit/license conditions and requirements; applicable local, state, and federal laws; regulations concerning environmental pollution control and abatement; and the specific requirements contained within the Specifications.

PART 2 PRODUCTS

2.1 SECTION INCLUDES

A. Odor and Emissions Control

B. Sorbent Booms and Pads

2.2 ODOR AND EMISSIONS CONTROL

A. Soil Equivalent Foam Concentrate: Contractor shall be prepared to provide within 24 hours of request from Construction Manager short-term soil equivalent foam concentrate to be used to control odors, VOCs, and/or other emissions from impacting the properties surrounding the Site or for localized control within the Site according to the requirements of Contractor's HASP and Environmental Procedures Plan, results of Contractor personnel monitoring, or as otherwise required by Construction Manager.

1. The soil equivalent foam shall meet the requirements of Resource Conservation and Recovery Act (RCRA) Subtitle D.

2. The short-term soil equivalent foam shall be capable of controlling odors and/or organic vapors for up to 12 hours in a single application.

3. The short-term soil equivalent foam shall be vanilla scented AC-645, manufactured by Rusmar, Inc., of West Chester, Pennsylvania, or an approved equal.

B. Contractor shall provide an adequate supply of concentrated (not diluted or pre-mixed), drummed odor/organic vapor suppression short-term foam within 24 hours of request from Construction Manager to apply the foam to stockpiles, active areas, or other operations that are determined to be the source of odor as determined by Construction Manager.

C. Pneumatic Foam Unit: Contractor shall supply and maintain an operational Pneumatic Foam Unit on Site within 24 hours of request from Construction Manager. Foam shall be applied by a towable, self-contained Pneumatic Foam Unit. The foam unit shall include an air compressor, pump, hoses, nozzles, 400-gallon solution storage tank, and freeze protection system. The foam application unit shall be capable of applying foam solution at a rate of at least 25 gallons per minute (gpm).

1. Pneumatic Foam Unit shall be Rusmar, Inc., model PFU400/25 or a Construction Manager-approved equal.

D. Odor Control Misters: Contractor shall furnish and install up to eight odor control misters to be used to control odors and/or other emissions from impacting the properties surrounding the Site or for localized control within the Site.

1. Each odor control mister shall be capable of providing a continuous mist into the air at a minimum fixed flow rate of 10 ounces per minute and have timer capabilities to control the duration of misting to allow for continuous operations.

2. Each odor control mister shall be capable of being affixed to a 55-gallon drum.

3. The concentration reagent used for misting shall be 100% biodegradable and shall be BioWorld Odor Neutralizer – Commercial Concentrate, manufactured by BioWorld Products, Inc., of Visalia, California, or approved equal.

4. Contractor shall provide adequate quantity of concentrated (not diluted or pre-mixed) concentration of misting reagent. Contractor shall mix the misting reagent with water in accordance with the manufacturer's recommendations.

2.3 SORBENT BOOMS AND PADS

A. Sorbent booms and pads shall be as specified in Section 01 57 30 – Marine Resuspension Controls.

PART 3 EXECUTION

3.1 SECTION INCLUDES

A. Notification of Non-compliance

B. Protection Outside Limits of Work

C. Protection of Water Resources

D. Protection of Fish and Wildlife

E. Spill Prevention and Control

F. Materials Storage and Control

G. Dust and Particulate Controls

H. Odor Control

I. Organic Vapor Control

3.2 NOTIFICATION OF NON-COMPLIANCE

A. Contractor will be notified by Construction Manager of non-compliance with the provisions of this Section, and Contractor shall take immediate corrective action to address the condition. A notification by Construction Manager, delivered at the Site, shall be

sufficient for Contractor to take action, and the date and time of such notice shall be recorded in Contractor's Daily Activity Report. Construction Manager may issue an order stopping all or part of the Work for failure to comply until the corrective action has restored compliance. No time lost due to such stop orders shall be the subject of a claim for extension of time or for costs or damages from Owner.

3.3 PROTECTION OUTSIDE LIMITS OF WORK

A. Areas outside the Limits of Work as shown on the Drawings shall not be disturbed without Construction Manger approval. Contractor shall not perform any unauthorized disruption of soil and/or sediment and shall be responsible for restoring such disruptions, to the satisfaction of the Construction Manager, including handling of any wastes generated therefrom at no additional cost to Owner.

3.4 PROTECTION OF WATER RESOURCES

A. Contractor shall comply with all requirements regarding protection of water resources in the permits referenced in Section 01 41 00 – Regulatory Requirements. Compliance with local, state, and federal water quality standards and conditions of any permits and clearances obtained for the Work is Contractor's responsibility.

B. Contractor shall comply with all applicable local, state, and fedreal laws concerning pollution of surface waters and groundwater.

C. Disposal of any wastes, effluents, trash, grease, chemicals, or other contaminants in waterways is not allowed. If any waste material is dumped in unauthorized areas, the material shall be removed and the area restored to pre-dumping condition. Contaminated ground shall be excavated and disposed of, and the area restored to its pre-disturbed condition at no additional cost to Owner.

D. Waste materials shall not be discharged to surface water or groundwater. Contractor shall comply with all applicable federal, state, and local laws concerning pollution of surface and ground waters. Contractor is responsible for proper management of any water that may be encountered during execution of the Work.

E. Install turbidity curtains and barriers in accordance with Section 01 57 30 – Marine Resuspension Controls to minimize migration of contaminated materials.

F. Contractor will implement the water quality monitoring program as required by the permits and in accordance with the Water Quality Monitoring Plan described in the approved Environmental Procedures Plan.

G. No sheen shall be allowed outside the area enclosed by the marine resuspension systems per Section 01 57 30 – Marine Resuspension Controls. Upon observation of sheen outside of the marine resuspension systems installed per Section 01 57 30 – Marine Resuspension Controls, Contractor shall immediately begin implementation of the cleanup procedures approved as part of the approved Environmental Procedures Plan. Operations may resume subject to the approval of Construction manager when the issue has been rectified.

3.5 PROTECTION OF FISH AND WILDLIFE

A. Work shall be conducted in accordance with Section 01 14 00 – Work Restrictions.

3.6 SPILL PREVENTION AND CONTROL

A. Take all necessary measures to ensure that no contamination of the soil, sediments, groundwater, surface waters, or other areas will occur from any activities, equipment, or materials used to perform the Work. Report all spills to Construction Manager immediately. Take corrective action immediately, using approved emergency response and spill containment techniques in accordance with Contractor's Environmental Procedures Plan and Section 01 35 29 – Health, Safety, and Emergency Response Procedures. These corrective actions shall be performed by Contractor at no additional cost to Owner. All spillages should be handled in accordance with the requirements set forth herein.

B. Contractor shall provide adequate secondary containment, in the form of impermeable berms and curbing and/or integrated double wall vessels for all tanks, vessels, and other containers of impacted, or potentially impacted liquids and/or fuels. In addition, all piping, valves, pumps, and other apparatuses that contain impacted or potentially impacted liquids shall be provided with secondary containment. These secondary containment systems shall be of adequate size to contain a minimum of 110 percent of the volume of the single largest container within the containment.

C. Contractor shall maintain a supply of containment products on the Site capable of controlling sheens and floating oil and/or tar, including, but not limited to, sorbent fabric that can be used to sweep surface water to remove sheen and oil, and oil-sorbent boom capable of isolating the spill or release. At a minimum, Contractor shall have at all times at least 1,000 linear feet of oil sorbent boom, 500 oil sorbent pads, and 300 pounds of speedy-dry sorbent on the Site. This supply shall be replenished upon usage at no additional cost to Owner.

D. Contractor shall provide and maintain on Site at all times all appropriate equipment and materials necessary to address unexpected spill or discharges as described herein and in his/her Environmental Procedures Plan. This equipment and material shall be kept on Site at all times during the Work and must be readily available to Site workers.

E. In the event of a spill or release, Contractor shall immediately implement all necessary means that can be deployed safely to stop the release, contain the spilled material, clean up the spill, absorb or otherwise collect spilled fluids, remove materials impacted by the release, and place the materials into appropriate containers. Complete cleanup may require removal of impacted soils, sediments, or liquids. Containerized waste materials shall be staged in an area approved by Construction Manager on an impermeable surface compatible with the material spilled (e.g., polyethylene sheeting).

F. Contractor shall be responsible for the supply, setup, maintenance, and removal of all secondary containment systems.

G. Equipment decontamination shall be completed in accordance with Section 02 51 00 – Equipment Decontamination.

H. Waste materials, petroleum residues, soils, sorbents, and other residual materials shall be disposed of by Contractor in accordance with Section 02 61 00 – Removal and Disposal.

3.7 MATERIALS STORAGE AND CONTROL

A. Hazardous material handling and storage shall comply with the requirements of the Certificate of Authorization.

B. Contractor shall keep a register of all hazardous materials and products being used or stored at the Site. The register shall identify the specific locations where the materials are being used or stored.

C. All hazardous materials, residuals, and waste materials shall be stored in a location approved by Construction Manager and designated for this purpose. Hazardous materials and waste storage areas shall be in a location approved by Construction Manager, away from vehicular traffic, and a reasonable distance from drainage structures, sumps, and other sensitive features. Hazardous material storage areas shall be protected from inclement weather. Ensure this area is developed in accordance with the laws and regulations in force. Equip the Site with a complete emergency kit so that intervention is possible in case of an accidental leak or spill.

3.8 DUST AND PARTICULATE CONTROLS

A. Contractor shall take the necessary actions to actively prevent dust and particulates from dispersing into the atmosphere.

B. Contractor shall implement dust and particulate control measures so as to not create hazardous or nuisance conditions and to adequately protect the public and employees of Contractor, Owner, Construction Manager, and Engineer. Implement and maintain dust and particulate control measures throughout the duration of Work and in accordance with the methods described in Contractor’s approved Environmental Procedures Plan.

C. Contractor shall provide means to prevent air-borne dust from dispersing into atmosphere.

1. Means and methods shall include watering, misting, mulching, and covering dust generating areas.

2. Contractor shall arrange for and maintain a reliable source of water for dust suppression.

D. In the event that it becomes necessary, in the opinion of Construction Manager to provide additional measures to control the release of dust or particulates, Contractor shall implement such measures immediately, at no additional cost to Owner.

E. Construction Manager reserves the right to suspend Work at any time, in the event that Contractor's control measures are not sufficient for controlling the release of dust and particulates into the atmosphere. Contractor shall not be entitled to any additional compensation for suspension of Work under such conditions. Contractor shall make all necessary changes, acceptable to Construction Manager, to operations prior to resuming any excavation, handling, processing, or any other Work that may cause a release of dusts or particulates, at no additional cost to Owner.

3.9 ODOR CONTROL

A. Take necessary actions to actively implement measures to prevent and control nuisance odors during the course of Work. Implement and maintain odor control measures in accordance with the methods described in Contractor's approved Environmental Procedures Plan. This may require use of an odor control foam or applying odor neutralizing agents to sediment transport barges, material piles, or other areas.

B. In the event that it becomes necessary, in the opinion of Construction Manager, to provide additional measures to control odor, Contractor shall implement such measures immediately, at no additional cost to Owner.

C. Construction Manager reserves the right to suspend Work at any time, in the event that Contractor's control measures are not sufficient for controlling odors. Contractor shall not be entitled to any additional compensation for suspension of Work under such conditions.

3.10 ORGANIC VAPOR CONTROL

A. Take necessary actions to actively implement measures to prevent and control organic vapor emissions during the course of Work. Implement and maintain organic vapor control measures in accordance with the methods as specified herein and in and as described in Contractor's approved Environmental Procedures Plan.

B. In the event that it becomes necessary, in the opinion of Construction Manager, to provide additional measures to control organic vapors, Contractor shall implement such measures immediately, at no additional cost to Owner.

C. Construction Manager reserves the right to suspend Work at any time, in the event that Contractor's control measures are not sufficient for controlling organic vapors. Contractor shall not be entitled to any additional compensation for suspension of Work under such conditions. Contractor shall make all necessary changes, acceptable to Construction Manager, to operations prior to resuming any excavation, handling, processing, or any other Work that may cause a release of organic vapors, at no additional cost to Owner.

END OF SECTION

SECTION 01 35 53 – SECURITY PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Referenced Sections

B. Summary

C. Submittals

D. Contractor's Security Program Requirements

1.2 REFERENCED SECTIONS

A. Section 01 31 13 – Project Coordination

B. Section 01 33 00 – Submittal Procedures

C. Section 01 53 00 – Temporary Construction

D. Section 01 55 00 – Traffic Control

1.3 SUMMARY

A. The Limits of Work are as shown on the Drawings.

B. Contractor is responsible for security within the Work Area as described herein. This includes, but is not limited to, coordination with Construction Manager and Owner personnel (including security personnel); production of all required Contractor and subcontractor personnel personal identification information; maintaining and securing all Work Areas and equipment during working and non-working hours; maintaining a log registering all visitors; and performing security checks.

1.4 SUBMITTALS

A. Contractor and all subcontractor(s) shall submit the following information to Owner for each worker who will be assigned to routinely work at the Site. This submittal is required for each worker at least 7 work days prior to conducting Work at the Site and shall be submitted per Section 01 33 00 – Submittal Procedures:

1. List of all Contractor and subcontractor(s) employee names.

2. Contact information for Contractor and subcontractor(s) main contact person(s), including emergency telephone numbers that can be reached during weekdays and weekends.

B. Contractor and subcontractor(s) must submit mobile equipment inspection forms, as well as provide proof of recent equipment inspection for any mobile equipment and vehicles Contractor plans to bring on Site at least 7 work days prior to conducting Work at the Site.

1.5 CONTRACTOR'S SECURITY PROGRAM REQUIREMENTS

A. Contractor shall implement a security program upon mobilization to the Site and maintain security program throughout the Work.

1. Contractor shall protect the Work Area from theft, vandalism, and unauthorized entry.

2. Should any unforeseen, potentially hazardous condition become evident during the performance of the Work, Contractor shall bring such to the attention of Construction Manager both verbally within 1 hour and in writing within 48 hours.

3. Contractor shall implement all necessary prudent action to establish and maintain safe working conditions and to safeguard employees, other project personnel, visitors, the public, and the environment.

B. Contractor shall be responsible for all costs associated with providing access restriction features, maintaining all features during construction and removal, and dismantling and disposing of temporary features at the conclusion of the Work.

C. Contractor's Site entry control requirements include the following:

1. Allow entrance only to authorized persons with proper identification.

2. Maintain a daily log of workers and visitors. The log shall be submitted to Construction Manager daily as part of the Daily Activity Report as defined in Section 01 31 13 – Project Coordination.

3. Visitors are not allowed within the Work Area without the approval of Construction Manager. Visitors must not be left unescorted. Visitors are not permitted to enter active Work Areas without permission from Construction Manager.

D. Contractor shall be responsible for security within the Work Area. Contractor shall be solely responsible for the security and protection of Contractor's and subcontractors' equipment, supplies, and materials at all times. Any vandalism, damage, or theft shall be the sole responsibility of Contractor.

PART 2 PRODUCTS

2.1 SECTION INCLUDES

A. Signage

B. Equipment

2.2 SIGNAGE

A. All vehicles, equipment, lift platforms, and baskets must be identified with the Contractor's or subcontractor's company logo.

B. Contractor shall ensure existing project signage is not damaged or disturbed.

2.3 EQUIPMENT

A. Contractor and subcontractor(s) shall provide appropriate locking mechanisms necessary to properly secure and lockout/tagout equipment and/or energy sources as needed throughout the duration of the Work.

PART 3 EXECUTION

3.1 SECTION INCLUDES

A. Maintaining Security During Site Access/Use

3.2 MAINTAINING SECURITY DURING SITE ACCESS/USE

A. Enclosures, barriers, and gates, if any, within the Work Area must be properly maintained by Contractor and gates must remain closed and locked during non-working hours and when not in active use during working hours. During working hours, Contractor is responsible for controlling access to the Work Areas for only authorized personnel, and gates shall remain closed at all times other than when needed for entry or exit.

B. Contractor shall be responsible for maintaining a registry (log) of personnel entering and exiting the Work Area. The log shall be submitted to Construction Manager daily as part of the Daily Activity Report as defined in Section 01 31 13 – Project Coordination.

C. Delivery/transport vehicles and associated personnel entering the Work Area shall sign a Site entry registry (log) upon arrival and upon departure.

END OF SECTION

SECTION 01 40 00 – QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Referenced Sections

B. Summary

C. Submittals

D. Quality Assurance and Quality Control of Installation

E. References and Standards

F. Permits

G. Testing Services

H. Manufacturer's Field Services

1.2 REFERENCED SECTIONS

A. Section 01 31 13 – Project Coordination

B. Section 01 33 00 – Submittal Procedures

C. Section 01 41 00 – Regulatory Requirements

1.3 SUMMARY

A. This Section describes Contractor's quality control (QC) requirements, duties, and responsibilities during execution of the Work. This Section requires Contractor to establish a necessary level of control that will provide sufficient information to assure both Contractor and Construction Manager that requirements of the Specifications are achieved.

B. Contractor shall establish, provide, and maintain a Construction Quality Control Plan (CQCP) as specified herein, detailing the methods and procedures that will be taken to ensure that all materials and completed construction elements conform to the Drawings, Specifications, and other requirements.

C. Although guidelines are established and certain minimum requirements are specified herein and elsewhere in the Contract Documents, Contractor shall ensure that construction and construction quality control (CQC) are accomplished in accordance with the stated purpose and the Specifications.

D. Contractor shall be prepared to discuss and present its understanding of the CQC requirements at the Pre-construction Meeting.

1.4 SUBMITTALS

A. Contractor shall submit a CQCP to Construction Manager for approval prior to the start of construction in accordance with Section 01 33 00 – Submittal Procedures. The CQCP will be reviewed by Construction Manager and must be approved before any Work may begin. The CQCP shall describe Contractor's entire QC program, both on and off Site, including Work by subcontractors, fabricators, suppliers, and purchasing agents. The CQCP will be used to document inspections, monitoring, surveys, and other actions to be performed by Contractor.

B. The CQCP shall identify personnel, procedures, methods, instructions, records, and forms to be used to control and verify the Work.

C. At a minimum, the CQCP shall include the following elements:

1. Description of the QC organization, including an organizational chart showing the various QC team members including a QC Supervisor, along with their designated responsibilities, lines of authority, and how these personnel integrate with other management/production and construction functions and personnel. Identify the number of QC staff that will be present for each definable feature of Work. Indicate which personnel are Contractor employees and which are provided by an outside organization.

2. Acknowledgement that the QC staff will conduct inspections for all aspects of the Work specified and shall report to the QC Supervisor or someone of higher authority in Contractor's organization.

3. The name, qualifications, duties, responsibilities, and authorities of each person assigned a primary QC function.

4. Qualifications of the proposed Field Superintendent(s). The proposed Field Superintendent(s) shall have a minimum of 10 years of relevant experience and have experience as the Field Superintendent on at least three projects of similar type and size.

5. A summary of the delegated responsibilities of the QC Supervisor, signed by an authorized official of the Contractor's firm.

6. A description of the QC procedures to ensure that all submittals are submitted to Construction Manager in accordance with the Contract Document requirements. The QC procedures shall address the scheduling, reviewing, certifying, and managing of submittals, including those of subcontractors, fabricators, and purchasing agents.

7. A list of the definable features of Work. A definable feature of Work is a task that is separate and distinct from other tasks and has separate control requirements. It could be identified by different trades or disciplines, or it could be a task by the same trade in a different environment. A description of each definable feature of Work shall be included in the plan. This list shall be agreed upon with Construction Manager before the Pre-construction Meeting.

8. Procedures for tracking preparatory, initial, and follow-up inspections, and control, verification, and acceptance tests, including any documentation associated with any inspections or tests.

9. Control, verification, and acceptance testing plan. The testing plan shall include the minimum tests and test frequencies required by each Specification Section, as well as any additional QC tests that Contractor deems necessary to adequately control production and/or construction processes. The testing plan shall be developed in a spreadsheet and shall, at a minimum, include the following:

    a. Specification item number.

    b. Item description (e.g., aggregate, dredge elevations).

    c. Test type (e.g., gradation, grade, hydrographic survey).

    d. Test standard (e.g., ASTM, as applicable).

    e. Test frequency (e.g., as required by Specifications or minimum frequency when requirements are not stated).

    f. Responsibility (e.g., hydrographic surveyor).

    g. Control requirements (e.g., target, permissible deviations).

    h. Test location.

10. Inspection plan. The inspection plan shall include, but not be limited to, the following for each definable feature of Work:

    a. A detailed description of each different type of preparatory, initial, follow-up, and completion inspection that will be conducted during the Work.

    b. A description of any specialized training for QC staff that will conduct inspections.

    c. A description of any equipment including manufacturer, model number, and serial number if available that will be used during inspections with calibration procedures and frequencies for that equipment.

    d. The minimum frequency of each inspection.

    e. The increase in frequency of inspections in the event that a deficiency has been identified by Construction Manager or Contractor.

    f. Specific inspection procedures to be described in CQCP.

11. Procedures for issuing and tracking QC deficiencies from identification through acceptable corrective action. These procedures will establish verification that identified deficiencies have been corrected.

12. Reporting procedures as described herein, including reporting formats.

13. Procedures for Quality Audits, to be performed by Contractor Quality personnel as described herein. Auditing shall be planned, performed, and documented in accordance with written instructions, procedures, or checklists to be included in the CQCP. The audit scope, frequency, and methods shall be defined in the CQCP.

14. Procedures for quality improvement.

15. The CQCP shall indicate the appropriate action to be taken when a feature of Work is deemed, or believed, to be out of control (out of tolerance) and detail what action will be taken to bring the feature of Work into control. (When applicable or required by the Contract Documents, Contractor shall establish and utilize statistical QC charts for individual QC tests and the requirements for corrective action shall be linked to those control charts.) The requirements for corrective action shall include both general requirements for operation of the QC program as a whole, and for individual items of Work contained in the Specifications. The CQCP shall detail how the results of QC inspections and tests will be used for determining the need for corrective action and shall contain clear sets of rules to gauge when a feature of Work is out of control and the type of correction to be taken to regain control for the feature of Work.

D. Contractor shall make all necessary amendments to the CQCP as instructed by Construction Manager, and resubmit to Construction Manager for acceptance within the time specified by Construction Manager or designee. Contractor will not be authorized to perform Work until the CQCP and other required submittals have been reviewed and accepted by Construction Manager. Acceptance is conditional and will be predicated on satisfactory performance during the construction. Construction Manager reserves the right to require Contractor to make changes in the CQCP and operations including removal of personnel, as necessary, to obtain the quality specified. No partial payment will be made for materials subject to specific QC requirements until the CQCP has been reviewed.

E. After acceptance of the CQCP, Contractor shall notify Construction Manager in writing of any proposed change. Proposed changes are subject to acceptance by Construction Manager.

F. Contractor is encouraged to add elements to the CQCP deemed necessary to adequately control all production and/or construction processes related to the Work.

1.5 QUALITY ASSURANCE AND QUALITY CONTROL OF INSTALLATION

A. Contractor shall monitor QC over suppliers, manufacturers, products, services, equipment, site conditions, and workmanship to produce Work of specified quality.

B. Contractor shall comply with the manufacturer’s instructions, including each step in sequence. Should the manufacturer’s instructions conflict with or differ from the Specifications and Drawings, Contractor shall request clarification from Construction Manager before proceeding.

C. Contractor shall comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

D. Contractor shall perform the Work by using persons qualified to produce required and specified quality.

E. Contractor shall verify that field measurements are as indicated on Shop Drawings or as instructed by the manufacturer.

F. Contractor shall familiarize themselves with pertinent codes and standards. In procuring all items used in the Work, Contractor shall verify the detailed requirements of the specifically named codes and standards and verify that the items procured for use during the Work meet or exceed the specified requirements.

G. Construction Manager reserves the right to reject items incorporated into the Work that fail to meet the specified minimum requirements. Construction Manager further reserves the right, and without prejudice to other recourse Construction Manager may take, to accept non-complying items subject to an adjustment in the Awarded Contract Price as approved by Construction Manager.

1.6 REFERENCES AND STANDARDS

A. Contractor shall provide products or workmanship specified by association, trade, or other consensus standards that comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Contractor shall conform to reference standard by date of issue of the Specifications, except where a specific date is established by code.

C. Contractor shall obtain copies of standards where required by product specification sections.

D. Neither the contractual relationships, duties, nor responsibilities of the parties in the Contract nor those of Owner shall be altered from the Contract Documents by mention or inference otherwise in any reference document.

E. All pertinent laws, ordinances, rules, regulations, and codes shall govern construction activities at the Site.

F. Construction not governed by governmental regulations or the Specifications will be governed by the more stringent provisions of the latest published edition or statute adopted, at the time of implementation, for applicable codes and standards.

1.7 PERMITS

A. All Work performed by Contractor shall comply with applicable permits in accordance with Section 01 41 00 – Regulatory Requirements.

1.8 TESTING SERVICES

A. Necessary testing of materials shall be performed by an independent testing Construction Manager-approved laboratory in accordance with the respective Specification Sections.

1.9 MANUFACTURER'S FIELD SERVICES

A. When specified by the manufacturer, Contractor shall require material or product suppliers or manufacturers to provide qualified staff personnel to observe conditions of surfaces and installation, quality of workmanship, and start-up equipment; test, adjust, and balance equipment as applicable; and initiate instructions when necessary.

B. Contractor shall report observations and cite decisions or instructions given to applicators or installers that are supplemental or contrary to the manufacturer's written instructions.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 SECTION INCLUDES

A. Description of Program

B. Quality Organization

C. Inspection

D. Tests (Other Than Chemical Sampling and Analysis)

E. Documentation

F. Surveillance by Construction Manager

G. Control of Non-conformance

H. Non-compliance

I. Audits

3.2 DESCRIPTION OF PROGRAM

A. Contractor is responsible for QC of the Work. Contractor's QC program shall consist of an integrated system of QC activities involving the planning, implementation, documentation, testing, inspection, reporting, and quality improvement activities to ensure that the Work meets or exceeds the standards and requirements defined in the Contract Documents. The QC program shall also consist of an overall system of technical activities that measures the attributes and performance of the Work against defined standards to verify that the attributes and performance of the Work meet or exceed the standards and requirements defined in the Contract Documents. The program shall cover all construction

and operations, both on and off Site, and shall be keyed to the proposed construction sequence. Contractor's Project Manager and QC Supervisor will be held responsible for the quality of the Work and are subject to removal by Construction Manager for non-compliance with quality requirements specified in the Contract Documents.

B. Contractor's QC program shall provide assurance that activities affecting quality are documented within the document control system and accomplished in accordance with the Contract Documents. Provisions shall be established for communicating to all responsible individuals in Contractor's organization that the QC program is a mandatory requirement and shall be implemented for all portions of the Work, on or off Site.

C. Activities affecting quality shall be accomplished under controlled conditions. Controlled conditions include the use of appropriate equipment; individuals with the requisite training; suitable environmental conditions for accomplishing the activity, such as adequate cleanliness; organized work spaces; adequate laboratory facilities; and assurance that all prerequisites for the given activity have been satisfied.

3.3 QUALITY ORGANIZATION

A. Contractor's QC program shall be implemented by the establishment of a QC staff organization. The QC staff shall perform QC functions as defined in the CQCP. Subject to prior written approval of Construction Manager, QC staff may be assigned collateral duties when those duties will not interfere or conflict with carrying out their QC duties. Contractor shall provide a QC organization that shall have appropriately experienced and trained representatives present for any Work occurring on or off Site at all times during progress of the Work and with complete authority to take any action necessary to ensure compliance with the Contract Documents. Contractor's QC staff organization shall consist primarily of Contractor's own salaried employees but may be supplemented by outside organizations as needed to fulfill the QC program. All QC staff members shall be subject to the qualification requirements below. All QC staff members shall be subject to acceptance by Construction Manager. At a minimum, Contractor's QC organization shall consist of the following staff positions.

B. QC Supervisor

1. The QC Supervisor shall be a full-time employee of Contractor or a consultant engaged by Contractor. The QC Supervisor shall have a minimum of 5 years of experience in related construction or operations and shall have had prior QC experience on a project of comparable size and scope as the Work.

2. Additional qualifications for the QC Supervisor shall include at least one of the following requirements:

   a. Licensed Professional Engineer with a minimum of 5 years of related construction experience acceptable to Construction Manager.

   b. An individual with a minimum of 10 years of related construction experience acceptable to Construction Manager and a Bachelor of Science Degree in Civil Engineering, Civil Engineering Technology, Construction or other related Construction Manager-approved Degree. .

3. The QC Supervisor shall have full authority to institute any and all actions necessary for the successful implementation of the QC program to ensure compliance with the Drawings and Specifications. The QC Supervisor shall be assigned to this project full time. QC Technicians and/or other QC staff shall report only to the QC Supervisor.

4. QC Supervisor roles include:

   a. Provide direction and leadership to staff.

   b. Train staff on inspection, reporting, documentation, and Specifications.

   c. Inform staff of modifications, changes, and revisions to the Work.

   d. Keep staff informed of issues and concerns.

   e. Ensure submitted documents comply with the Contract Documents.

   f. Ensure documents are submitted within the timeframe required by the Contract Documents.

5. The QC Supervisor shall report directly to an officer of Contractor's company.

C. QC Technicians

1. A sufficient number of QC Technicians, directly reporting to and directed only by the QC Supervisor, necessary to adequately implement the QC program shall be provided. These personnel shall be trained as engineers, engineering technicians, or experienced craftsman and shall have a minimum of 2 years of experience in their area of expertise. The QC Technicians shall report directly to the QC Supervisor and shall perform the following functions:

   a. Inspection of all materials, construction, operations, services, and equipment for conformance to the Specifications, Drawings, and Contractor's submittals.

   b. Performance of all QC tests as required by the Specifications, Drawings, and Contractor's submittals.

D. Staffing Levels

1. Contractor shall provide sufficient qualified QC personnel to monitor each Work activity at all times. The nature, frequency, and duration of the QC monitoring shall be sufficient to ensure each definable feature of Work is accomplished in accordance with the Contract Documents. Contractor shall increase the nature, frequency, and/or duration of the QC monitoring during critical Work elements, Work involving previously identified deficiencies, or as otherwise directed by Construction Manager. The QC personnel shall be present at the location where the definable feature of Work is taking place and in position to safely and directly monitor the feature of Work. Where material is being produced in a plant for incorporation into the Work, separate plant and field technicians shall be provided

at each plant and field placement location. The scheduling and coordinating of all inspection and testing staff must match the type and pace of Work activity.

3.4 INSPECTION

A. Contractor shall establish a program for inspection of activities affecting quality and shall cover all construction, operations, and laboratory work both on and off Site. Inspections shall be performed to verify compliance with the requirements and standards in the Contract Documents. Such inspections shall be performed by a member of the QC organization. Inspections cannot be performed by those individuals who performed or supervised the activity being inspected. Inspections shall be performed for each shift to ensure continuing compliance with Contract requirements until completion of the particular feature of Work. The scheduling and coordinating of all inspections shall match the type and pace of Work activity. The results of inspections shall be noted on the Daily QC Report.

B. The four phases of inspection for all definable features of Work are:

1. Preparatory Inspection.

2. Initial Inspection.

3. Follow-up Inspection.

4. Completion Inspection.

C. Preparatory Inspection

1. Perform preparatory inspections prior to beginning any Work on any definable feature of the Work. Preparatory inspections shall include a review of Contract requirements including:

a. A review of Specifications, Drawings, and Contractor's submittals.

b. A check to ensure that all materials and/or equipment have been tested, submitted, and approved.

c. A check to ensure that provisions have been made to provide required testing resources including test equipment, sampling kits and tools outside testing laboratories (if applicable), and additional equipment as required for testing.

d. Examination of the Contract Work Area to ascertain that all preliminary Work has been completed.

e. A review of all required permits and other authorizations.

f. A review of the reporting documentation.

g. A review of the Job Safety Analyses (JSAs).

h. A physical examination of materials, equipment, and samples to ensure that they conform to approved Shop Drawings or submittal data, that all materials and/or equipment are on hand, and all equipment is properly calibrated and in proper working condition.

i. A review of similar Work performed and any lessons learned related to QC.

2. Prior to commencement of the definable feature of Work, a meeting conducted by Contractor shall be held to assure that the required preparatory inspection activities have occurred to the satisfaction of Construction Manager, and shall be attended by all key personnel responsible for the appropriate definable feature of Work. Notify Construction Manager at least 24 hours in advance of the preparatory inspection meeting. Subsequent to the preparatory inspection and prior to commencement of Work, Contractor shall instruct each applicable worker as to the acceptance level of workmanship required in order to meet the Specification, Drawing, and Contractor's submittal requirements.

D. Initial Inspection

1. Perform an initial inspection as soon as a representative portion of the particular feature of Work has been accomplished. A separate initial inspection shall be conducted for each new crew of workers involved in achieving the definable feature of Work. If the Work involves multiple shifts, the initial inspection shall be of the Work completed by both shifts; however, Contractor shall clearly delineate and separately inspect the Work conducted by each shift. The initial inspection shall include:

a. A review of the preparatory inspection records.

b. Re-examination of preliminary Work.

c. Review of specific documentation for the definable feature of Work including any noted deficiencies.

d. An examination of the quality of workmanship.

e. A review of control testing for compliance with Contract requirements.

f. A review of any use of defective or damaged materials.

g. A review of any omissions as documented in Daily QC Reports.

h. A review of compliance with dimensional requirements.

2. Notify Construction Manager at least 24 hours in advance of the initial inspection. Within 24 hours of Construction Manager's request, Contractor shall conduct a meeting attended by all key personnel responsible for the appropriate definable feature of Work to review the results of the initial inspection.

E. Follow-up Inspection

1. Perform follow-up inspections throughout each shift to ensure continuing compliance with Contract Document requirements, including control testing, until completion of the particular definable feature of Work.

2. The frequency of follow up-inspections should be per shift at a minimum but may be more frequent depending on the type and pace of Work activity and if any deficiencies have been noted.

3. Prior to the addition of new features of Work, conduct a final follow-up inspection to confirm that any noted deficiencies have been corrected.

F. Completion Inspection

1. At the completion of all Work or any increment thereof established by completion criteria stated elsewhere in the Specifications, the QC Supervisor or QC Technician shall perform a completion inspection of the Work and develop a "punchlist" of items that do not conform to the requirements defined in the Specifications, Drawings, or Contractor's submittals. The punchlist shall be included in the construction QC documentation, as specified herein, and shall include the estimated date by which each of the deficiencies will be corrected. Perform a second completion inspection after all punchlist items have been completed. Punchlist items must be completed by the Contract completion date(s).

3.5 TESTS (OTHER THAN CHEMICAL SAMPLING AND ANALYSIS)

A. Procedures

1. When testing is required by the Contract Documents submittals, Contractor shall establish a test program to ensure that all required testing is properly identified, planned, documented, and performed under controlled and suitable environmental conditions, including cleanliness. Testing shall be performed in accordance with written test procedures. Test procedures shall incorporate or reference the requirements as contained in the Contract Documents, or Contractor's submittals. Contractor shall submit the test procedures to Construction Manager for review and acceptance prior to their implementation. Test procedures shall contain the following information at a minimum:

a. Test objective.

b. Reference to tests being conducted by qualified personnel trained in the proper application and use of various instruments and methods involved.

c. Reference to use of calibrated instrumentation, appropriate and adequate test equipment, preparation conditions, and items to be tested.

B. Testing

1. The acceptability of Contractor's proposed laboratories shall be subject to approval by Construction Manager.

2. Construction Manager has the right of access to assess laboratory equipment and operations in the proposed laboratories for compliance with the CQCP and to assess the laboratory's testing procedures and techniques.

3. All testing and measuring equipment shall be individually identified, controlled, calibrated, and maintained at prescribed intervals, or prior to each use, and be traceable to certified equipment having known valid relationships to nationally recognized standards. If no national standards exist, the basis for calibration shall be documented.

4. Equipment shall be marked to indicate calibration status. Records that include information specific to individual equipment, date of last calibration, by whom it was calibrated, and the next calibration due date shall be maintained.

5. Monitoring and measuring devices shall be protected from damage and deterioration during handling, maintenance, and storage.

6. Monitoring and measuring devices shall be safeguarded from adjustments that could invalidate measurement results.

7. When monitoring and measuring devices are found to be out of calibration, Contractor's staff shall assess and document the validity of previous test results or operation history. The assessment shall determine the appropriate action on the equipment, and any product affected and records shall be maintained.

8. The scheduling and coordinating of all testing shall match the type and pace of Work activity.

3.6 DOCUMENTATION

A. Records

1. Sufficient records shall be prepared and maintained as Work is performed to furnish documentary evidence of the quality of construction and laboratory analysis and of activities affecting quality. Records shall provide evidence of conformity to requirements and of the effective operation of the QC system. Records shall be consistent with applicable portions of the Contract. Legible copies of these records shall be furnished to Construction Manager within 24 hours of Construction Manager's request.

2. The records shall include the results of any bathymetric or topographic surveys, reviews, inspections, tests, audits, equipment calibrations, monitoring of Work performance, and laboratory analysis. The records shall also include, as appropriate, closely related data such as qualifications of personnel, procedures and equipment, and other documentation required by applicable parts of the Contract. Inspection and test records shall, at a minimum, identify the date of inspection or test, inspector or data recorder, type of observation, results, acceptability, and action taken in connection with any deficiencies noted. Required records shall be legible, readily identifiable, and retrievable. Contractor shall have a documented procedure to define controls needed for the identification, storage, protection, retrieval, retention time, and disposition of records. Legible

copies of these records shall be furnished to Construction Manager within 24 hours of Construction Manager's request.

3. Records shall cover both complying and defective or non-complying features and shall include a statement that supplies and materials incorporated in the Work comply with the Contract. Legible copies of these records shall be furnished to Construction Manager within 24 hours of Construction Manager's request.

4. All records including but not limited to inspection and test results shall be available for inspection and audit, at any time, by Construction Manager.

5. Contractor shall maintain on-site document storage that contains all inspection reports, test records, raw data from continuous monitors, operating logs, and material certification documents. Custody over these records will be the responsibility of Contractor's QC Supervisor. The CQCP shall include procedures for the storage of QC records prior to the time they are turned over to Construction Manager.

B. Reports

1. Specific Contractor QC reports required for the Contract shall include, but not necessarily be limited to, the following records:

a. Daily QC Inspection Reports. Each Contractor QC Technician shall maintain a daily log of all inspections performed for both Contractor and subcontractor operations on a form acceptable to Construction Manager. The daily reports shall provide factual evidence that continual QC inspections have been performed at all Work areas and for each shift and shall, as a minimum, include the following:

i Specification item number and description.

ii Compliance with approved submittals.

iii Proper storage of materials and equipment.

iv Proper operation of all equipment.

v Adherence to plans and Specifications.

vi Review of QC tests.

b. The Daily QC Inspection Reports shall identify inspections conducted, results of inspections, location and nature of defects found, causes for rejection, and remedial or corrective actions taken or proposed and results of corrective actions taken in the field. The Daily QC Inspection Reports shall be signed by the responsible QC Technician and the QC Supervisor. Contractor shall submit copies of each daily QC inspection report as part of the Daily Activity Report in accordance with Section 01 31 13 – Project Coordination.

c. Daily Test Reports. Contractor shall be responsible for establishing a system that will record all QC test results. Daily Test Reports shall document the following information:

i Specification item number and description.

ii Test designation.

iii Location.

iv Date of test.

v Control requirements.

vi Test results.

vii Causes for rejection.

viii Recommended remedial actions.

ix Retests.

d. As part of the Daily Activity Report in accordance with Section 01 31 13 – Project Coordination, test results from each day's Work period shall be submitted to Construction Manager. When required by the Specifications, Contractor shall maintain statistical QC charts. The Daily Test Reports shall be signed by the responsible QC Technician and the QC Supervisor. The QC data will need to be submitted electronically on a daily basis in a data format compatible with industry standard software and acceptable to Construction Manager.

e. The QC Supervisor shall prepare reports for each preparatory, initial, and final inspection. These reports shall include test and inspection results, minutes of the associated meeting that include any discussions, and a list of attendees of the associated meeting. Each report shall be attached to the appropriate Daily QC Report.

3.7 SURVEILLANCE BY CONSTRUCTION MANAGER

A. Contractor operations related to its Work shall be subject to surveillance by Construction Manager at the location the operations are performed. Construction Manager shall have reasonable access to all operational data, including but not limited to, equipment position, production data, logs and journal entries, survey data, and monitoring data at the point of generation.

B. All items of material and equipment shall be subject to surveillance by Construction Manager at the point of production, manufacture, or shipment to determine if Contractor, producer, manufacturer, or shipper maintains an adequate QC system in conformance with the requirements detailed herein and the applicable Specifications and Drawings. In addition, all items of materials, equipment, and Work in place shall be subject to surveillance by Construction Manager at the Site for the same purpose. Surveillance by

Construction Manager does not relieve Contractor of performing QC inspections of either Contractor's or subcontractor's Work either on or off Site.

C. Construction Manager shall be provided the opportunity to witness all pre-shipment testing of equipment.

D. Upon request, Contractor shall allow split or duplicate samples of any material to be taken by Construction Manager at no additional cost to Owner.

3.8 CONTROL OF NON-CONFORMANCE

A. Contractor shall take the appropriate action when a feature of Work is deemed, or believed, to be out of control (out of tolerance) to bring that feature of Work into control. The requirements for corrective action shall include both general requirements for operation of the QC program as a whole, and for individual items of Work contained in the Specifications. Contractor shall use the results of QC inspections and tests to determine the need for corrective action and shall define clear procedures to gauge when a feature of Work is out of control and the type of correction to be taken to regain control of the feature of Work.

B. Contractor shall immediately inform Construction Manager of any identified deficiencies or non-conformance with the Specifications.

3.9 NON-COMPLIANCE

A. If Construction Manager notifies Contractor of any non-compliance with any of the foregoing requirements, Contractor shall immediately take corrective action.

B. In cases where QC activities do not comply with either the Contractor's QC program or the Contract provisions, or where Contractor fails to properly operate and maintain an effective QC program, as determined by Construction Manager, Construction Manager may:

1. Order Contractor to replace ineffective or unqualified QC personnel or subcontractors.

2. Order Contractor to stop operations until appropriate corrective action is implemented.

C. Owner or Construction Manager may issue an order stopping all or part of the Work until satisfactory corrective action has been taken.

3.10 AUDITS

A. Contractor shall establish and document an auditing system to verify the implementation of and conformance to its QC program. The auditing system shall be used to make a determination regarding the effectiveness of Contractor's QC program.

B. Auditing shall be planned, performed, and documented in accordance with written instructions, procedures, or checklists. The audit scope, frequency, and methods shall be defined in the CQCP. Audits shall be performed by qualified and properly trained

personnel who are familiar with the QC system, auditing procedures, and techniques. Selection of auditors and the conduct of audits shall ensure the objectivity and impartiality of the audit process. Auditors shall not audit their own Work and shall not be members of Contractor's project team. The scope the auditing system shall include, but not be limited to, on-site Work by Contractor and subcontractor, disposal facilities, and off-site suppliers critical to the performance of the Work. The results of audits shall be documented and promptly reported to Construction Manager. All non-conformance conditions identified during audits shall be re-audited to verify the corrective actions taken by the appropriate organization.

END OF SECTION

SECTION 01 41 00 – REGULATORY REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Submittals

B. Project Permit Records

C. Workmanship

1.2 SUBMITTALS

A. Within 30 days of Notice to Proceed, Contractor shall submit a list of permits that will be obtained by Contractor and necessary for Contractor to complete the Work scope. This list will be subject to review by Construction Manager.

B. Contractor shall submit copies of all applicable permits and associated regulatory approvals, not previously obtained by Owner, to Construction Manager at least 14 days prior to start of relevant Work. Contractor shall retain hard copies of all permits in their on-site project files.

C. Contractor shall submit copies of all correspondence issued to permitting agencies to Construction Manager within 1 day of issuance.

D. Contractor shall submit copies of all correspondence from permitting agencies and any permit addenda to Construction Manager within 2 days of receipt.

1.3 PROJECT PERMIT RECORDS

A. Contractor shall maintain at the Site complete and accurate copies of all permits, addenda, and relevant correspondence to/from appropriate agencies.

1.4 WORKMANSHIP

A. All workmanship and materials shall conform to local, state, and federal regulations and other applicable standards. In case of conflict with these Drawings and Specifications, such laws and regulations shall apply wherever they may require workmanship or materials other than required in the Contract. In the event of conflict between standards, the more stringent standard as determined by Construction Manager shall apply.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 SECTION INCLUDES

A. Permits Obtained by Owner

B. Permits Obtained by Contractor

C. Project Permit Compliance

3.2 PERMITS OBTAINED BY OWNER

A. Owner will obtain or is in the process of obtaining certain permits and approvals necessary for the Work.

B. Permits that have been obtained by Owner include:

1. Massachusetts Environmental Protection Act (MEPA) – Notice of Project Change (Remediation)

2. MEPA – Multiple Filings (Resort and Navigational Dredging, including removal of sunken barge)

3. Massachusetts Wetlands Protection Act (WPA) Notice of Intent (NOIs) for resort project (Everett) – Order of Conditions (Navigational Dredging, including sunken barge removal)

4. Massachusetts Department of Environmental Protection (MassDEP) Combined 401 Water Quality Certification (Navigational Dredging, including sunken barge removal)

5. MassDEP Waterways – Chapter 91 License (Resort and Navigational Dredging, including sunken barge removal)

6. US Army Corps of Engineers (USACE) Clean Water Act (CWA) Section 404 Individual Permit (Resort and Navigational Dredging, including sunken barge removal)

C. Permit applications that have been submitted by Owner include:

1. Massachusetts WPA Notices of Intent (NOIs) for remediation (Boston and Everett) (Remediation)

2. MassDEP Combined 401 Water Quality Certification (Remediation)

3. MassDEP Waterways – Chapter 91 License (Remediation)

4. USACE Individual Permit Modification (Remediation)

D. Contractor shall perform all Work in compliance with these permits and approvals. Contractor shall be responsible for obtaining all other permits and approvals necessary for

the execution of the Work in accordance with all applicable local, state, and federal regulations.

3.3 PERMITS OBTAINED BY CONTRACTOR

A. Contractor shall obtain all other permits and approvals required to complete the Work in accordance with local, state, and federal regulations. Permits to be obtained by Contractor will depend on Contractor's means, methods, and scope. Within 30 days of Notice to Proceed, Contractor shall submit to Construction Manager a list of permits and other agency approvals that will obtained by Contractor and necessary for Contractor to complete the Work scope.

3.4 PROJECT PERMIT COMPLIANCE

A. Contractor shall comply with all terms and conditions of all project permits and local, state, and federal laws and regulations in the execution of the Work, and pay any and all fines and/or penalties resulting from non-compliance with project permit requirements or failure to obtain or maintain necessary local, state, or federal project permits required for completion of the Work.

B. Contractor shall inform and update Construction Manager on permit status and regulatory compliance.

END OF SECTION

SECTION 01 51 00 – TEMPORARY UTILITIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. References Sections

B. Description

C. Requirements of Regulatory Agencies and Utilities

1.2 REFERENCED SECTIONS

A. Section 01 18 00 – Project Utility Sources

B. Section 01 35 43 – Environmental Procedures

C. Section 01 41 00 – Regulatory Requirements

D. Section 01 53 00 – Temporary Construction

E. Section 01 52 00 – Construction Facilities

F. Section 02 61 00 – Removal and Disposal

1.3 DESCRIPTION

A. Contractor shall furnish, install, and maintain all temporary utilities required for the Work and remove same upon completion of Work as described herein. Temporary utilities include, but are not limited to, electrical power, potable and non-potable water supply, sanitary services, telephone service, internet service, and temporary fuel service. Temporary utilities shall serve the temporary facilities within the Limits of Work during construction, as described in Section 01 52 00 – Construction Facilities and and shall be available to all Site employees for use at any time.

1.4 REQUIREMENTS OF REGULATORY AGENCIES AND UTILITIES

A. Contractor shall comply with local, state, and federal codes; regulations; and utility company requirements, as specified in Section 01 41 00 – Regulatory Requirements.

PART 2 PRODUCTS

2.1 SECTION INCLUDES

A. Materials, General

2.2 MATERIALS, GENERAL

A. Materials must be adequate in capacity for the required usage, must not create unsafe conditions, and must comply with the requirements of all applicable codes and standards and requirements of the Drawings and Specifications.

PART 3 EXECUTION

3.1 SECTION INCLUDES

A. Temporary Utilities

B. Removal

3.2 TEMPORARY UTILITIES

A. Contractor shall incur all costs and responsibility for startup and activation of temporary utilities.

B. Contractor shall protect installed utilities from damage and shall be responsible for all replacement and lost production costs associated with damaged utilities.

C. Construction Power

1. Contractor shall make the necessary arrangements to provide and maintain temporary electric service required for the performance of the Work. See Section 01 18 00 – Project Utility Sources for information on access to electrical services.

2. Any electrical service provided by Contractor shall be of sufficient capacity and characteristic to supply the proper current for the various types of equipment, pumps, and tools with motors, lights, and other required facilities to implement the Work. All necessary supports, connections for utility wiring, panelboards, outlets, switches, lamps, lamp holders, circuit protection devices, controls, and accessories shall be provided by Contractor and shall conform to all applicable local, state, and federal codes and regulations.

3. Contractor shall use due diligence to observe sustainable and conservational utility use practices.

4. Contractor may utilize generators for temporary power throughout the Work. All generators shall operate within Occupational Health and Safety Administration (OSHA) noise limits. Generators required to operate overnight shall be enclosed or equipped with sufficient noise reduction devices so that the generators are not audible outside the Limits of Work. All generators shall be grounded and equipped with a ground fault circuit interrupter (GFCI).

5. All temporary wiring materials and devices installed as part of the Work shall conform to all applicable local, state, and federal codes and regulations and shall be completely removed by Contractor upon completion of the Work.

D. Water Supply

1. Contractor shall provide all potable and non-potable water, unless otherwise specified herein, in sufficient quantity and of sufficient quality for all potable needs of Owner, Construction Manager, Engineer, and Contractor during the Work. See Section 01 18 00 – Project Utility Sources for information on access to water services.

2. Contractor shall use due diligence to observe sustainable and conservational water use practices.

3. Contractor shall be responsible for removal of all temporary water supply lines and equipment at the completion of the project.

4. Use of water from the Mystic River is not permitted, except as otherwise specified.

E. Temporary Sanitary Facilities

1. Contractor shall provide and maintain sanitary facilities for use by all Site employees in compliance with all applicable laws and regulations at the Site.

2. At least one of the sanitary facilities shall be dedicated to female project personnel.

3. Contractor shall provide sanitary facilities prior to mobilization of labor to the Site.

4. Temporary toilets shall be locked when construction operations are not underway. Construction Manager and Engineer shall be provided a key.

5. Contractor shall service, clean, and maintain the temporary sanitary facilities on a minimum weekly basis, or more frequently if requested by Construction Manager.

F. Temporary Telephone Service

1. Contractor shall provide and pay for temporary telephone service for the Project needs of Contractor, Construction Manager, and Engineer during the Work.

2. At least one active telephone line shall be provided for Project use in each field office trailer as described in Section 01 52 00 – Construction Facilities. Contractor shall keep all personnel on the job informed of the location of such telephones.

3. Telephone service shall remain active and uninterrupted for the duration of construction. Cancellation of telephone service for any reason at any time must be approved by Construction Manager.

4. Cellular phones may be utilized provided that Contractor confirms cellular reception/operation is reliable at the Site prior to the start of Work.

5. Contractor’s project superintendent, or at least one regular member of each shift, shall be charged with the responsibility of promptly calling emergency services when necessary.

G. Temporary Internet Service

1. Contractor shall provide and pay for temporary secure, high-speed internet service for the Project needs of Contractor, Construction Manager, and Engineer during the Work.

2. Each temporary field office as described in Section 01 52 00 – Construction Facilities shall have individual wireless internet access.

3. Secure internet service shall remain active and uninterrupted for the duration of construction (full duration of the Contract). Cancellation of secure internet service for any reason at any time must be approved by Construction Manager.

4. Contractor shall establish and maintain an email address for Contractor's project manager and project superintendent. Contractor's project manager and superintendent shall be able to send, receive, and view emails at all times while on Site throughout the duration of the project.

H. Temporary Fuel Service

1. Contractor shall provide and maintain temporary fuel storage facilities as needed to complete the Work in compliance with all applicable laws and regulations at the Site.

2. Storage facilities shall comply with the requirements of Section 01 35 43 – Environmental Procedures.

3. Contractor shall be responsible for removal of all temporary fuel storage facilities and equipment at the completion of the project.

I. Temporary Lighting

1. Contractor shall be responsible for installing and maintaining temporary lighting.

2. Contractor shall provide lighting to sufficiently illuminate work areas at his own discretion or as directed by Construction Manager and, at a minimum, as required by OSHA 29 Code of Federal Regulations (CFR) 1926.56 – Illumination, including meeting the Minimum Illumination Intensities for General Construction Area Lighting described in this OSHA standard.

3. Contractor shall provide branch wiring from the power source to distribution boxes with lighting conductors, pigtails, and lamps as necessary.

4. Contractor shall maintain lighting and make routine repairs as necessary.

5. Prior to undertaking Work in low light conditions (e.g., in the early morning or late afternoon and evenings), Contractor shall assemble and test lighting equipment in similar low light conditions in the presence of Construction Manager. Work may be stopped by Construction Manager if lighting is deemed inadequate and will not be authorized until construction lighting is deemed sufficient by Construction

Manager. Contractor will not be provided additional compensation due to Work stoppages to address inadequate lighting.

3.3 REMOVAL

A. Unless approved by Construction Manager, Contractor shall be responsible for the removal and proper disposition of all materials installed for temporary utilities at the completion of the project.

B. Contractor shall be responsible for cutting, capping, and temporary utility service shutdown in accordance with utility provider requirements and to the satisfaction of Construction Manager.

C. Contractor shall be responsible for surface restoration to match pre-Work conditions once the temporary utilities are removed.

END OF SECTION

SECTION 01 52 00 – CONSTRUCTION FACILITIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Referenced Sections

B. Requirements

C. Submittals

1.2 REFERENCED SECTIONS

A. Section 01 14 00 – Work Restrictions

B. Section 01 33 00 – Submittal Procedures

C. Section 01 51 00 – Temporary Utilities

D. Section 02 51 00 – Equipment Decontamination

1.3 REQUIREMENTS

A. Contractor shall furnish, install, and maintain all construction support facilities as necessary to complete the Work. Construction support facilities include, but are not limited to, office space for all Project personnel, equipment storage, lighting, and storage areas. This Section also includes requirements for snow removal during the Work.

B. Contractor shall provide a minimum of two office trailers, at a minimum (one for Contractor and one for Engineer and Construction Manager), to serve as the office space throughout the duration of the Work.

C. Contractor shall place/install construction support facilities at the locations specified in the Drawings and Specifications or as otherwise approved by the Construction Manager.

D. The layout and installation of the construction support facilities shall comply with the restrictions described in Section 01 14 00 – Work Restrictions.

E. Construction support facilities shall be installed prior to initiating construction activities.

F. Contractor shall maintain the construction support facilities to the satisfaction of Construction Manager for the duration of the Work. If any deficiencies are noted by Construction Manager, Contractor shall address such deficiencies as soon as possible and at no additional cost to Owner.

G. At the end of the Work, Contractor shall decontaminate, as necessary, all construction support facilities in accordance with Section 02 51 00 – Equipment Decontamination.

H. Contractor shall not perform Work activities when adequate lighting is not provided at the Site, in accordance with Section 01 51 00 – Temporary Utilities and as determined by the Construction Manager.

I. At the end of the Work, Contractor shall remove and demobilize all construction support facilities and restore areas.

1.4 SUBMITTALS

A. Pre-construction

1. Construction Facilities Layout Plan: Contractor shall provide a Construction Facilities Layout Plan in accordance with Section 01 33 00 – Submittal Procedures. At a minimum, the Construction Facilities Layout Plan shall include the proposed layout and sizing for office trailers, sanitary facilities, and equipment storage.

2. Construction Lighting Plan: Contractor shall prepare and submit a Construction Lighting Plan in accordance with Section 01 33 00 – Submittal Procedures. At a minimum, the Construction Lighting Plan shall include:

a. Types of lighting to be used both in upland and marine areas.

b. Light locations (both upland and marine).

c. Energy sources to power the lights.

d. Contingency plan in the event of power outages or if certain lights fail to operate (e.g., availability of spare lighting equipment).

PART 2 PRODUCTS

2.1 SECTION INCLUDES

A. Field Office Trailers

B. Construction Lighting

2.2 FIELD OFFICE TRAILERS

A. Each field office trailer shall provide a minimum of 400 square metres of floor space and shall be portioned to provide three rooms: two small rooms and one large room with adjoining doors. The smaller rooms shall be not less than 96 square metres in area, and shall each contain windows. Each field office trailer shall require at least two outside doors.

B. Contractor shall install and maintain, in accordance with all applicable codes and regulations, electric, telephone, and internet services for the office trailers in accordance with Section 01 51 00 – Temporary Utilities.

C. Each field office trailer shall have the following built-in items:

1. Four two-drawer file cabinets.

2. One drafting table with double storage cabinets underneath.

3. Forced air heat.

4. One 8,000 British thermal unit (BTU) air conditioner.

5. Closet.

6. Sufficient supply of electrical outlets and a minimum of two telephone outlets.

7. Internet access in accordance with Section 01 51 00 – Temporary Utilities.

D. Each field office trailer shall have the following movable items, at a minimum:

1. Four flat-top movable desks (measuring 44 inches by 30 inches) with filing and lockable storage drawers.

2. Four adjustable office chairs.

3. One printer with scanning capabilities.

4. Three large waste baskets.

5. Eight folding or stacking chairs.

6. Two tables (measuring 30 inches by 60 inches).

7. One vertical filing plan rack for two sets of 22-inch by 36-inch plans.

8. Fire extinguishers meeting local fire codes, mounted on the wall near each doorway.

9. One first-aid kit.

10. One refrigerator (minimum capacity of 2.5 cubic feet).

11. Two telephones with speaker capability.

12. Six keys for each office lock.

2.3 CONSTRUCTION LIGHTING

A. Contractor shall provide construction lighting, including but not limited to construction light plants, equipment lights, marine lighting, and lighting for signage. All Work shall be performed consistent with the requirements of Occupational Safety and Health

Administration (OSHA) 29 Code of Federal Regulations (CFR) 1926.56 – Illumination and applicable state and local requirements.

B. Contractor shall provide, install, maintain, and remove temporary lighting consistent with the approved Construction Lighting Plan.

PART 3 EXECUTION

3.1 SECTION INCLUDES

A. Preparation

B. Installation and Maintenance

C. Snow Removal

D. Removal/Demobilization

3.2 PREPARATION

A. Contractor shall consult with Construction Manager to review Site conditions and factors that affect the Work described herein or that may be affected by execution of the Work. Areas available for Contractor access and storage are shown on the Drawings.

3.3 INSTALLATION AND MAINTENANCE

A. Office Trailers

1. Contractor shall mobilize and set up office trailers in the areas approved by Construction Manager.

2. Contractor shall ensure offices are securely leveled and secured using fasteners or equivalent means to provide secure structures. Fasteners shall be inspected at least weekly and maintained as necessary at no additional cost to Owner.

3. Contractor shall provide each office with continuous electrical service of sufficient capacity and characteristic to power lights, office equipment, battery chargers, monitoring stations, and all other Work-related power equipment in accordance with Section 01 51 00 – Temporary Utilities.

4. Offices and sheds shall remain locked when not in use.

5. Offices shall remain available throughout construction activities.

6. Trailer entrances shall have steps that meet the requirements of OSHA 29 CFR 1926.1052 – Stairways.

B. Construction Light and Power

1. In the event that Contractor utilizes artificial lighting, Contractor shall utilize controls to prevent excessive light from impacting neighboring individuals/businesses. Additionally, Contractor's lighting shall not interfere with or impede navigation.

2. If Work during non-daylight hours is required and prior approval is obtained from Construction Manager, Contractor shall provide lights for Work in accordance with the approved Construction Lighting Plan as specified herein during non-daylight hours. Non-daylight hours are defined as 30 minutes before sunset and 30 minutes after sunrise. A Work Area walk-through with Construction Manager and approval by Construction Manager shall be required a minimum of 24 hours prior to the start of non-daylight activities. Non-daylight activities shall only occur with Construction Manager's approval and in accordance with local ordinance, the approved Construction Lighting Plan, and all application state and federal requirements including, but not limited to, OSHA 29 CFR 1926.56 – Illumination.

3. Contractor shall provide lighting setup for a Work Area at least 48 hours prior to using the lighting scheme. Contractor shall escort Construction Manager on a walk-through of the lit Work zones during non-daylight hours prior to the start of Work.

4. While conducting the Work, in the event that the Work zones do not meet the minimum lighting requirements specified above or have been deemed unsafe by Site workers (including Construction Manager), Work shall stop immediately. Work will only resume after Construction Manager has determined the minimum requirements have been met and the Work Area is safe. Any delays or additional costs related to inadequate lighting and/or non-approval by Construction Manager shall not result in additional cost to Owner.

3.4 SNOW REMOVAL

A. Contractor is responsible for snow and ice removal, as necessary, within the Work Area.

B. Contractor shall locate and manage snow piles as needed to not hinder Project construction activities. Snow piles shall be located in areas approved by Construction Manager. Contractor shall coordinate snow removal activities so as to not adversely impact Owner's ongoing construction operations.

C. Dumping of snow into waterbodies is not permissible.

D. Snow shall not be removed from the Site without prior approval from Construction Manager.

E. Products proposed to be used to enhance snow and ice melting, removal, or traction shall be submitted to Construction Manager for prior review and approval.

F. Snow removed from construction site shall be transported by truck to an approved snow disposal location. The snow disposal location selected by Contractor shall be approved by Construction Manager before use.

3.5 REMOVAL/DEMOBILIZATION

A. Contractor shall be responsible for the removal and disposal of all installed construction facilities at the completion of the Project.

B. Contractor shall decontaminate materials discussed herein, as appropriate, prior to removal from the Site. Decontamination activities shall be performed in accordance with Section 02 51 00 – Equipment Decontamination.

C. Contractor shall be responsible for all surface restoration to match pre-Work conditions.

END OF SECTION

SECTION 01 57 30 - MARINE RESUSPENSION CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Related Sections

B. Description

C. Applicable Codes, Standards and Specifications

D. Submittals

E. Performance Criteria

1.2 RELATED SECTIONS

A. Section 01 14 00 – Work Restrictions

B. Section 01 31 13 – Project Coordination

C. Section 01 33 00 – Submittal Procedures

D. Section 01 35 43 – Environmental Procedures

E. Section 02 51 00 – Equipment Decontamination

F. Section 02 61 00 – Removal and Disposal

G. Section 35 00 00 – Waterway and Marine Construction

1.3 DESCRIPTION

A. Contractor shall furnish and/or provide all supervision, labor, tools, materials, equipment, services, and appurtenances necessary for the installation, deployment, inspection, movement, and maintenance of the resuspension control systems presented in this Section and shown on the Drawings for the duration of the Work to the satisfaction of Construction Manager. Contractor may propose alternative marine resuspension controls and/or contingency systems as part of an alternate bid; however, the base bid must include all minimum requirements described herein.

B. Contractor shall conduct all marine Work in accordance with the water quality requirements outlined in Section 01 35 43 – Environmental Procedures and Section 01 41 00 – Regulatory Requirements. Contractor shall stop Work and modify Work methods, procedures, or operation of the marine resuspension control systems if the water quality criteria are not being met. Any modifications required to meet water quality criteria shall be performed by Contractor at no additional cost to Owner. Contractor’s alternate bid

approach can include alternate contingency systems; however, both the alternate bid and base bid shall include, at a minimum, the dedicated Work vessel and crew.

C. Contractor shall not begin Work that could result in the generation of turbidity or sheens until marine resuspension controls are in place per this Section and the Drawings as determined by Construction Manager.

1.4 APPLICABLE CODES, STANDARDS, AND SPECIFICATIONS

A. Silt Curtains as a Dredging Project Management Practice, Department of Energy Resources (DOER) Technical Notes Collection (ERDC TN-DOER-E21), U.S. Army Engineer Research and Development Center, Vicksburg (Francingues and Palermo 2005).

B. International Organization of Standardization 7027.

C. Private Aids to Navigation set forth in the U.S. Coast Guard (USCG) Code of Federal Regulations Title 33, Chapter 1, Parts 64 and 66.

1.5 SUBMITTALS

A. PRE-CONSTRUCTION

1. Contractor shall provide a Marine Resuspension Control Plan. in accordance with Section 01 33 00 – Submittal Procedures. indicating how the requirements outlined herein, the permits, and shown on the Drawings will be satisfied. The Marine Resuspension Control Plan shall include, but not be limited to, the following:

a. Plan view figure showing all resuspension systems to be deployed.

b. Proposed plan for the installation, deployment, inspection, and maintenance of each system, including system locations.

c. Proposed plan for performing inspections of the marine resuspension control systems twice per day (minimum) to ensure they are free from defects and remain effective during the Work performed.

d. Proposed methods and equipment for turbidity curtain reefing, where applicable.

e. Proposed methods for turbidity curtain anchoring, where applicable.

f. Proposed methods for turbidity curtain weight attachment, where applicable.

g. Proposed contingency measures to be taken by Contractor to meet water quality requirements in the event that marine resuspension controls are not adequate and shall include, at a minimum, a dedicated Work vessel and crew to contain and remove sheen, modifications to construction operations (e.g., fall height, cycle time, bucket handling procedures, use of a rinse tank, placement procedures), and/or detailed modifications to the marine resuspension control systems.

h. Lighting and signage that will be implemented to adequately notify project and non-project vessels of a Work area and the presence of an in-water marine resuspension control and contingency system in accordance with Section 35 00 00 – Waterway and Marine Construction.

i. Proposed resuspension control relocation plan outlining turbidity control details and potential settling durations based on anticipated turbidity levels and settling rates, as well as the presence of sheens.

j. Proposed maintenance plan (including repair and replacement of curtain sections, if needed) to ensure adequate performance of the marine resuspension controls and contingency systems to meet the performance criteria.

k. Proposed storm management plan to ensure marine resuspension controls are adequately secured and will not damage the surrounding areas or interfere with normal waterway operations during storm events.

l. Proposed plan for removal and final decontamination or characterization/disposal of marine resuspension controls prior to demobilization from the project per Section 02 51 00 – Equipment Decontamination.

B. DURING CONSTRUCTION

1. Twice daily (at a minimum) marine resuspension control systems Inspection Reporting.

a. As part of the Daily Activity Report, Contractor shall provide a daily written report citing the results of the twice daily (minimum) inspections (one at the start and one at the end of the Work day), and any maintenance activities that were conducted to achieve the water quality requirements in accordance with Section 01 31 13 – Project Coordination.

b. Daily updates shall be documented in the Daily Activity Report to describe any modifications to the marine resuspension controls and/or in-water construction operations required to meet water quality requirements.

c. Additional inspections shall be performed by Contractor as directed by Construction Manager based on observed field conditions at no additional cost to Owner.

1.6 PERFORMANCE CRITERIA

A. Water quality monitoring shall be conducted by Contractor and results communicated to Construction Manger as received. It is Contractor's responsibility to ensure the performance criteria specified in all applicable permits are achieved.

PART 2 PRODUCTS

2.1 SECTION INCLUDES

A. Stand-alone Permeable Turbidity Curtain

B. Secondary Oil Containment Boom

C. Sorbent Booms and Pads

2.2 STAND-ALONE PERMEABLE TURBIDITY CURTAIN

A. The Stand-Alone Permeable Turbidity Curtain shall consist of the following elements:

1. Stand-Alone Permeable Turbidity Curtain with flotation collar or equivalent as approved by Construction Manager with reefing lines and billow controls as shown on the Drawings.

2. Sorbent Booms and Pads per the Drawings and this Specification.

2.3 SECONDARY OIL CONTAINMENT BOOM

A. The Secondary Oil Containment Boom shall consist of the following elements:

1. Secondary Containment Boom with flotation collar.

2. Sorbent Booms and Pads per the Drawings and this Specification.

2.4 SORBENT BOOMS AND PADS

A. Sorbent Booms shall be Spilldam Environmental Inc., B5 5” x 10’ Oils Sorbent Booms or equivalent as approved by Construction Manager.

B. Sorbent Pads shall be Spilldam Environmental Inc., P9W 15” x 19” Medium Weight Oil Sorbent Pads or equivalent approved by Construction Manager.

PART 3 EXECUTION

3.1 SECTION INCLUDES

A. General Execution

B. Stand-alone Permeable Turbidity Curtain

C. Secondary Oil Containment Boom

D. Contingency Systems

E. Maintenance, Decontamination, and Demobilization

3.2 GENERAL EXECUTION

A. Contractor shall furnish, install, deploy, inspect, and maintain all marine resuspension controls in strict accordance with the manufacturer's recommended procedures to the satisfaction of Construction Manager and consistent with approved Marine Resupension Control Plan. If such controls/systems are not adequately installed, deployed, inspected, relocated, and maintained to the satisfaction of Construction Manager, remediation activities shall be halted immediately until acceptable conditions are established as determined by Construction Manager at no additional expense to Owner.

B. Contractor shall size and install marine resuspension control systems to enclose Marine Work Areas as shown on the Drawings for the purpose of the base bid. Contractor may provide alternate layouts or system designs as an alternate bid.

C. Contractor shall deploy marine resuspension control systems in accordance with Section 35 00 00 – Waterway and Marine Construction.

D. Contractor shall size turbidity curtains and use reefing lines to accommodate varying water depths due to dredging and tidal fluctuations. Turbidity curtains shall remain greater than 12 inches but no more than 36 inches above the sediment surface along the length of the curtain to avoid the curtain resting on the sediment surface during all Work and shall be adjusted as requested by Construction Manager.

E. Contractor shall anchor resuspension controls using anchor weights or other Construction Manager approved method. Anchor weight spacing shall be selected by Contractor and approved by Construction Manager prior to installation. Existing structures may be used by the Contractor as anchor point with Construction Manager's approval at Contractor's own risk. Any damage to the turbidity curtain, existing structures, shoreline features, or surrounding property due to improper sizing, installation, or moving of the weight anchors shall be the sole responsibility of Contractor and shall be repaired to the satisfaction of Construction Manager at no additional expense to Owner.

F. Contractor shall secure sorbent booms to the inside edge of the marine resuspension controls deployed to address sheen during the Work.

G. If sheens are observed outside of the marine resuspension controls, Contractor shall deploy a secondary containment system as shown on the drawings and maintain the secondary containment system for the remainder of the Work unless otherwise approved in writing by Construction Manager.

3.3 STAND-ALONE PERMEABLE TURBIDITY CURTAIN

A. Contractor shall install and maintain the Stand-Alone Permeable Turbidity Curtain as shown on the Drawings for use during debris removal, dredging, capping, and any other potentially silt-producing work as determined by Construction Manager.

B. Contractor shall conduct debris removal, dredging, capping, and any other potentially silt-producing work as determined by Construction Manager within resuspension controls unless directed otherwise by Construction Manager. Contractor shall replace the turbidity curtain following the completion of dredging activities and prior to the placement of cap material.

C. Contractor shall determine the size of the resuspension controls required to ensure that the Work is performed and completed within the project schedule provided by Contractor and permits in accordance with Section 01 14 00 – Work Restrictions and Section 01 41 00 – Regulatory Requirements.

D. All costs associated with the resuspension controls, including, but not limited to, size of system, components of system, and planned modifications, shall be included in Contractor's bid.

3.4 SECONDARY OIL CONTAINMENT BOOM

A. Contractor shall install a secondary containment boom as part of a secondary containment system if sheen is observed outside any of the marine resuspension controls or as directed by Construction Manager. The secondary containment boom shall be installed down current of the in-water Work and maintained at all times unless otherwise approved by Construction Manager. Once installed, Contractor shall ensure that all sheen shall be removed from inside the secondary containment boom prior to moving the secondary containment boom or moving vessels through the Work areas.

B. Contractor shall secure two rows of sorbent booms to the inside of the secondary containment boom to control sheen during Work activities. Sorbent booms and sorbent pads shall be used in conjunction with the secondary containment boom to control surficial sheens that may be encountered during the Work and prevent transport of sheens outside of the Work area.

C. Contractor shall maintain a minimum of 300 feet of secondary containment boom available at the Site.

3.5 CONTINGENCY SYSTEMS

A. Contractor shall provide and maintain an additional 100 feet of stand alone permeable turbidity curtain and 200 feet of secondary containment boom as contingency items at all times for immediate use if needed for system repairs or modifications and/or addressing observed surficial impacts at the direction of Construction Manager and in accordance with the information provided herein and on the Drawings.

B. Contractor shall not begin marine Work until the contingency items listed above are on Site or approved by Construction Manager.

C. Contractor shall have a dedicated vessel and crew for deploying additional sorbent booms and pads to address sheen observed outside of deployed resuspension systems and at the direction of Construction Manager.

3.6 MAINTENANCE, DECONTAMINATION, AND DEMOBILIZATION

A. Contractor shall visually inspect resuspension control system and associated components from a boat or vessel during installation and during Work at a minimum of twice per day as specified herein. Additional inspections shall be conducted at Contractor's discretion and/or at the request of Construction Manager, following storm periods, noticeable turbidity increases outside the system, unexpected curtain position/behavior, contact of the curtain by equipment or debris, or other abnormal events. Contractor shall conduct diver

inspections of the resuspension control system, at no additional cost to Owner, if downstream turbidity levels exceed permitted levels and no obvious system malfunctions were identified from the surface.

B. Contractor shall maintain resuspension control systems in proper working order during the Work. Any torn, damaged, or otherwise ineffectively functioning sections of the system identified during routine inspections shall be promptly repaired or replaced by Contractor as necessary to maintain the performance criteria as specified in Section 01 35 43 – Environmental Procedures and in compliance with all applicable permits and approvals, at no additional cost to Owner.

C. Contractor shall have a Work boat dedicated to addressing sheen outside of areas enclosed by resuspension control systems in accordance with Section 01 35 43 – Environmental Procedures.

D. Prior to moving resuspension control systems, Contractor shall ensure that all sheens are removed and turbidity within the curtained-off area reaches an acceptable level, as determined by Construction Manager.

E. Materials used during the Work described herein shall be disposed of in accordance with Section 02 61 00 – Removal and Disposal.

F. Contractor shall replace the resuspension controls with new at the completion of dredging activities and prior to the placement of cap materials. The removed curtain shall be disposed of in accordance with Section 02 61 00 – Removal and Disposal.

END OF SECTION

SECTION 01 74 00 – CLEANING AND WASTE MANAGEMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Referenced Sections

B. Description

1.2 REFERENCED SECTIONS

A. Section 01 35 43 – Environmental Procedures

B. Section 02 51 00 – Equipment Decontamination

C. Section 02 61 00 – Removal and Disposal

1.3 DESCRIPTION

A. Contractor shall remove all debris and perform all cleaning required as a result of the performance of the Work.

B. Cleaning work shall be performed throughout the duration of the project in a neat, safe, and organized manner. Contractor shall keep the Work Areas in a neat and clean condition that is free of debris to the satisfaction of Construction Manager. Contractor shall legally recycle or dispose of all materials and debris accumulated in conjunction with completing this Work at an appropriately licensed facility consistent with the Specifications.

C. Contractor shall furnish all labor, containers, transportation, and payment of fees associated with recycling, re-use, salvage, and disposal of construction materials. Contractor shall provide dumpsters for their own use. Dumpsters shall be of adequate size to handle all refuse and shall be emptied on a regular schedule or more often as needed.

D. Prior to demobilizing, cleanup shall be performed by Contractor to the satisfaction of Construction Manager.

E. Contractor shall conduct cleaning and disposal operations to comply with all local, state, and federal laws, regulations, and the Specifications.

F. Burning of waste material is not permitted.

G. Discharge of wastes to waterways is not permitted.

H. Materials encountered during the Work shall be handled and disposed of in accordance with Section 01 35 43 – Environmental Procedures and Section 02 61 00 – Removal and Disposal.

PART 2 PRODUCTS

2.1 SECTION INCLUDES

A. Materials

2.2 MATERIALS

A. Contractor shall use only those cleaning materials that will not create hazards to health or property and that will not damage surfaces.

B. Contractor shall use only those cleaning materials and methods recommended by the manufacturer of the surface material to be cleaned.

C. Contractor shall use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 3 EXECUTION

3.1 SECTION INCLUDES

A. Cleaning During Construction

3.2 CLEANING DURING CONSTRUCTION

A. Contractor shall execute periodic cleaning to keep the Work Area free from accumulation of waste materials, rubbish, and windblown debris resulting from construction operations.

B. Contractor shall wet down dry materials and prevent blowing dust.

C. Contractor shall remove snow and ice within the Work Area that impedes access, impedes the implementation of the Work, impedes drainage, or presents danger to workers, public, or property.

D. All packaging devices including cartons, crating, boxes, wrappings that have been used to enclose materials, and devices or equipment brought to the premises for use in the Work and identifiable in any proven way as to be such, shall be removed from the premises by Contractor.

E. Contractor shall remove waste materials, debris, and rubbish from the Site and legally dispose of the materials.

F. Debris or waste material from cutting, patching, or other construction procedures shall be removed by Contractor at the end of each day’s Work.

3.3 FINAL CLEANING

A. At completion of the Work, Contractor shall clean all Work Areas and remove from the Site all debris and waste material in compliance with the Specifications. Contractor shall then perform a general and final cleanup of the Site.

B. Contractor shall abide by the cleaning procedures set in Section 02 51 00 – Equipment Decontamination.

C. Prior to completion of the Work, Construction Manager shall view all Work Areas to verify that the entire Limits of Work are clean. Contractor shall perform additional cleanup as necessary to satisfy Construction Manager at no additional cost to Owner.

END OF SECTION

SECTION 01 77 00 – CLOSEOUT PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Referenced Sections

B. References

C. Substantial Completion

D. Final Inspection

E. Re-inspection Fees

F. Contractor's Closeout Submittals

G. Guarantees and Warranty

H. Final Adjustments of Accounts

I. Final Application for Payment

1.2 REFERENCED SECTIONS

A. Section 01 78 39 – Project Record Documents

1.3 REFERENCES

A. Contract

1.4 SUBSTANTIAL COMPLETION

A. When Contractor considers the Work is substantially complete, Contractor shall submit a notice of Substantial Completion to Construction Manager, in writing. This shall, at a minimum, include the following:

1. A notice that the Work is substantially complete, including Record Drawings per Section 01 78 39 – Project Record Documents.

2. A list of items to be completed or corrected and the associated schedule.

B. Within 5 days after receipt of notice per Paragraph 1.4.A.1, Construction Manager will review the Work to determine the status of completion.

C. Should Construction Manager, after discussions with Owner, determine that the Work is not substantially complete:

1. Construction Manager will notify Contractor promptly in writing, giving the reasons therefore.

2. Contractor shall remedy the deficiencies in the Work and send a second written notice of Substantial Completion to Construction Manager.

3. Construction Manager will review the Work to determine status of completion.

D. When Construction Manager and Owner concur that the Work is substantially complete, Owner or Construction Manager on behalf of Owner will:

1. Prepare and deliver to Contractor a Certificate of Substantial Completion, accompanied by a list of items to be completed or corrected by Contractor as a precedent to final payment.

1.5 FINAL INSPECTION

A. When Contractor considers the Work is complete, Contractor shall submit written Work Completion Certification to Construction Manager that:

1. Drawings and Specifications have been reviewed.

2. Work has been inspected for compliance with Drawings and Specifications.

3. Work has been completed in accordance with Drawings and Specifications.

4. Work is completed and ready for final inspection by Construction Manager and Owner.

B. Construction Manager and Owner will review the Work to verify the status of completion with reasonable promptness after receipt of such certification.

C. Should Construction Manager or Owner consider that the Work is incomplete or defective:

1. Construction Manager will notify Contractor promptly in writing, listing the incomplete or defective Work.

2. Contractor shall take immediate steps to remedy the stated deficiencies, and send a second written certification to Construction Manager that the Work is complete.

3. Construction Manager will review the Work.

D. When Construction Manager and Owner find that the Work is acceptable under the terms of the Contract, Construction Manager will request Contractor to complete closeout submittals.

1.6 RE-INSPECTION FEES

A. Owner reserves the right to deduct re-inspection fees from the final payment to Contractor should Construction Manager and Owner have to view the Work more than once after Contractor notifies Construction Manager that the Work is substantially complete or

complete due to failure of the Work to comply with the claims of status of completion made by Contractor.

1.7 CONTRACTOR'S CLOSEOUT SUBMITTALS

A. Contractor shall provide closeout submittals to Construction Manager within 7 days of receiving the request from Construction Manager to complete closeout submittals unless otherwise agreed to by Construction Manager.

B. The following documentation shall be provided in the closeout submittals to Construction Manager:

1. Evidence of compliance with requirements of governing authorities.

2. Project Record Documents as specified in Section 01 78 39 – Project Record Documents.

3. Evidence of Payment and Release of Liens in connection with the requirements of the Contract.

4. Guarantees and warranties.

5. Bonds.

1.8 FINAL APPLICATION FOR PAYMENT

A. Contractor shall submit the final Application for Payment in accordance with procedures and requirements stated in the Contract.

B. Owner or Construction Manager on behalf of Owner shall issue a Certificate of Completion of Work to Contractor at the completion of the project after receipt of all required maintenance instructions, schedules, Record Drawings, guarantees, bonds, insurance certificates, and Releases of Liens. The date of the Certificate of Completion shall be the beginning date of all guarantees.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01 78 39 – PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Referenced Sections

B. Description

C. Submittals

1.2 REFERENCED SECTIONS

A. Section 01 33 00 – Submittal Procedures

B. Section 01 77 00 – Closeout Procedures

C. Section 02 21 00 – Surveys

1.3 DESCRIPTION

A. Work includes keeping accurate record documents for the Work and all additions, substitutions of material, variations in Work, and any other additions or revisions to the Contract.

B. This Section includes administrative and procedural requirements for Project Record Documents, including:

1. Survey Record Drawings.

2. As-built Record Drawings.

3. Project Records.

4. Record Specifications and Addenda.

C. See individual Specifications for specific requirements for Project Record Documents of the Work specified.

1.4 SUBMITTALS

A. Survey Record Drawings: Contractor shall provide Survey Record Drawings as listed in Table A of Section 01 33 00 – Submittal Procedures and as described in Section 02 21 00 – Surveys.

1. All Survey Record Drawings shall be stamped and signed by the professional responsible for the survey Work.

2. A hard copy of the Survey Record Drawings shall be submitted. In addition, an electronic copy of the Survey Record Drawings shall be submitted on a compact disk (CD) or other electronic format acceptable to the Construction Manager. Electronic versions of Survey Record Drawings shall be in AutoCAD Civil 3D (2014 or later) format or other program approved by Construction Manager.

B. As-built Record Drawings: Contractor shall prepare and submit a complete set of As-built Record Drawings at the time of Substantial Completion as described in Section 01 77 00 – Closeout Procedures.

1. Construction Manager will provide a set of Drawings electronically for Contractor use in preparing As-built Record Drawings.

2. Contractor shall record all variations to the Drawings as described herein.

3. When Contractor considers Work to be Substantially Complete, Contractor shall submit As-built Record Drawings, with all deviations from the Drawings clearly marked, for Construction Manager review and comment in accordance with Section 01 77 00 – Closeout Procedures.

a. As-built Record Drawings shall use the coordinate systems shown on the Drawings and be at a scale not smaller than 1 inch = 30 feet.

b. A hard copy of the As-built Record Drawings shall be submitted. In addition, an electronic copy of the As-built Record Drawings shall be submitted on a CD or other electronic format acceptable to the Construction Manager. Electronic versions of As-built Record Drawings shall be in AutoCAD Civil 3D (2014 or later) format or other program approved by Construction Manager.

c. AutoCAD information shall be organized into separate electronic files that correspond to each sheet of the Drawings. Each file shall be named with the sheet identification and clearly designated as a Project Record Drawing as described herein.

4. Upon receipt of request for closeout submittals from Construction Manager, Contractor shall submit a final set of As-built Record Drawings in electronic format to Construction Manager.

C. Project Records: Contractor shall provide Project Records as listed in Table A of Section 01 33 00 – Submittal Procedures and described in the individual Specification sections. Examples of Project Records include, but are not limited to, photographs, survey information, and installation records.

D. Record Specifications and Addenda: Contractor shall submit one copy of Record Specifications, including addenda and Contract modifications at the time of Substantial Completion, as described in Section 01 77 00 – Closeout Procedures.

E. Owner or Construction Manager may request Survey Record Drawings and Project Records in addition to those listed in Table A of Section 01 33 00 – Submittal Procedures when deemed necessary to adequately describe the work covered in the respective sections.

Contractor shall provide these additional Project Record Documents at no additional cost to Owner.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 SECTION INCLUDES

A. Maintenance of Documents

B. Recording

3.2 MAINTENANCE OF DOCUMENTS

A. Contractor shall maintain at the Site a minimum of one copy of the following:

1. Drawings.
2. Specifications.
3. Addenda.
4. Permits.
5. Contractor’s Health and Safety Plan.
6. Reviewed Shop Drawings and submittals.
7. Change Orders.
8. Any other modifications to the Contract.
9. Field Orders or written instructions from Construction Manager.
10. Field Test Reports.
11. Disposal Manifests.
12. Material delivery receipts and tickets.

B. Contractor shall maintain all documents in Contractor’s field office apart from documents used for construction.

C. Contractor shall maintain all documents in clean, dry, legible condition.

D. Project Record Documents shall not be used for construction purposes.

E. Contractor shall make all documents available at all times for inspection by Construction Manager.

3.3 RECORDING

A. Contractor shall identify and date each Project Record Document, including the designation “PROJECT RECORD DOCUMENT” in a prominent location.

B. Contractor shall keep record documents current.

1. Contractor shall make changes and modifications to Project Record Documents as they occur and not wait until the end of the Project.

2. Contractor shall not permanently conceal or cover any installed project components until the required information has been obtained and recorded.

C. Survey Record Drawings: Information required for inclusion in the Drawings is defined in Section 02 21 00 – Surveys.

D. As-built Record Drawings: Contractor shall legibly mark As-built Record Drawings to record actual construction where construction varies from that shown on the original Drawings, including, but not limited to, the following:

1. Details not on original Drawings.

2. Field changes of dimension and detail.

3. Use of alternate materials and equipment.

4. Connection details.

5. Changes made by Field Order or by Change Order.

E. Project Records: See individual Specifications for specific requirements for Project Records of the Work specified.

F. Specifications and Addenda: Contractor shall legibly mark up each specification section to record the following:

1. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed, including substitutions.

2. Changes made by Change Order or Field Order.

END OF SECTION

SECTION 02 21 00 – SURVEYS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Referenced Sections

B. References

C. Qualifications of Surveyors

D. Description

E. Project Datums

F. Submittals

G. Survey Reference Points

1.2 REFERENCED SECTIONS

A. Section 01 33 00 – Submittal Procedures

B. Section 01 18 00 – Project Utility Sources

C. Section 01 78 39 – Project Record Documents

D. Section 02 22 00 – Existing Conditions Assessment

E. Section 35 20 23 – Dredging

F. Section 35 20 30 – Dredged Material Management and Processing

G. Section 35 20 50 – Capping

1.3 REFERENCES

A. U.S. Army Corps of Engineers (USACE), 2013. *Engineering and Design – Hydrographic Surveying*. EM 1110-2-1003.

B. American Land Title Association, Minimum Standard Detail Requirements for ALTA/ACSM Land Title Surveys, effective February 2011.

C. Geometric Geodetic Accuracy Standards and Specifications for Using GPS Relative Positioning Techniques, Federal Geodetic Control Committee, Version 5.0, May 1988 and corrected August 1, 1989.

1.4 QUALIFICATIONS OF SURVEYORS

A. The qualifications of the Surveyors (Topographic and Hydrographic Surveyors) shall be submitted in the Survey Work Plan outlined herein. Construction Manager reserves the right to disallow the person(s) selected by Contractor for surveying. If, in Construction Manager opinion, the person is not qualified to do the work, Contractor shall select another surveyor and submit qualifications until a qualified person is approved. Use of alternative surveyors shall be at no additional cost to Owner.

B. Topographic Surveyor

1. The Topographic Surveyor selected by Contractor shall be a Professional Land Surveyor licensed in the State of Massachusetts with qualifications acceptable to Construction Manager, and shall perform the topographic surveys.

2. The Topographic Surveyor shall have actively engaged in land survey operations during the past 3 years.

C. Hydrographic Surveyor

1. The Hydrographic Surveyor selected by Contractor shall be a Registered Hydrographic Surveyor certified by the American Congress on Surveying and Mapping with qualifications acceptable to Construction Manager, and shall perform the hydrographic surveys.

2. The Hydrographic Surveyor shall have actively engaged in hydrographic survey operations during the past 3 years.

1.5 DESCRIPTION

A. Contractor shall perform all topographic and hydrographic survey work described in the Specifications and shown on the Drawings.

B. Contractor shall perform a debris survey prior to the start of in-water Work. At minimum, the debris survey shall consist of side scan sonar and magnetometer surveys. Contractor shall include other survey methods, as necessary, for the Contractor to adequately evaluate the extent of debris present and determine appropriate removal methods. The Contractor shall use the debris survey findings to evaluate the locations, types, and sizes of debris and other obstructions and determine whether pre-dredging debris removal is needed to facilitate the dredging operation in accordance with Section 35 20 23 – Dredging.

C. Contractor shall perform all topographic survey work described in the Specifications and shown on the Drawings. This work includes, but is not limited to, the following areas:

1. Pre-demolition barge survey of the five abandoned barges.

2. Pre-dredge topographic survey.

3. Post-demolition barge survey of the foot print of the abandoned barges for the areas above mean low water (MLW).

4. Post-dredge topographic survey.

5. Post-cap topographic survey of the cap placed in the Intertidal Areas.

D. Contractor shall perform all hydrographic survey work described in the Specifications and shown on the Drawings. This work includes, but is not limited to, the following areas:

1. Pre-dredge multi-beam hydrographic survey of the Subtidal Area.

2. Post-dredge multi-beam hydrographic survey of the Subtidal Area including the footprint of the removed abandoned barge below MLW

3. Post-cap multi-beam hydrographic survey of Subtidal Area.

E. Contractor shall retain the services of a Hydrographic Surveyor to perform hydrographic surveying in accordance with the USACE *Engineering and Design – Hydrographic Surveying* guidance for all payment surveys.

F. Contractor's Topographic and Hydrographic Surveyors shall make all necessary measurements of length, depth, and area necessary to calculate quantities of the Work performed consistent with these Specifications and as shown on the Drawings. The results of these survey measurements and all relevant backup calculations shall be provided for review and approval.

G. Contractor's Topographic and Hydrographic Surveyors shall make all necessary measurements of length, depth, and area necessary to calculate quantities of the Work performed consistent with these Specifications and as shown on the Drawings. The results of these survey measurements and all relevant backup calculations shall be provided to Construction Manager for review and approval.

H. Contractor shall prepare Survey Record Drawings to be used for confirming quantities and documenting construction. The final Survey Record Drawings shall be prepared and certified by Contractor's Surveyors and in accordance with Section 01 78 39 – Project Record Documents.

1.6 PROJECT DATUMS

A. All topographic and hydrographic surveys shall be prepared using the project datums listed in these Specifications and as shown on the Drawings:

1. Horizontal Datum: Massachusetts State Plan Mainland Zone, North American Datum of 1983 (NAD83) in U.S. Survey Feet.

2. Vertical Datum: Based on NOAA Station 8443662, Amelia Earhart Dam, Mystic River, MA and refer to the North American Vertical Datum of 1988 (NAVD88).

1.7 SUBMITTALS

A. With Bid

1. Alternative Survey Methods: Contractor may propose different survey methods than those described herein. Proposed alternative survey methods, including equipment, procedures, calibration methods, calibration frequency, and estimated precision/accuracy of measurements need to be provided as part of Contractor's Bid.

B. Survey Work Plan

1. Contractor shall submit a Survey Work Plan in accordance with Section 01 33 00 – Submittal Procedures. Survey Work shall not commence until the Survey Work Plan is approved. At a minimum, the Survey Work Plan shall include the following:

   a. Name, address, and summary of qualifications of the Surveyor(s) selected to complete the survey work and a copy of the State of Massachusetts license for the Surveyors that will certify the topographic and hydrographic work.

   b. A listing of all required surveying tasks and areas to be surveyed for both horizontal limits and elevations as necessary to perform and document the Work described in the Specifications and on the Drawings.

   c. A description of proposed survey methods, including equipment, procedures, calibration methods, calibration frequency, and estimated precision/accuracy of measurements.

   d. Instrument and GPS calibration certificates (6 months current).

   e. A description of recordkeeping procedures during surveying.

   f. A proposed survey deliverable format, including example electronic files of survey surfaces for in-water work in the format specified herein. Construction Manager will evaluate whether the file format is acceptable for use in determining compliance with the Specifications for dredging and capping.

C. Pre-Construction

1. The topographic and hydrographic data presented on the Drawings are based on the latest available Site surveys based on the dates indicated on the Drawings. The Contractor's selected Surveyor(s) shall conduct topographic and hydrographic surveys and a pre-construction utilities location survey of the Limits of Work at least 30 days, but no more than 60 days, prior to the start of construction. Contractor's Surveyor(s) shall perform the pre-construction topographic and hydrographic surveys in accordance with the requirements of this Specification.

   a. Contractor shall submit detailed survey information in accordance with the requirements of this Specification.

   b. Contractor shall submit the pre-dredge topographic and hydrographic Survey Record Drawings within 10 days after the survey is completed.

The Survey Record Drawings shall be certified by Contractor's Surveyor(s). Material removal and related construction activities shall not be initiated until the survey work is accepted by Construction Manager.

c. Contractor shall submit a letter certifying that the Work is located as required by the Contract within 10 days after the survey is completed. If Contractor's Surveyor determines that the Work is not located as required by the Contract, Contractor shall notify Construction Manager immediately and provide documentation prepared by Surveyor(s) describing and illustrating the inconsistencies with the Contract.

D. During Construction

1. Contractor shall submit a daily visual presentation of dredging and cap placement progress consistent with the requirements of this Specification.

2. Interim topographic and hydrographic surveys as required, for progress payment requests only.

3. Topographic and hydrographic surveys conducted during construction within 2 business days after the completion of the survey and in accordance with Section 01 78 39 – Project Record Documents. Dredging and capping shall not continue until the surveys are accepted by Construction Manager, unless approval is given by Construction Manager. If the surveys are not accepted, Contractor shall resurvey at no additional cost to Owner.

4. Contractor shall provide, on request of Construction Manager, documentation of accuracy of survey work, survey logs, and survey field notes.

E. At the Completion of Construction

1. Contractor shall submit final combined hydrographic and topographic plans as part of the Survey Record Drawings within 10 business days after the completion of the Work and in accordance with Section 01 78 39 – Project Record Documents. The Survey Record Drawings will be used to determine the final compliance with the Contract.

2. Contractor shall submit, at the completion of construction, all survey logs and field notes developed over the course of construction.

1.8 SURVEY REFERENCE POINTS

A. Existing control points (horizontal and vertical control) for the project shall be provided prior to Construction.

B. Contractor shall locate and protect monuments and control points prior to starting the Work and preserve all permanent reference points during Construction.

1. Contractor shall not make changes or relocations without prior written notice to Construction Manager and after obtaining approval.

2. Contractor shall report to Construction Manager when any reference point is lost, destroyed, or requires relocation because of necessary changes in grades or locations.

3. Topographic Surveyor shall correctly replace project monuments or control points that may be lost or destroyed and establish replacements based on original horizontal and vertical controls at no additional cost to Owner.

PART 2 MATERIALS

NOT USED

PART 3 EXECUTION

3.1 SECTION INCLUDES

A. Survey Limits

B. Required Surveys

C. Project Survey Requirements

D. Verification

E. Survey Record Drawings and Reporting

3.2 SURVEY LIMITS

A. Contractor's Surveyor(s) shall use horizontal and topographic and hydrographic survey methods to execute the survey work outlined in this Specification. The survey method for each area is described herein. Contractor's Surveyor(s) shall provide the required surveys for a given area using a consistent survey technique over the course of construction.

B. Contractor's Topographic Surveyor shall use topographic survey methods in areas above the above the mean low water (MLW) elevation.

C. The Contractor's Hydrographic Surveyor shall use hydrographic survey methods to survey the marine areas below MLW elevation.

D. Contractor may propose a different survey method than that described herein for a given area. Proposed survey methods for each area shall be submitted for approval as specified herein and shall be approved by Construction Manager prior to employing such methods.

E. The survey limits for a given area shall extend a minimum of 40 feet beyond the planned Limits of Work or beyond the designated area footprint for the survey.

3.3 REQUIRED SURVEYS

A. Conditions Survey

1. Contractor shall conduct pre-construction and post-construction conditions surveys in accordance with Section 02 22 00 – Existing Conditions Assessment.

B. Utilities Surveys

1. Contractor shall conduct a pre-construction utilities location survey in accordance with Section 01 18 00 – Project Utility Sources. Existing utilities shall be clearly marked, defined, and protected, if applicable. Construction Manager shall be notified immediately of any utility discrepancies.

2. Contractor shall survey locations of any utilities capped during the Work, if applicable, and provide survey results to Construction Manager within 10 days of completion of survey.

3. Contractor shall conduct a post-construction utilities location survey to determine Line and Grade of existing utilities, if applicable.

C. Barge Survey

1. Pre-demolition Survey

a. Perform pre-demolition topographic survey of abandoned barge geometry including limits of plan location, top of barge elevation in four corners, and hull thickness in four corners.

D. Dredge Surveys

1. Pre-dredge Surveys

a. Perform pre-dredge topographic and multi-beam bathymetric surveys of the dredge and cap areas prior to dredging.

b. The pre-dredge surveys must be accepted by Construction Manager before dredging commences.

2. Post-dredge Surveys

a. Perform applicable post-dredge topographic or multi-beam bathymetric surveys in the dredge and cap area, including the footprint of the demolished abandoned barges, within 5 days following the completion of dredging.

b. The post-dredge surveys shall be used as the basis for acceptance of dredging Work by Construction Manager.

c. The same survey method shall be used for both the pre- and post-dredging surveys for a given area.

3. Contractor is required to achieve the dredge elevations as shown on the Drawings and as specified in Section 35 20 23 – Dredging. Verification of the dredge elevations shall be as specified herein. If required dredging has not been achieved

as determined by Construction Manager, Contractor shall re-dredge and resurvey the area. The resurveying shall be conducted at no additional cost to Owner.

E. Cap Surveys

1. Pre-Cap Survey

a. Post-dredge surveys shall be used as pre-cap surveys. The elevations of the post-dredge survey shall be used in planning the placement of cap material.

b. The pre-cap surveys must be accepted by Construction Manager before cap placement commences.

2. Post-Cap Survey

a. Perform applicable post- cap topographic or multi-beam bathymetric surveys following the placement of the cap material, including material placed in the footprint of the demolished abandoned barges.

b. The same survey methods shall be used for both the pre-cap and post-cap surveys for a given area, unless otherwise approved by Construction Manager.

3. If the comparison of the pre-cap and post-cap surveys indicates that the required cap material extent or thicknesses have not been achieved within acceptable tolerances as shown on the Drawings and per Section 35 20 50 – Capping and as determined by Construction Manager, Contractor shall place or remove cap material, as necessary, in the identified areas. Following additional placement and/or material removal, the identified areas shall be resurveyed and rechecked by Construction Manager. The resurveying shall be conducted at no additional cost to Owner.

3.4 PROJECT SURVEY REQUIREMENTS

A. Both topographic and hydrographic survey methods shall be used during the execution of this Specification, including pre-construction surveys, Line and Grade Control, and post-construction surveys.

B. Survey procedures—including, but not limited to, positioning modes, calibration, data reduction, adjustment, processing, and plotting—shall conform to recognized industry standards. Horizontal location observations shall compensate for errors, geodetic corrections, and atmospheric variations. Failure to perform and process such surveys in accordance with recognized standards will result in a rejection and non-payment for work performed.

C. Contractor’s Surveyor(s) shall verify work utilizing manufacturer calibration and field verification procedures per industry standards.

D. Topographic surveys shall meet the following additional criteria, at a minimum:

1. Measure the target horizontal and vertical position to an accuracy of 0.01 foot and the target elevation to an accuracy of 0.01 foot.

2. Contractor's Surveyor shall provide coverage of the Work Area based on the size of the area to adequately characterize the surface and subsequently calculate volumes subject to the approval of Construction Manager.

E. Hydrographic surveys shall meet the following additional criteria, at a minimum:

1. Single-beam and multi-beam hydrographic surveys shall comply with the standards defined in the USACE Engineering and Design – Hydrographic Surveying guidance, unless otherwise stated herein.

2. Multi-beam surveys are required for all pre- and post-dredge and cap final verification and payment. Contractor may elect to use single-beam survey techniques for interim progress surveys, but final verification and payment will be made upon approval of multi-beam surveys only unless previously approved by the Construction Manager.

3. Transect spacing for hydrographic data collected using single-beam survey equipment to support progress payments shall not exceed 15 feet.

4. Transect spacing for hydrographic data collected using multi-beam survey equipment to support progress payments shall be adequate to cover the survey area completely.

5. All hydrographic surveys shall meet the following repeatable accuracy:

a. For elevation, to the nearest 0.1 foot.

b. For horizontal distance, to plus or minus 3.0 feet.

6. Positioning shall be by Real-Time Kinematic (RTK) Differential Global Positioning System (DGPS) or equivalent technology capable of providing the same level of positioning accuracy.

7. In shallow water areas, single-beam survey or topographic survey methods may be used to supplement the multi-beam hydrographic survey. Contractor shall obtain written approval from Construction Manager where single-beam survey or land survey methods are proposed to supplement the multi-beam hydrographic survey.

8. Contractor shall provide multi-beam survey data sorted on a 1 foot by 1 foot grid with grid centroids matching the electronic dredge design files provided by Construction Manager.

F. Dredge Bucket GPS System and Software

1. The dredge shall be equipped with RTK DGPS and the necessary sensors, to enable accurate positioning of the dredge bucket and for Contractor to continuously monitor the location of the dredge bucket. The dredge bucket shall have a vertical

positioning accuracy of plus or minus 0.1 foot and a horizontal accuracy of plus or minus 3.0 feet.

2. The dredge positioning software shall be capable of the following:

   a. Using a true three-dimensional (3-D) computational system to calculate the position of the bucket, taking into account the tilt and list of the dredge platform as well as the standard positioning sensors.

   b. Inputting a dredge prism template (e.g., an x, y, z file on a gridded interval of 1.0 foot by 1.0 foot).

   c. Recording all excavator sensor information electronically so that the position and movements of the excavator can be reviewed at a later date (playback capability).

   d. Producing plots showing the location of each dredge bucket in the dredge area.

   e. Showing the dredge operator, in real-time, the depth of material as the bucket takes a bite in relation to the dredge prism.

   f. XYZ file export.

   g. Color coding capabilities of the seabed identifications.

      Note: IHC Systems' Excavator Position Monitor (XPM) System and Hypack, Inc.'s Dredgepack System are acceptable versions of such dredge positioning system software.

3. Contractor shall show that the error budget of the dredge positioning system allows it to work within the stated vertical and horizontal accuracies. The error budget shall include all errors associated with measuring the positioning of the bucket.

4. Contractor's selected positioning system shall be approved by Construction Manager.

5. Contractor shall demonstrate the ability to achieve, monitor, and report these accuracies in the Survey Work Plan. Contractor shall verify its error budget (i.e., quality control check of all sensors one time per day) and include it in the Daily Activity Report.

3.5 VERIFICATION

A. All pre-dredge and post-dredge surveys and all pre-cap and post-cap surveys shall conform to the topographic and hydrographic survey requirements provided herein.

B. Dredge Verification

1. Contractor shall provide post-dredge multi-beam hydrographic survey data sorted to present an average elevation within each 1-foot by 1-foot grid square at the grid centroids matching the electronic dredge design files provided by the Owner.

2. Construction Manager will verify that the post-dredge elevations achieve the minimum required percentage of the dredge area specified in Section 35 20 23 – Dredging. This verification will be determined by comparing the post-dredge survey elevations to the pre-dredge/surface elevations, both averaged on a 5-foot by 5-foot grid basis.

3. Owner will verify that no high spots are greater than that specified in Section 35 20 23 – Dredging by comparing the post-dredge survey elevations to the pre-dredge surface elevations, both averaged on a 1-foot by 1-foot grid basis.

C. Post-Cap Placement Verification

1. Contractor shall provide post-cap hydrographic survey data for the post-dredge cap material. Contractor shall provide survey data sorted to present an average elevation within each 1-foot by 1-foot grid square at the grid centroids matching the electronic dredge design files provided by the Construction Manager.

2. Construction Manager will verify that post-dredge Cap material placement meets the thickness requirements specified in Section 35 20 50 – Capping. This verification will be determined by comparing the post-dredge survey elevations to the post-cap survey elevations for the Cap material, both averaged on a 5-foot by 5-foot grid basis. The average thickness of the Cap material for each grid cell will be determined based on the difference between the average survey elevations for that grid cell.

3. Construction Manager will verify that the top of cap elevation is within the allowable material placement tolerances specified in Section 35 20 50 – Capping. This verification will be determined by reviewing the shallowest (i.e., highest) elevation within each 1-foot by 1-foot grid cell from the post-cap survey.

3.6 SURVEY RECORD DRAWINGS AND REPORTING

A. Maintain a complete, accurate log of all control and survey work as it progresses. Survey logs and field notes are to be provided to Construction Manager upon request.

B. Update Drawings as a condition for approval of progress and final payment requests in accordance with Section 01 78 39 – Project Record Documents.

C. Final quantity computations for dredging and capping shall be computed by Contractor's Surveyor(s). Quantities shall be computed to the nearest cubic yard of volume, based on the Work Areas indicated on the Drawings. Contractor shall submit in tabular format a summary of the elevations, thicknesses (as applicable), and quantities achieved. Construction Manager may verify measurements and quantities.

D. Construction Manager will review the results of the survey, including the provided quantities, within 7 working days of the submittal and give subsequent release if Contractor has successfully fulfilled the requirements of the Work.

E. Contractor shall provide Construction Manager the following items for Survey Record Drawings and reporting:

1. All Survey Record Drawings, which shall meet the requirements specified in Section 01 78 39 – Project Record Documents.

2. For Marine Areas: AutoCAD Civil 3D (2014 or later) format or compatible Digital Terrain Model (DTM) of the survey. The DTM must contain adequate 3-D points and 3-D break lines required to accurately model the digital surface to within the above-stated accuracy. The DTM must also provide a two-dimensional (2-D) polyline defining the limits and footprint of the area(s) surveyed.

END OF SECTION

SECTION 02 22 00 – EXISTING CONDITIONS ASSESSMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Referenced Sections

B. Work Included

C. Submittals

1.2 REFERENCED SECTIONS

A. Section 01 33 00 – Submittal Procedures

B. Section 02 21 00 – Surveys

1.3 WORK INCLUDED

A. This Section includes the performance of pre-construction and post-construction conditions surveys to document and provide a record of baseline conditions and identify any changes in condition that may have occurred during the Work.

1.4 SUBMITTALS

A. All submittals shall be in accordance with Section 01 33 00 – Submittal Procedures.

B. Submit pre-construction conditions survey documentation as specified herein, including videos, photographs, indexes, Drawings, and topographic survey information. Pre-construction conditions survey documentation shall be submitted to Construction Manager at least 30 days prior to the start of Work.

C. Submit post-construction survey documentation as specified herein, including videos, photographs, indexes, Drawings, and topographic survey information. Post-construction conditions survey documentation shall be provided to Construction Manager within 10 days of completion of the Work. The post-construction conditions survey shall consist of the same elements as the pre-construction conditions survey and shall also note any discrepancies from the pre-construction conditions survey.

D. Two hard copies of each conditions survey report shall be submitted to Construction Manager. In addition, two electronic copies of each conditions survey report shall be submitted on in an electronic format acceptable to Construction Manager. Electronic versions of Drawings shall be in AutoCAD Civil 3D (2014 or later) format or other program approved by Construction Manager.

PART 2 PRODUCTS

2.1 SECTION INCLUDES

A. Digital Images

B. Digital Videos

2.2 DIGITAL IMAGES

A. Provide digital image files in uncompressed .jpg format (or approved equivalent), produced by a digital camera with a minimum sensor size of 8.0 megapixels and at an image resolution of no less than 1,600 by 1,200 pixels.

2.3 DIGITAL VIDEOS

A. Provide digital image files in .mp4 format (or approved equivalent), produced by a digital video camera with a minimum video resolution of not less than full high definition at 1,920 by 1,080 pixels.

PART 3 EXECUTION

3.1 SECTION INCLUDES

A. Conditions Surveys

3.2 CONDITIONS SURVEYS

A. At a minimum, pre-construction and post-construction conditions surveys shall be completed for the Limits of Work to document the conditions of designated Work Areas, bulkheads, wharves, structures, shorelines, vegetation, exposed utilities, and other relevant features in the Work Areas.

B. The pre-construction conditions survey shall be conducted before commencement of the Work. The post-construction conditions survey shall be conducted after completion of the Work.

C. Pre-construction and post-construction conditions surveys shall consist of digital photographs, videos, Drawings, and sketches.

D. An index of videos and photographs is required. The index must use a counter or other indexing technique so that individual photographs and video footage can be located and identified. Videos must be labeled and narrated. Photographs shall be numbered. A key plan shall be provided to show the location and general direction of each photograph and video.

E. Documentation of the pre-construction conditions survey shall consist of a written description of the condition of the Site features and of each structure within the Limits of Work. Descriptions shall identify and locate any existing damage, damage to adjacent ground surface, or other defects, and shall include such information to make it possible to

determine the effect, if any, of Contractor's operations on the defect. Particular note shall be made of evident structural faults and deficiencies, or recent repairs. Inspection documentation shall include a space for Construction Manager to initial, confirming that the identified defects have been discussed. Photographs and video shall be provided to support the inspection documentation.

F. Construction Manager will accompany Contractor during the pre-construction and post-construction surveys, but Contractor is responsible for supplying video and photographic equipment, taking photographs, making and narrating videos, creating an index, labeling videos and photographs, and making video and photographic copies.

G. Contractor shall maintain a copy of the pre-construction conditions survey on Site during the performance of the Work.

END OF SECTION

SECTION 02 51 00 – EQUIPMENT DECONTAMINATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Referenced Sections

B. Description

C. Requirements

D. Submittals

1.2 REFERENCED SECTIONS

A. Section 01 18 00 – Project Utility Sources

B. Section 01 33 00 – Submittal Procedures

C. Section 01 35 43 – Environmental Procedures

D. Section 01 51 00 – Temporary Utilities

E. Section 01 53 00 – Temporary Construction

F. Section 02 61 00 – Removal and Disposal

G. Section 02 72 00 – Water Decontamination

1.3 DESCRIPTION

A. Contractor shall decontaminate equipment and materials so as to not transfer contamination to other areas of the Site, including, but not limited to, areas that are uncontaminated, areas that have already been dredged (remediated) as part of the Work, or off-site areas.

1.4 REQUIREMENTS

A. Contractor shall provide and maintain the equipment required for decontamination and shall construct and maintain decontamination stations and associated temporary water treatment system to collect, store, treat, and discharge decontamination fluids in accordance with the permits.

1.5 SUBMITTALS

A. Contractor shall prepare and submit to Construction Manager a project-specific Decontamination Plan in accordance with Section 01 33 00 – Submittal Procedures. At a minimum, the Decontamination Plan shall include the following:

1. Plan (drawn to scale) showing the proposed layout of personnel and equipment decontamination stations relative to sediment and debris handling areas and temporary water treatment system.

2. Construction details for equipment decontamination stations, including methods for collecting decontamination fluids.

3. Construction details and the locations of personnel decontamination stations and boot-wash stations for personnel entering and exiting contaminated areas and sediment/debris handling areas, including methods for collecting decontamination fluids.

4. Decontamination methods and equipment to be used for personnel and materials leaving the Site.

5. Procedures to inspect, test, and document decontamination, including sampling and analytical chemistry methods and frequencies.

6. Methods of storage, transport, and disposal for decontamination wastes.

7. The procedures, equipment, and clearance criteria to be used for the decontamination of equipment to be removed from the Site. Provide details for all equipment, pad construction materials, and cleaning materials (including all Safety Data Sheets [SDSs]) for proposed decontamination additives in accordance with Section 01 35 43 – Environmental Procedures. If surfactants or other additives are proposed, demonstrate that the surfactants/additives can be treated in the temporary water treatment system to permit-required discharge levels, or describe means for containerizing and off-site treatment/disposal of the liquid waste materials.

B. Contractor shall prepare and submit an Equipment Decontamination Documentation Report to Construction Manager for approval at least 72 hours prior to the demobilization of any equipment that has contacted the dredged materials or handled contaminated waters. The Equipment Decontamination Documentation Report shall include a description of decontamination procedures, a summary of inspection and testing results, and certification that all equipment being demobilized from the Site has been decontaminated in accordance with this Section and the approved Equipment Decontamination Plan.

PART 2 MATERIALS

2.1 SECTION INCLUDES

A. Water

B. Decontamination Fluid Additives

2.2 WATER

A. Contractor shall obtain and use water for surface cleaning, decontamination, and other activities associated with the Work as specified in Section 01 18 00 – Project Utility Sources and Section 01 51 00 – Temporary Utilities.

B. Decontamination within, or use of water from, the Mystic River is not permissible for decontamination.

2.3 DECONTAMINATION FLUID ADDITIVES

A. Contractor may use additives, such as surfactants or water-borne abrasives, to facilitate removal of hardened material from equipment or debris only if approved by Construction Manager. SDSs for all additives shall be submitted to Construction Manager prior to construction, in accordance with Section 01 35 43 – Environmental Procedures. Contractor shall properly collect decontamination fluids used during the project and treat fluids in accordance with Section 02 72 00 – Water Decontamination and Section 02 61 00 – Removal and Disposal.

PART 3 EXECUTION

3.1 SECTION INCLUDES

A. Need for Decontamination

B. Decontamination Requirements

C. Decontamination Procedures

D. Disposal of Decontamination Fluids

3.2 NEED FOR DECONTAMINATION

A. All vehicles or equipment that have been in contact with contaminated materials, shall require decontamination.

B. All equipment contacting contaminated material shall be decontaminated by Contractor prior to handling clean materials.

C. All dredging equipment, dredged material handling equipment, process equipment, storage tanks, and related equipment removed from the Site shall require decontamination prior to transport off Site.

D. All equipment, vehicles, and tanks shall be cleared of sediment, washed sufficiently to remove all visible residuals, and verified clean through visual observation or testing prior to transport off Site.

3.3 DECONTAMINATION REQUIREMENTS

A. VEHICLES

1. All vehicles requiring decontamination shall be washed sufficiently to remove all visible sediment from the vehicle body, undercarriage, and tires. Contractor shall ensure no visible tracking of sediment onto roadways occurs, as visually confirmed by Construction Manager.

B. EQUIPMENT DECONTAMINATION

1. Contractor shall use approved areas for the decontamination of all equipment and vehicles. Equipment too large for these areas shall be decontaminated in place, in a manner that contains all decontamination water. Contractor shall ensure that any equipment, vehicles, or personnel that have been in contact with contaminated materials are decontaminated properly before leaving the Work Area.

2. All dredging equipment, dredged material handling equipment, process equipment, storage tanks, and related equipment removed from the Site shall be decontaminated and determined clean by Construction Manager prior to leaving the Site.

3.4 DECONTAMINATION PROCEDURES

A. The decontamination process shall be performed in such a manner that all water used and sediment removed during decontamination is captured and transferred to the temporary water treatment system, as described in Section 02 72 00 – Water Decontamination or disposed of in accordance with all laws and regulations.

B. Sediment and decontamination water captured shall be removed as operationally necessary, or as required by Construction Manager.

C. Wheel-wash stations shall be washed down at the completion of each day of Work.

D. Sediment collected during decontamination activities shall be placed with the dredged sediment or dewatered and containerized for future transportation and disposal off Site in accordance with Section 02 61 00 – Removal and Disposal.

E. Contractor shall perform daily cleaning of all decontamination areas, including personnel locker areas, shower trailers, decontamination trailers, and other decontamination areas.

F. At a minimum, the equipment decontamination procedures shall include the following:

1. Contractor shall propose the location(s) for conducting equipment decontamination for approval by Construction Manager. The equipment decontamination location(s) shall be established to adequately decontaminate the necessary equipment in a timely manner and adequately collect and contain any decontamination fluids generated.

2. Remove sediment from equipment surfaces using shovels, brooms, and other hand tools as necessary.

3. Wash equipment surfaces using pressure washers and related supplies (e.g., equipment for scrubbing, plastic sheeting), where appropriate, to remove any additional sediment and residuals that may remain.

4. Collect decontamination liquids and solids for treatment and disposal as specified.

5. Visually inspect equipment surfaces to verify proper decontamination.

6. Submit an Equipment Decontamination Documentation Report to Construction Manager to certify that decontamination has been completed on each piece of equipment before it is demobilized.

3.5 DISPOSAL OF DECONTAMINATION FLUIDS

A. All decontamination wash water and stormwater that accumulates within decontamination areas shall be collected, contained, and handled by Contractor in accordance with Section 02 72 00 – Water Decontamination.

B. Decontamination fluids and sediments generated from this activity shall be collected, managed, treated, and disposed of in accordance with Section 02 61 00 – Removal and Disposal and Section 02 72 00 – Water Decontamination.

END OF SECTION

SECTION 02 61 00 – REMOVAL AND DISPOSAL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Referenced Sections

B. Description

C. Submittals

D. Characteristics of Material to be Dredged

1.2 REFERENCED SECTIONS

A. Section 00 31 00 – Available Project Information

B. Section 01 14 00 – Work Restrictions

C. Section 01 20 00 – Price and Payment Procedures

D. Section 01 33 00 – Submittal Procedures

E. Section 01 35 43 – Environmental Procedures

F. Section 01 53 00 – Temporary Construction

G. Section 02 72 00 – Water Decontamination

H. Section 35 20 30 – Dredged Material Management and Processing

1.3 DESCRIPTION

A. Contractor shall furnish all labor, equipment, materials, tools, supervision, transportation, and incidentals necessary to characterize, handle, manage, and transport all waste materials to an appropriate facility for re-use, salvage, recycling, treatment, and disposal in accordance with all applicable laws and regulations. This includes, but is not limited to, all tipping and transport fees; local, state, and federal taxes; licenses; permits; and facility surcharges.

B. Contractor shall be paid for off-site transportation and disposal of waste materials generated during the Work consistent with the payment items described in Section 01 20 00 – Price and Payment Procedures. These payment items identify certain waste categories, and estimated quantities for these categories are included on the bid form.

C. Contractor shall engage an independent testing laboratory to perform all analytical testing of all waste materials as necessary for waste characterization, handling, transportation, and

recycling/re-use/treatment/disposal at licensed disposal facilities. Laboratories shall hold the appropriate state certification for testing waste.

D. Construction Manager will be responsible for preparation of the final waste profiles, Bills of Lading (BOLs), manifests, and other shipping documents. Contractor shall assist Construction Manager as necessary in preparation of all required waste profiles, BOLs, manifests, and other shipping documents as required by the disposal facilities.

E. Owner or Construction Manager on behalf of Owner as the Generator will sign all necessary waste profiles and shipping documents.

F. Contractor shall contract directly with the disposal facilities to facilitate the off-site transportation and re-use, salvage, recycling, treatment, and disposal of all waste materials generated during the work.

G. All costs associated with the transportation and treatment/disposal of waste materials as defined herein and in Section 01 20 00 – Price and Payment Procedures (including all tipping and transport fees; local, state, and federal taxes; characterization sampling and laboratory analysis; licenses; permits; and facility surcharges) shall be included in Contractor's bid price.

1.4 SUBMITTALS

A. Pre-construction

1. Contractor shall prepare and submit to Construction Manager a project-specific Waste Materials Removal and Disposal Plan in accordance with Section 01 33 00 – Submittal Procedures. At a minimum, the plan shall outline Contractor's methods for characterizing, managing, tracking, handling, loading, transporting, and disposing of all waste materials generated during the Work as specified herein. Contractor shall not submit samples from the Site to a laboratory, or remove any generated material from the Site, until the Waste Materials Removal and Disposal Plan has been approved. If, following approval of the plan, Contractor desires or identifies a need to use any laboratory or facility not included in the plan, Contractor shall submit all the information as required herein, and receive approval for same, prior to such use. At a minimum, the Waste Materials Removal and Disposal Plan shall include, but not be limited to, the following:

a. A detailed flow chart or schematic describing the means and methods for identifying, managing, characterizing, tracking, handling, loading, and off-site transportation of all waste materials, including those specifically identified in this Section and on the bid form and those considered incidental to the Work. Contractor shall provide a list of equipment to be used to complete the Work outlined in the flow chart or schematic.

b. Proposed disposal, treatment, and recycling facilities for all waste materials requiring disposal and identification of what waste materials will be disposed of at the facilities. The information shall include the name, title, and telephone number of the contact person for each facility.

c. A proposed analytical laboratory for performing analytical testing, as needed, for waste characterization samples collected by Contractor. The information shall provide a description of what types of samples will be analyzed by the laboratory and shall include the name, title, and telephone number of the contact person for the laboratory, and approved analytical certifications held by the laboratory.

d. Estimated quantities of each type of waste material expected to be generated with an estimated waste generation schedule.

e. Designated areas for interim staging of waste materials in accordance with the access and use restrictions specified in Section 01 14 00 – Work Restrictions.

f. Description of equipment, methods, and controls for designated areas for interim staging of waste materials to prevent discharges of contaminants from waste materials to air, soil, surface water, and groundwater.

g. Details, materials, and methods for characterizing waste materials, as required by the disposal facilities. Information shall include, but not be limited to, methodology for sample collection, chemical and physical analyses, sampling and testing frequencies, and applicable criteria.

h. Contractor's methods for characterizing, tracking, handling, loading, shipping, and disposing of all waste materials.

i. Details, materials, and methods to test materials to verify all transportation and disposal requirements are satisfied.

j. Lists of materials that each facility will accept for this project, as well as whether the facility is a recycling, re-use, treatment, storage, or disposal facility.

k. Estimated quantities of waste materials expected to be transported off Site to each facility-specific location and schedule for transportation and disposal.

l. Written confirmation from the various facilities that they will accept the type and quantities of materials, the daily maximum and minimum quantities (cubic yards or tons per day), and the dates and times (including days of the week) they will accept materials from this Work.

m. A description of Contractor's procedures to manage and track materials and an example of Contractor's material tracking log.

n. Name, title, and telephone number of contact person for each transporter to be used.

o. For each transporter to be used, copies of licenses or up-to-date permits to operate and confirmation that they are permitted to transport materials to the respective facility.

B. During Construction

1. Contractor shall submit daily disposal logs to Construction Manager. Logs shall include date, waste type, transporter, disposal facility identification and location, BOL/manifest number, vehicle number, driver, and approximate volume and weight of waste.

2. Contractor shall track daily production of waste on a register that is kept in good standing and shall be made available for review at any time by Construction Manager. The daily register shall be compiled and submitted weekly and monthly to Construction Manager.

3. Prior to submission of a progress payment for Work including material disposal, and within 5 days of transportation from the Site, Contractor shall document actual disposal of the waste at the designated facility by submitting to Construction Manager disposal receipts from the facility. Such certificates and receipts shall bear the printed name of the facility operator and shall specify the date of delivery, quantity and type of material delivered, and weight tickets, and shall be signed by an on-site representative of the facility operator. Payment may be withheld at the discretion of Construction Manager for the disposal of materials for which there are no signed disposal receipts.

4. Contractor shall submit a copy of all analytical testing results, including specific location for each sample identified on a plan, along with the date and time samples were obtained, and other pertinent information.

5. Contractor shall submit a copy of all chain-of-custody forms demonstrating complete record of custody during time of handling and transport for all samples sent to the laboratory.

6. Contractor shall submit certificates of recycle for all recycled materials generated during the course of the Work. Certificates of recycle shall include date, recycle facility, identification and location, approximate volume, weight, and description of recycle methods.

7. Contractor shall submit all paperwork associated with material transportation and disposal to Construction Manager.

1.5 CHARACTERISTICS OF MATERIAL TO BE DREDGED

A. Results of previous laboratory analyses performed on samples collected at the Site are provided in documents as described in Section 00 31 00 – Available Project Information.

PART 2 MATERIALS

NOT USED

PART 3 EXECUTION

3.1 SECTION INCLUDES

A. Coordination

B. Characterization of Materials

C. Waste Materials Handling and Loading

D. Off-site Transportation and Disposal Procedures

3.2 COORDINATION

A. Contractor shall notify Construction Manager a minimum of 3 business days prior to sampling for waste characterization for off-site recycling or treatment/disposal. Construction Manager will have the option to observe all sampling activities performed by Contractor. Construction Manager may require that any sampling performed without the knowledge of Construction Manager be repeated by Contractor to the satisfaction of Construction Manager, at no additional cost to Owner.

B. Contractor shall coordinate the removal, processing (if applicable), and off-site transportation of all materials with Construction Manager.

3.3 CHARACTERIZATION OF MATERIALS

A. Contractor shall segregate dredged material from other waste materials and shall store, handle, and dispose of the dredged material in accordance with all applicable regulations and as specified. All characterization testing of dredged material shall be performed consistent with the requirements of the licensed disposal facilities.

B. Contractor shall coordinate the labeling system for waste material stockpiles with Construction Manager, and shall, at a minimum, include location, identification number, date of generation, and estimated quantity.

C. Contractor shall supplement existing characterization data as required by the off-site disposal facilities. This shall include sampling and laboratory analytical testing of chemical characterization and physical characteristics for all waste materials required by the disposal facilities.

D. Contractor shall collect and prepare composite samples of waste prior to off-site transport at the frequency of sampling required by the disposal facility. Contractor shall analyze the samples in accordance with the requirements of the disposal facility using an approved analytical laboratory.

3.4 WASTE MATERIALS HANDLING AND LOADING

A. Contractor shall perform the following tasks for the proper handling and loading of waste materials that shall be transported to the identified recycling, re-use, or treatment/disposal facilities:

1. Contractor shall arrange and pay for all testing necessary to properly characterize wastes for disposal at the selected facility in accordance with facility requirements. Contractor shall segregate waste material types by waste classification.

2. Contractor shall further segregate waste materials by intended disposition of the materials (i.e., re-use, recycling, treatment, disposal).

3. Waste materials shall be transferred into temporary stockpiles or containers approved by United States Department of Transportation (DOT) to be provided by waste transporter(s) or Contractor and staged for waste classification sampling.

    a. Stockpiled materials shall be managed consistent with Section 01 35 43 – Environmental Procedures, and shall be covered at the end of each Work day with a strong, durable, impermeable, tear-resistant, 10-mil-minimum thickness polyethylene.

    b. Containers shall be DOT shippable.

    c. Shipping containers shall be filled within legal weight and height limits for shipping.

    d. Containers shall not be overloaded.

    e. Debris shall be sized, as necessary, and placed in transport containers to achieve appropriate minimum dimensions and dimensional requirements of the receiving facility. Containers shall be covered, as appropriate, with tarpaulin.

    f. Waste materials shall be contained to comply with the disposal facility requirements.

4. Pending off-site disposal, waste materials shall be temporarily staged in an area designated in the approved Waste Materials Transportation and Disposal Plan and in accordance with the access and use restrictions in Section 01 14 00 – Work Restrictions and the requirements of this Section.

5. Contractor shall manage all waste materials such that characterization and removal can be performed efficiently.

    a. Waste materials shall be managed in accordance with applicable laws, regulations, and disposal facility requirements governing transportation, recycling, and treatment/disposal.

    b. Contractor shall employ environmental controls as specified in Section 01 35 43 – Environmental Procedures during all processes involving the generation, management, handling, temporary storage, and transportation of all waste materials.

    c. Construction water generated through dewatering activities, decontamination, and stormwater that accumulates in waste material handling/staging areas shall be collected, treated, and discharged in

accordance with Section 02 72 00 – Water Decontamination and applicable permits.

d. Coordinate, assist Construction Manager, and manage the custody of necessary waste profiles, BOLs, hazardous waste manifests, and labels.

B. Contractor shall be responsible for removal of solid waste and debris at the Site throughout the duration of the Work. At all times, Contractor shall ensure that the area within the Limits of Work and the adjoining areas are free of solid waste and debris and shall clean up the Site and remove all solid waste and debris as Work progresses.

C. Pack and label materials for transportation following all local, state, and federal laws and regulations.

D. Contractor shall coordinate the labeling system for temporary dredged material stockpiles, roll-off boxes, and debris stockpiles with Construction Manager, and shall, at a minimum, include location, identification number, date of generation, and estimated quantity.

3.5 OFF-SITE TRANSPORTATION AND DISPOSAL PROCEDURES

A. Off-site transportation and disposal of all waste materials generated as a result of the Work shall be in accordance with all applicable local, state, and federal laws, regulations, permits, and the Waste Materials Removal and Disposal Plan.

B. Contractor shall perform the following tasks for the proper off-site transportation and treatment/disposal of all waste materials generated as a result of the Work:

1. Transport and dispose of all waste materials in accordance with all applicable local, state, and federal laws, regulations, permits, and the Waste Materials Removal and Disposal Plan.

2. Engage a licensed transporter.

3. Select the appropriate receiving facilities for each type of waste materials. Contractor shall contract directly with each facility selected to implement the Work.

4. Transport the materials to the disposal facility in appropriate containers or trucks per the applicable laws, regulations, and permits.

C. Contractor shall coordinate the schedule and transport of materials with the facilities. Work delays due to scheduling or acceptance of the material at the disposal facilities for any reason shall be at no additional cost to Owner.

D. Waste shall be transported in lined and covered DOT-approved containers to be provided by waste transporter(s) or drums to be provided by Contractor, and staged for waste classification sampling. Containers shall meet all DOT shipping requirements. Shipping containers shall be filled to within legal weight and height limits for shipping. Waste shall be contained to comply with all disposal facility requirements. Contractor shall be responsible for temporarily staging waste in an area designated in the approved Waste Material Transportation and Disposal Plan.

E. Contractor shall coordinate, manage, and pay for (as a part of the bid price) all waste handling activities including transportation to the approved receiving facilities. Contractor shall be responsible for all transport fees, tipping fees, taxes, and facility surcharges for all waste categories. Waste handling activities shall be conducted in accordance with the approved schedule so as not to delay Work.

F. Contractor shall schedule all waste shipments, in coordination with Construction Manager.

1. Owner and Licensed Site Processional will sign necessary waste profiles and shipping documents. Contractor shall provide waste manifests and BOLs to Construction Manager a minimum of 72 hours prior to shipment of waste, and Construction Manager will, in turn, be responsible for obtaining appropriate signatures in a 3-day time period. Contractor shall assist Construction Manager in preparing BOLs, manifests, and other shipping papers.

2. Materials transported from the Site to a recycling, re-use, or treatment/disposal facility shall be tracked under BOLs or manifests as appropriate.

G. Any demurrage costs associated with transportation shall be borne by Contractor at no additional cost to Owner.

H. Contractor shall be responsible for transportation of all waste to the re-use, recycling, or treatment/disposal facilities unless otherwise noted in the Contract. Contractor shall provide weigh tickets for all waste disposal using commercially available scales with current calibration records. Portable scales will not be permitted for determination of pay quantities. Failure to properly weigh and record wastes transported for disposal will result in non-payment by Owner.

I. Contractor shall maintain a daily log of each truck's weight and all waste shipped off Site.

J. Contractor shall coordinate the schedule and transport construction waste including, but not limited to, materials used to construct temporary facilities, spill-absorbent materials, and general construction debris and waste to the Contractor-selected facility.

END OF SECTION

SECTION 02 72 00 – WATER DECONTAMINATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Referenced Sections

B. Description

C. Design and Performance Criteria

D. Schedule

E. Submittals

1.2 REFERENCED SECTIONS

A. Section 01 18 00 – Project Utility Sources

B. Section 01 51 00 – Temporary Utilities

C. Section 02 61 00 – Removal and Disposal

1.3 DESCRIPTION

A. Contractor shall furnish all labor, equipment, and materials necessary to mobilize, construct, test, power, operate, and maintain a temporary water treatment system (WTS) to successfully treat construction waters generated during performance of the Work. Construction waters include, but are not limited to:

1. Water generated during dredging operations.

2. Water generated from sediment processing activities.

3. Water generated from decontamination activities.

4. Stormwater that accumulates in the Sediment Unloading/Processing Area and any temporary dredged material and debris staging areas.

5. Water generated from dredged sediment dewatering activities.

B. This Section provides minimum requirements for the temporary WTS, the WTS effluent concentration criteria, and minimum equipment and operating requirements in general terms. All equipment, materials, and processes shall be selected and sized by Contractor including, but not limited to, all necessary equipment, tanks, pumps, piping, manifolds, valves, gauges, instrumentation, connections, materials, supports, controls, electrical, instrumentation, and appurtenances to meet or exceed the minimum requirements specified. Contractor shall design the temporary WTS to meet or exceed all applicable

permit requirements and the minimum requirements specified. The temporary WTS described herein is conceptual and is not intended to represent detailed design for the final WTS that shall be designed, operated, and maintained by Contractor.

C. Contractor shall be fully responsible for inspecting Work performed by all of its subcontractors to ensure that the Work complies with the Drawings, Specifications, and Contract.

D. All waters generated during the project activities that cannot be treated by temporary WTS shall be characterized and disposed of in accordance with Section 02 61 00 – Removal and Disposal.

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

A. Contractor shall review the available Site materials, data, Drawings, and reports.

B. The WTS shall be designed to collect and successfully treat all construction waters generated during performance of the Work.

C. The WTS shall be located on a barge or within an area designated for use by Contractor as shown on the Drawings. The WTS shall be located within a secondary containment area. The secondary containment area shall be constructed with a minimum 15-centimetre berm around the perimeter of the containment area to contain liquids within the containment area; and sloped to collect water that accumulates in the containment area.

D. Contractor shall comply with local, state, and federal codes, ordinances, laws, and regulations for treatment and discharge of all waters.

1. Contractor shall be aware and meet all local, state, and federal pollution control regulations for all Work performed under this Contract. No chemicals, petroleum products, or other deleterious materials are allowed to fall, flow, leach, or otherwise enter open waters.

2. Contractor shall be aware and observe all statutes, ordinances, and regulations pertaining to the prevention of environmental pollution and the preservation of public natural resources.

3. Contractor shall furnish any and all bonds and insurance required by the controlling agencies and shall, if requested, pay for any inspections and testing accomplished or furnished by them.

E. Water treated by the WTS shall meet the effluent limits required by the permits prior to discharge.

F. The WTS shall be designed with sufficient equipment redundancy to ensure the successful operation of the WTS and to achieve the specified effluent criteria. At a minimum, redundancy shall be provided for all critical treatment equipment (e.g., filters, adsorption units).

G. The WTS shall include instrumentation to measure the continuous, instantaneous, and totalized flow of the WTS influent, WTS effluent, and backwash water flow.

H. The WTS shall include instrumentation to measure all tank levels and to provide high, high-high, and low-level alarms/indication.

I. The WTS piping network shall be equipped with pressure gauges to indicate the pressures entering and exiting each process unit to provide information on the pressure drop across the units.

J. Valves shall be installed to allow for isolation of each process unit and tank.

K. Sample ports/locations and a means of access shall be provided for Contractor and Construction Manager to collect samples before and after each process unit.

L. The discharge from the WTS shall be diffused or otherwise controlled to prevent the erosion or scour during discharge, such that the discharge does not cause resuspension of sediment.

M. The WTS shall operate in wet weather and in wet environment through proper protection of pipes and electrical power and signal conductors.

N. Water treatment equipment shall be designed/installed to allow operation that is not affected by temperature/seasonal changes for the anticipated period of Work. Installation shall be performed in a manner that allows for efficient winterization of equipment that may remain exposed to the elements.

O. The WTS shall be designed to operate in a manual mode to run continuously or as needed and to shut down automatically in the event of a high level alarm, high pressure alarm, low flow alarm, or other potentially dangerous or emergency situation. The WTS shall also automatically notify Contractor or operator of any alarms by visual and audible alarms.

P. Clearly mark all WTS components and storage containers.

Q. The WTS shall be modified at no additional cost to Owner if, after installation, the system does not perform as required or if the system causes or threatens to cause damage to existing buildings, structures, or utilities.

1.5 SCHEDULE

A. Contractor shall plan and be prepared to conduct stormwater management and WTS operations 7 days per week, 24 hours per day as necessary based on field conditions (e.g., precipitation, snow melt).

1.6 SUBMITTALS

A. Pre-construction

1. Contractor shall prepare and submit a Temporary Water Treatment Plan, stamped by a Professional Engineer licensed to practice in Massachusetts, to Construction Manager for approval prior to mobilization of the WTS. At a minimum, the Water Treatment Plan shall include the following:

a. A description of the water treatment equipment, process operations, instrumentation, and controls, including the types, sizes, quantities, arrangements, power sources, and capacities of each WTS component.

b. Drawings showing the locations, arrangement, and layout of each WTS component.

c. A process layout and a Process and Instrumentation Diagram for each system component.

d. A description of any chemicals (e.g., polymers, coagulants) that will be used, including the basis for determining the quantity of chemicals to be added. Safety Data Sheets (SDSs) shall be provided for all chemicals proposed for use.

e. A description of the sampling and analysis that will be performed by Contractor.

f. A description of how spent filter media, absorption media, and solids filtered during water treatment will be handled and disposed of.

g. Details for the WTS discharge, including the proposed location and configuration of the discharge (e.g., a diffuser) to prevent the scour of sediment during discharge.

h. Calculations used to size water collection, treatment, and discharge systems, including calculations demonstrating the adequacy of the proposed system and design sizes of all WTS components to meet the required discharge criteria.

i. An Operations and Maintenance (O&M) Manual for each component of the temporary WTS that includes a general narrative detailing Contractor's O&M activities. The O&M Manual shall include the following information (as applicable) for each major system component:

    i. Startup testing, normal (daily) operations, trouble shooting, and shut-down procedures.

    ii. Preventative or routine inspection and maintenance requirements.

    iii. Sampling plan, including schedule, sampling access points, sampling equipment, sampling methods, and laboratory testing of samples.

    iv. Recommended spare parts list.

    v. Calibration and alignment information.

    vi. Manufacturer's O&M Manuals.

B. During Construction and Operation

1. A written report summarizing the startup and construction testing activities, issues identified during startup, and their resolution. A report shall be submitted for all testing performed and for all tests that failed. The report shall describe the cause of test failures, any corrective actions, and the re-testing performed.

2. Control/monitoring data as requested by Construction Manager.

3. Results of testing, sampling, and monitoring performed by Contractor.

4. Corrective Action Reports as required by the Specifications.

5. Copies of permit-required reports.

PART 2 MATERIALS

2.1 SECTION INCLUDES

A. General

B. Water Treatment System

C. Spare Parts

2.2 GENERAL

A. This Section describes the minimum requirements for major WTS components. Contractor shall be responsible for the selection of all processes, equipment, pumps, piping, manifolds, tanks, valves, gauges, connections, supports, controls, electrical, instrumentation, and appurtenances related to the Work. Products used in the Work shall be produced by manufacturers regularly engaged in the production of such items and have a successful history of product acceptability, as interpreted by Construction Manager.

2.3 WATER TREATMENT SYSTEM

A. At a minimum, the temporary WTS shall include the following components. Contractor may propose alternate or additional components for Construction Manager approval:

1. Oil-water Separation: At least one closed-top, baffled fractionation (“frac”) tank with underflow and overflow weirs shall be provided for initial discharge from the influent pumps. The frac tank(s) shall be:

a. Appropriately equipped with inlet and outlet, valves, and cleanouts.

b. Sized to provide an adequate retention time for gravity oil-water separation and sediment settling.

c. Provided with gravity overflow discharge to an oil-water separator chamber for subsequent discharge through the WTS and to the discharge point.

d. Equipped with a high-level switch alarm in case of overfill that will shut down the influent pumps and alert the operator of the alarm 24 hours a day.

2. Water Storage: Adequate water storage capacity shall be provided for equalization, backwash operations, maintenance, and emergency purposes. Contractor shall supply and operate all required transfer pumps and piping necessary to transfer influent flow to and from the water storage.

3. Transfer Pumps and Piping: Transfer pumps and piping shall be provided as necessary to transfer influent flow to the WTS, flow through the WTS components, and flow to the effluent discharge location. All transfer pumps shall be plumbed and capable of pumping their rated capacity at the total dynamic head required for all system components and through the discharge location.

4. Particulate Filtration: Particulate filter units, along with initial supply of filter media and replacement as necessary, shall be provided to remove solids during water treatment. At a minimum, the particulate filters shall include:

   a. Removal of suspended solids prior to granulated activated carbon (GAC) vessels to achieve removal of 0,5-micron suspended solids or smaller.

   b. Removal of suspended solids after GAC vessels to achieve removal of 0,5-micron suspended solids or smaller.

   c. Supply piping and valves such that the filters may operate in a parallel or series configuration.

   d. Valves before and after each filter housing to allow for isolation and media change-outs/backwash while the WTS remains active.

   e. Pressure gauges before and after each filter housing.

5. GAC Vessels: GAC vessels shall be supplied, along with initial supply of virgin activated carbon, and replacement carbon as necessary, to achieve the specified discharge criteria. At a minimum, the GAC vessels shall include:

   a. Adequate empty bed contact time (EBCT) to meet permit requirements.

   b. Supply piping and valves such that the GAC vessels may operate in a parallel or series configuration.

   c. Valves before and after each GAC vessel to allow for vessel isolation and media change-outs while the WTS remains active.

   d. Pressure gauges before and after each GAC vessel.

B. Effluent Storage: At a minimum, two closed-top, frac tanks shall be provided for storage of treated effluent prior to discharge. Treated effluent may be used for backwash supply.

C. Flow Meters: Flow meters shall be provided to measure the continuous, instantaneous, and totalized flow of the WTS influent, WTS effluent, and backwash water flow.

D. Sample Ports: Sample ports shall be provided such that water quality samples can be collected before and after each WTS component.

E. Miscellaneous Components: All other miscellaneous components (e.g., valves, piping, controls, and gauges) shall be provided as necessary for a complete and operable system.

2.4 SPARE PARTS

A. Contractor shall furnish spare parts and accessories for equipment necessary to maintain continuous operation of the temporary WTS at no additional cost to Owner.

B. Spare parts for the WTS shall be maintained and stored either on Site or within a reasonable distance from the Site by Contractor. Sufficient spare parts shall be provided to ensure the continuous operation of the WTS with minimal downtime.

PART 3 EXECUTION

3.1 SECTION INCLUDES

A. Temporary Power

B. Mobilization, Training, and Startup

C. Water Treatment System Operation

D. Testing and Reporting

3.2 TEMPORARY POWER

A. Any power requirements shall be the responsibility of Contractor to provide by means of a temporary connection to available power (complete with ground-fault and over-current protections) or an electrical generator.

3.3 MOBILIZATION, TRAINING, AND STARTUP

A. Contractor shall start up, test, and commission all equipment, pumps, tanks, piping, valves, gauges, processes, instrumentation, controls, and monitoring systems to ensure that all process components are not leaking, are in good operating condition, are operating in compliance with the Specifications, and are operating as intended in Contractor's approved plans.

B. Contractor shall conduct a preparatory meeting, attended by key personnel from Contractor and Construction Manager, to discuss training and startup.

C. Contractor shall test the WTS with clean water to ensure that the system components are operating properly and that there are no leaks from any system components (e.g., pumps, piping, tanks, process vessels). All components of the WTS shall be tested. Water used

for this testing may be discharged directly to the Site. This testing shall be performed in the presence of Construction Manager. Contractor shall provide Construction Manager with a minimum written notice of 48 hours prior to the start of commissioning and testing.

D. During the commissioning period, Contractor shall provide training to its operating staff on the proper and safe operation and maintenance of equipment and controls.

E. Contractor shall be responsible for securing any water source and any other materials required to test and operate the WTS during commissioning. Water from the Site may be used for start-up testing following approval by Construction Manager.

F. Contractor shall verify proper operation of each unit operation. Contractor shall test and adjust equipment, controls, and/or operational procedures and correct any and all deficiencies, as necessary, to successfully complete the commissioning and testing requirements and allow full production.

G. Testing shall be performed under conditions that simulate normal operating conditions as closely as possible.

H. Contractor shall provide testing equipment and instrumentation necessary to perform startup and testing. Test equipment and instrumentation used during startup and testing shall be of sufficient quality and accuracy to test and measure system performance within the tolerances required to determine adequate performance. Instrumentation shall be calibrated on the manufacturer's recommended intervals with calibration tags permanently affixed to the instrument being used. Instrumentation shall be maintained in good repair and operational condition throughout the duration of use on the Project.

I. If WTS testing fails to achieve acceptance requirements, Contractor will be responsible for all additional costs needed to successfully achieve the acceptance requirements. Construction Manager may recommend solutions to deficiencies identified during startup and testing; however, the burden of responsibility to solve, correct, and retest deficiencies resides with Contractor.

J. Testing of the WTS shall be completed prior to initiating dredging operations.

3.4 WATER TREATMENT SYSTEM OPERATION

A. Contractor shall conduct all water treatment and discharge operations in accordance with all applicable permit requirements, including but not limited to, all sampling, testing, reporting, and notifications. Contractor shall be responsible for performing all permit-required testing and meeting all permit-required discharge limits.

B. Contractor shall maintain continuous and complete operation and effectiveness of the WTS at all times during Work.

C. All liquids that require treatment in the WTS shall be collected and transferred to the WTS. The method(s) by which water is collected and transferred shall be conducted in a manner that prohibits the spillage, leakage, or other release of water as collected.

D. Water shall be treated to meet the specified effluent limits prior to discharge.

E. Surfactants and/or chemicals shall not be discharged to the WTS, unless Contractor's WTS is designed to treat the surfactants/chemicals and the surfactants/chemicals have been approved for use by Construction Manager.

F. The discharge of water shall be diffused or controlled so that the discharge does not cause erosion or resuspension of soils/sediment. Discharge locations and control measures shall be subject to approval by Construction Manager.

G. The WTS shall be operated and maintained in accordance with the Specifications and Contractor's approved plans. Contractor shall collect and record data to demonstrate that the equipment is operating within the limits recommended by the equipment manufacturers and in accordance with Contractor's approved plans. Equipment, pumps, piping, and tanks shall be maintained in good condition at all times. Any and all leaks shall be immediately and properly repaired.

H. Filter media and adsorption media shall be backwashed and/or changed out as necessary to maintain effective operation of the WTS.

I. The WTS shall not be decommissioned or removed from service without pre-approval by Construction Manager. In the event systems, or portions thereof, are removed without prior approval from Construction Manager, all costs associated with remobilization and setup shall be borne solely by Contractor.

3.5 TESTING AND REPORTING

A. Contractor shall perform all monitoring and testing of the WTS in accordance with the permit requirements (e.g., monitoring parameters, frequencies, methods).

B. During the course of operating the WTS, Contractor shall collect and test water samples before and after each unit operation of the WTS as necessary in order to monitor the performance of the WTS unit processes and for troubleshooting purposes. Sampling shall be conducted by Contractor as part of startup and testing operations and during WTS operations to verify that the WTS is functioning in compliance with this Section and as intended in Contractor's approved submittals. The Contractor's Temporary Water Treatment System Plan shall identify the proposed monitoring frequency, parameters, and methods for this monitoring program.

C. Contractor shall submit all monitoring data to Construction Manager within 2 days of collection or sooner if requested by Construction Manager.

D. Samples collected by Contractor for chemical analysis shall be analyzed in accordance with all permit-required parameters and methods at an Owner-approved laboratory.

E. Contractor shall prepare and submit all permit-required reports associated with water treatment.

F. Contractor shall immediately notify Construction Manager if any monitoring data exceeds any specified effluent criteria. If any monitoring result exceeds the specified effluent criteria, Contractor shall perform an engineering evaluation and propose corrective action(s) in a written Corrective Action Report to be submitted to Construction Manager

within 24 hours of notification of the exceedance. At a minimum, the following actions shall be evaluated:

1. Additional testing to assess the problem.

2. Equipment/filter/activated carbon change-out.

3. Repairs to equipment.

4. Operational modifications (e.g., modifying additive dosages, modifying lead/lag operations, modifying the water collection approach, reducing flow rate).

5. Modification to or replacement of treatment equipment.

6. Temporary cessation of operations (if necessary).

END OF SECTION

SECTION 31 05 13 – SOILS AND AGGREGATES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Referenced Sections

B. Description

C. Testing and Materials Standards

D. Submittals

1.2 REFERENCED SECTIONS

A. Section 01 31 13 – Project Coordination

B. Section 01 33 00 – Submittal Procedures

C. Section 01 35 43 – Environmental Procedures

D. Section 01 53 00 – Temporary Construction

1.3 DESCRIPTION

A. This Section includes descriptions of all soils and aggregates necessary to complete the Work specified in the Drawings and Specifications.

B. Materials specified herein shall meet the requirements of the Work outlined in the Drawings and Specifications.

C. Contractor shall be responsible for sourcing the specified materials and transporting the materials to the placement areas in accordance with the Drawings and Specifications.

D. Contractor shall furnish all labor, materials, tools, supervision, and transportation necessary to perform material inspection, testing, and analysis to meet the requirements specified herein.

E. The final approval of the sources for all materials will be at the discretion of Construction Manager. Construction Manager will be responsible for the approval or rejection of the suitability of all soil and aggregate materials.

F. Imported materials must be free of chemical contamination, sampled, and tested by Contractor, and approved by Construction Manager prior to delivery to the Site. Any change in source during the Work requires approval of Construction Manager.

1.4 TESTING AND MATERIALS STANDARDS

A. Comply with applicable provisions and recommendations of the latest version of ASTM International standards.

1. Latest version of ASTM International standards:

a. ASTM C136 – Standard Test Methods for Particle Size Analysis of Nature and Man-Made Riprap materials

b. ASTM D422 – Standard Test Method for Particle-Size Analysis of Soils

c. ASTM D2487 – Standard Practice for Classification of Soils for Engineering Purposes

d. ASTM D2216 – Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

e. ASTM D75 – Standard Practice for Sampling Aggregates

B. Where reference is made to one of the above standards, the revision in effect at the time of the bid opening shall apply.

1.5 SUBMITTALS

A. Contractor shall propose independent analytical laboratories to perform required testing as described herein for approval by Construction Manager and Owner.

B. Contractor shall perform chemical and physical properties testing as specified herein, and shall submit results confirming that the proposed materials meet the specified requirements in accordance with Section 01 33 00 – Submittal Procedures. Pre-construction testing results for each proposed material source shall be submitted at least 4 weeks prior to delivering material to the Site. Subsequent testing results (after the material source has been approved) shall be submitted at least 2 weeks prior to delivering material to the Site. Use of materials by Contractor prior to testing and Construction Manager approval shall be at Contractor's risk and at no additional cost to Owner.

C. For each material specified in Part 2, Contractor shall submit the following prior to delivery of any materials to the Site:

1. The proposed material source or sources, including name, address, and contact information and the type(s) of material to be obtained from the source.

2. A certification letter from the material source owner and/or operator that the source is not an industrial site or suspected to have been modified by the addition of manufactured chemicals and that the material does not contain oil or hazardous material, as supported by test data to be provided with certification letter.

3. The results of pre-construction testing as specified in Part 3 herein for all materials proposed from each source.

4. A 5-pound sample (or Construction Manager-approved alternate) of each material type for inspection by Construction Manager.

D. Chemical characteristics of imported materials shall include non-detect for organic constituents and herbicides (excluding TOC) and below the MCP S1 and/or Background/Benchmark Screening concentrations for metals. Materials brought on-site by Contractor that do not meet these criteria will not be accepted and shall be legally disposed of off-site by Contractor at no cost to Owner. Any on-Site materials or Work adversely impacted by the presence of contaminated borrow materials shall be removed, replaced or repaired by Contractor at no cost to the Owner.

1. The testing suite shall consist of the following:

a. Volatile organic compounds (VOC) – U.S. EPA SW-846 Method 8260;

b. Semi-volatile organic compounds (SVOC) – U.S. EPA SW-846 Method 8270;

c. Pesticides and polychlorinated biphenyls (PCB) – U.S. EPA SW-846 Method 8082;

d. Herbicides – U.S. EPA SW-846 Method 8151

e. Dioxins – U.S. EPA-846 Method 8290

f. Massachusetts Contingency Plan (MCP) 14 metals – U.S. EPA-846 Method 6010/7471.

g. Total Organic Carbon (TOC) – U.S. EPA SW-846 Method 9060.

E. Contractor shall submit the anticipated schedule for delivery of all materials intended to be delivered to the Site.

F. Contractor shall document total amount and type of material imported to the Site. All import quantities shall be based on material weight slips. All weigh slips are to be compiled and transmitted to Construction Manager on a daily basis with the Daily Activity Report in accordance with Section 01 31 13 – Project Coordination.

PART 2 PRODUCTS

2.1 SECTION INCLUDES

A. Materials

2.2 MATERIALS

A. CAP TYPE A – SAND

1. Sand shall consist of clean, inert, hard, durable grains of quartz or other durable rock, free from loam, clay, ice, snow, roots, sod, rubbish, surface coatings, or other deleterious materials. It shall conform to the following gradation requirements:

SIEVE SIZE	PERCENT FINER BY WEIGHT
No. 8	100
No. 10	78
No. 20	16
No. 200	5

B. CAP TYPE B - GRAVEL

1. Gravel aggregate material shall consist of clean, inert, hard, durable grains of quartz or other durable rock, free from soft, thin, elongated or laminated particles, organic material, loam, clay, ice, snow, roots, sod, rubbish, surface coatings, or other deleterious materials. Graded Gravel shall meet the following grain size distribution:

SIEVE SIZE	PERCENT FINER BY WEIGHT
1 inch	100
3/8 inch	78
No. 4	16
No. 200	5

C. CAP TYPE C - XXXXXX

1. CAP TYPE C MATERIAL TO BE DETERMINED PRIOR TO BID.

D. PIPE OUTLET PROTECTION - XXXXXXX

1. PIPE OUTLET PROTECTION MATERIAL TO BE DETERMINED PRIOR TO BID

PART 3 EXECUTION

3.1 SECTION INCLUDES

A. Material Testing Requirements

B. Laboratory Testing Requirements

3.2 MATERIAL TESTING REQUIREMENTS

A. Chemical Testing

MATERIAL	VOC (8260)	SVOC (8270)	PESTICIDES/ PCB (8081/8082)	HERBICIDES (8151)	DIOXINS (8290)	METALS (6010/7471)	TOC (9060)
Cap Type A	X	X	X	X	X	X	X
Cap Type B	X	X	X	X	X	X	X
Cap Type C	X	X	X	X	X	X	X
Pipe Outlet Protection Material	-	-	-	-	-	-	-

B. Physical Testing

Material	Grain Size/Stone Size Analysis (D422/C136)	Material Classification (D2487)	Moisture Content (D2216)
Cap Type A	X	X	X
Cap Type B	X	X	X
Cap Type C	X	X	X
Pipe Outlet Protection Material	X	X	X

3.5 LABORATORY TESTING REQUIREMENTS

A. All material testing shall be performed by an independent and certified laboratory. Employ and pay for services of an independent laboratory authorized to operate in the Commonwealth of Massachusetts.

B. Re-testing or re-inspection required because of non-conformance to specified requirements shall be performed by same independent laboratory on instructions by Construction Manager. Payment for re-testing or re-inspection will be charged to Contractor by deducting testing charges from Contract Sum/Price.

C. Testing Agency/Laboratory Reports: After each test, promptly submit two copies of report to Construction Manager. When requested by Construction Manager, provide interpretation of test results, including the following:

1. Date issued.

2. Project title and number.

3. Name of inspector.

4. Date and time of sampling or inspection.

5. Identification of product and Specifications section.

6. Location in project.

7. Type of inspection or test.

8. Date of test.

9. Results of tests.

10. Conformance with Contract.

END OF SECTION

SECTION 35 00 00 – WATERWAY AND MARINE CONSTRUCTION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Referenced Sections

B. References

C. Description

D. Submittals

1.2 REFERENCED SECTIONS

A. Section 01 52 00 – Construction Facilities

1.3 REFERENCES

A. United States Coast Guard (USCG) Code of Federal Regulations (CFR), Title 33, Chapter 1, Parts 64 and 66 – Private Aids to Navigation (PATON)

B. American National Standards Institute (ANSI) 535.1 standard for Safety Colors

1.4 DESCRIPTION

A. Contractor shall maintain vessels and provide safety equipment per USCG regulations and to the satisfaction of Construction Manager.

B. Contractor shall comply with all PATON regulations and permit requirements in accordance with Section 01 41 00 – Regulatory Requirements regarding navigation, lighting, signage, and marine notifications to the satisfaction of Construction Manager.

1.5 SUBMITTALS

A. Contractor shall submit a Waterways Navigation Plan to Construction Manager in accordance with Section 01 33 00 – Submittal Procedures. At a minimum, this document shall include the following:

1. Qualifications of person(s) responsible for performing inspections of dredges and related equipment before they are entered into service to make sure they are in safe operating condition.

1. Means and methods proposed by Contractor to appropriately mark, light, or make all in-water equipment visible to commercial and recreational vessel traffic at all times of day and night. Contractor shall place all markings and/or lighting outside of the designated Federal Navigation Channel.

2. Means, methods, and proposed signage by Contractor to provide floating signs stating “Construction Ahead” and “No Wake Zone” to alert boaters. Contractor shall place all signage outside of the designated Federal Navigation Channel.

B. Prepare and submit an Anchoring Plan to the Construction Manager for review and approval. At a minimum, the Anchoring Plan shall include the following:

1. The locations, methods, procedures, and protocols that will be used to secure the Work-related vessels (including dredges, barges, and other Work vessels) during the Project, including during both active Work and non-Work periods.

2. A description of how the Contractor’s anchoring system will work when a temporary movement is required for navigation or other purposes.

3. The proposed locations and methods for securing, mooring, and anchoring Work-related vessels, including dredges, barges, and other vessels. Such locations shall provide sufficient water depth to accommodate Work-related vessels, provide safe distance and clearance from infrastructure, and provide and comply with all requirements provided herein.

4. The locations and procedures for securing all vessels during storm conditions and extreme wave conditions.

5. Procedures to avoid anchoring in previously capped areas.

PART 2 MATERIALS

NOT USED

PART 3 EXECUTION

3.1 SECTION INCLUDES

A. Vessel Requirements

B. Marine Equipment Operations

C. Navigation

D. Lighting and Signage

E. Anchoring

F. Local Notice to Mariners

3.2 VESSEL REQUIREMENTS

A. Contractor shall inspect, certify, license, and number all vessels and equipment according to applicable regulations of USCG and other jurisdictional entities before placing them in service.

B. Contractor shall plainly mark on all vessels the maximum occupancy and carrying capacity allowed onboard for safe passage (i.e., USCG maximum capacities). Contractor shall not exceed this maximum occupancy or carrying capacity.

C. Contractor shall make sure each vessel has enough room, freeboard, and stability to safely carry the maximum cargo and passengers under various weather and water conditions.

D. Contractor shall equip gasoline engines, except for outboard types, with a USCG-approved backfire flame arrestor. The arrestor must be attached to the air intake with a flame-tight connection, or per manufacturer specifications. It must be kept clean and in serviceable condition.

E. Contractor shall comply with USCG regulations for fire extinguishers.

F. Vessels with permanently installed gasoline engines must have powered ventilation systems to remove gasoline vapors from the vessel.

G. Contractor shall store fuel in approved containers suitable for marine use. Fuel lines must be equipped with a valve to cut off fuel flow. In addition, if the vessel will not be in use for 8 hours or longer, the valve must be closed.

H. Contractor shall equip vessels with approved personal flotation devices (PFDs) and approved throwable devices in accordance with applicable rules and regulations. A PFD shall be worn at all times when personnel are onboard a vessel or work platform or working within 10 feet of water where a drowning hazards exists.

I. All tow/tug boats used for propelling barges and other equipment shall be equipped with GPS navigational equipment, radar, corrected compass, at least two marine very high frequency (VHF) radios approved for Site use by Construction Manager, and depth sounding equipment, which is to be maintained in good operating condition during execution of the Work. The tow/tug boats utilized by Contractor for this purpose shall be of a size adequate for pushing the anticipated load and have necessary reserve power for maneuvering with material barges under emergency conditions as well as for control of material barges at the loading area.

J. Contractor shall equip all vessels and work platforms with adequate safety equipment to meet USCG requirements and any hazards that may be encountered during normal operations.

K. Contractor shall equip all vessels and work platforms with adequate safety equipment to meet USCG requirements and any hazards that may be encountered during normal operations.

L. Personnel shall not directly enter the water from waterfront structures, vessels, or any floating equipment unless he/she is a certified diver whose duties require such entrance and are approved by Construction Manager.

M. All vessels and barges shall be properly identified for both daytime and nighttime operations in accordance with USCG Navigation Rules.

N. Contractor shall operate all marine equipment so as to maintain a draft suitable to avoid running aground.

3.3 MARINE EQUIPMENT OPERATIONS

A. A qualified person must inspect dredges, cranes, support barges, or other support equipment before they are entered into service to ensure they are in safe operating condition. The qualified person must have a recognized degree, certificate, or license or professional standing, as well as extensive knowledge, training, and experience in solving problems related to the Work. Inspections must be documented and submitted to Construction Manager.

B. A qualified person must directly supervise any mobilization, demobilization, or relocation of dredges, support barges, or other support equipment.

3.4 NAVIGATION

A. Contractor shall obey all navigational regulations and conduct operations so as to interfere as little as possible with the use of channels, fairways, and passages. Contractor shall install and maintain any and all protection to navigation as may be required by a properly constituted authority of the waterway. During the course of the Work, do not dispose of any surplus or waste materials in navigable waters.

B. All vessels performing recreation, commercial, state, and federal activities, moving through the Work areas shall take precedence over Contractor's operations. Marine work shall be planned and conducted so as to minimize interference with those activities and operations. In the event Contractor's equipment obstructs the navigable waterway, Contractor shall immediately move the equipment to facilitate activities at no additional cost to Owner.

3.5 LIGHTING AND SIGNAGE

A. Vessels, barges, containment booms, and other equipment must be able to display navigation and marker lights required by USCG. Lights shall be displayed between sunset and sunrise and any other time visibility is reduced. Lighting shall comply with the Construction Manager-approved Waterways Navigation Plan and the Construction Manager-approved Construction Lighting Plan referenced in Section 01 52 00 – Construction Facilities.

B. Lights shall conform to the requirements specified in USCG requirements for visibility and color.

C. Signage and/or flags shall be installed to clearly identify Work areas, water vessels, barges, containment booms, silt curtains, and other equipment to provide proper warning to mariners.

3.6 ANCHORING

A. Remove visible sediment and vegetation from all anchors before leaving the location of anchoring.

B. No anchoring is permitted in areas where caps have been placed.

C. All anchoring systems for Work-related vessels must be kept in proper working order. All anchoring chains and winches shall be inspected prior to deployment each day to ensure proper working order. Repairs and preventive maintenance to equipment shall be made in a timely manner to minimize downtime and loss of production. Repairs shall also be made to ensure the safety of the operation, as well as continue the efficiency of all operating equipment. Inspections of equipment shall be allowed at any time.

D. Anchor vessels and equipment in a safe and secure manner during storm conditions and extreme wave conditions.

3.7 LOCAL NOTICE TO MARINERS

A. Contactor shall submit a Local Notice to Mariners form to the USCG at least 3 weeks prior to the start of in-water Work or installation of temporary in-water structures that may pose hazards to navigation or to the public.

END OF SECTION

SECTION 35 05 05 – SELECTIVE DEMOLITION FOR WATERWAY AND MARINE CONSTRUCTION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Referenced Sections

B. Summary

C. Submittals

D. Regulatory Requirements

E. Qualifications

F. Project Conditions

1.2 REFERENCED SECTIONS

A. Section 01 14 00 – Work Restrictions

B. Section 01 33 00 – Submittal Procedures

C. Section 01 41 00 – Regulatory Requirements

D. Section 02 21 00 – Surveys

E. Section 02 61 00 – Removal and Disposal

1.3 SUMMARY

A. Contractor shall provide all supervision, labor, tools, materials, equipment, services, and appurtenances necessary for, or incidental to perform all demolition activities necessary to remove the five abandoned barges as described in the Specifications and as shown on the Drawings.

B. Contractor shall provide all supervision, labor, tools, materials, equipment, services, and appurtenances necessary to handle, segregate, and manage demolition materials generated from the demolition and removal of the five abandoned barges in accordance with the Specifications and permits.

1.4 SUBMITTALS

A. Contractor shall prepare and submit a Demolition Work Plan in accordance with Section 01 33 00 – Submittal Procedures, for review and approval. The Demolition Work Plan must be approved by Construction Manager prior to commencing demolition activities. At a minimum, the Demolition Work Plan shall include the following:

1. Contractor's (and any subcontractors') business name, address, telephone number, on-site demolition representatives, and emergency contact phone numbers. If subcontractors are employed, describe the roles of each subcontractor.

2. Details for the demolition equipment to be utilized to perform the demolition and related Work, including manufacturer, number, type, and size of the direct removal equipment, barges, tow/tug boats, material transport equipment, containers, and other support equipment. If multiple vehicles, vessels, or pieces of equipment (e.g., dredges, cranes, excavators, barges, scows, or other) will be used for demolition activities, the Demolition Work Plan shall include the anticipated activity that each piece of equipment will perform.

3. A description of the startup operations that will be implemented by Contractor to verify proper operation of the equipment, processes, controls, and procedures used for demolition, material transport, and unloading.

4. A description of how Work will be performed to meet the project schedule requirements. Describe the sequence in which the Work will be performed. Note that Construction Manager reserves the right to alter the sequence of Contractor's Work as necessary to maintain compliance with Project requirements, enable access to the Contract Work Area by others, or as otherwise deemed necessary. Include a breakout of the specific abandoned barge removal order and aliquoted time to remove each barge. Identify assumptions made for effective/non-effective time and lost demolition time associated with high wave/storm conditions and other weather-related delays.

5. Description, dimensions, capacity, and drawings or photographs of the primary equipment, to be used for barge demolition.

6. Proposed approach and location(s) for deployment and inspection of equipment and personnel, including mobilization of primary and other ancillary equipment to the Site and daily deployment of personnel in accordance with Section 01 14 00 – Work Restrictions.

7. Proposed location for a processing area including a layout plan and delineation of the Work Areas to be used by Contractor including areas for staging, decontamination, and transportation.

8. Detailed drawings and descriptions of the approach to completing the Work in accordance with Section 01 14 00 – Work Restrictions.

9. Proposed plan for pre-demolition survey and investigation to identify potential obstructions and hazards within the barges that may require specialized training and/or management (i.e., asbestos containing material, wildlife).

1.5 REGULATORY REQUIREMENTS

A. Contractor shall comply with all local, state, and federal codes, ordinance, laws, and regulations for demolition of structures, safety and protection of adjacent structures, dust control, noise control, vibration control, vermin control, soil erosion and sedimentation control, and waste disposal.

B. Contractor shall comply with Work restrictions as outlined in the permits provided in Section 01 41 00 – Regulatory Requirements and as specified in Section 01 14 00 – Work Restrictions.

C. Contractor shall comply with all local, state, and federal permits obtained by or applied for by Owner. Contractor shall also comply with all permits obtained directly by Contractor as required during the course of construction and as necessary to complete the Work.

1.6 QUALIFICATIONS

A. Contractor shall demonstrate that the Contractor's key personnel or subcontractor has completed similar work of similar scope and complexity and has competently managed and supervised the manpower, materials, equipment and tools necessary to complete the Work.

B. On-site supervisors shall have a minimum of four years of experience in supervising demolition work of similar scope and difficulty to those shown in the Drawings. The work experience shall be direct supervisory responsibility for the on-site demolition work.

1.7 PROJECT CONDITIONS

A. Data and information from previously conducted investigations are available for reference as described in Section 00 31 00 – Available Project Information.

B. The results of prior surveys and investigations are indicative of general conditions at their respective locations considering the equipment employed. Variations are to be expected. The data and results of prior surveys and investigations reflect available information at the time of data collection, are approximate, and may have changed since the time of data collection. Although the results of such investigations are considered generally representative of conditions at their respective locations at the time of the investigation, local variations in the materials are to be expected and, if encountered, shall not be considered materially different within the purview of the Contract.

C. Contractor shall conform to applicable laws and regulations when hazardous or potentially hazardous materials or contaminated substances not previously identified are encountered. Contractor is directed not to disturb or attempt to remove any discovered hazardous or potentially hazardous materials or contaminated substances without first notifying Construction Manager. Immediately notify Construction Manager upon the discovery of such conditions.

D. Contractor shall be solely responsible for evaluating existing facilities and Site conditions and considering all factors that may affect the progress or performance of the Work.

E. Asbestos containing materials (ACM) may be present within the debris at the Site. Should Contractor observe suspect ACM, Construction Manager shall be notified immediately. Contractor shall coordinate sampling and testing of the suspect ACM and provide results to Construction Manager.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 SECTION INCLUDES

A. General Execution of The Work

3.2 GENERAL EXECUTION OF THE WORK

A. Prior to the start of demolition, Contractor shall perform a pre-demoliton survey in accordance with Section 02 21 000 – Surveys.

B. Contractor shall conduct all demolition operations in accordance with the permits. Contractor shall install marine resuspension control systems, as specified in the Drawings and Section 01 57 30 – Marine Resuspension Controls. Resuspension controls shall be installed per manufacturer's specifications and in accordance with Contractor's Resuspension Control Plan prior to the start of demolition Work.

C. Contractor shall complete all demolition Work described herein in accordance with the approved Demolition Work Plan and per Section 01 14 00 – Work Restrictions. Significant changes to operating procedures, equipment, or changes to the duration of Work, must be reviewed and approved by Construction Manager.

D. Work shall be conducted in such a manner as to keep it confined within the Limits of Work as shown on the Drawings.

E. Equipment operators shall have the required experience and training to execute precise and non-abrupt maneuvers for the various activities to be performed.

F. During demolition operations, implement measures to address and control sheens (if any) on the water surface in accordance with Section 01 35 43 – Environmental Procedures.

G. Contractor shall furnish, set, and maintain ranges, buoys, and markers needed to define the Work and to facilitate inspection per Section 35 00 00 – Waterway and Marine Construction.

H. Contractor shall perform the Work in a manner to prevent damage and maintain the stability of structures and shoreline features adjacent to the Work. Contractor shall repair damage resulting from demolition operations or other Contractor Work activities. Repairs shall, at a minimum, match pre-Work conditions. Repairs will be subject to review and approval by Construction Manager. Owner shall bear no costs associated with damage to such structures.

I. Contractor shall repair any damages caused by non-compliance with the Work in the Drawings and Specifications at no additional cost to Owner.

J. Contractor shall not be permitted to drop demolition material from elevated areas into the water.

K. Contractor shall conduct the Work while minimizing interference with navigation. Work shall be conducted in accordance with Section 35 00 00 – Waterway and Marine Construction.

L. Conduct equipment decontamination in accordance with Section 02 51 00 – Equipment Decontamination.

M. Contractor shall segregate demolition debris including, but not limited to, painted and unpainted timber, granite block, steel, concrete, brick, asphalt, and general demolition debris to the extent practicable. Demolition debris shall be segregated according to materials and disposed of in accordance with Section 02 61 00 – Removal and Disposal.

END OF SECTION

SECTION 35 20 23 – DREDGING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Referenced Sections

B. Description

C. Submittals

D. Permits

E. Job Site and Subsurface Conditions

1.2 REFERENCED SECTIONS

A. Section 00 31 00 – Available Project Information

B. Section 01 14 00 – Work Restrictions

C. Section 01 18 00 – Project Utility Sources

D. Section 01 20 00 – Price and Payment Procedures

E. Section 01 31 13 – Project Coordination

F. Section 01 33 00 – Submittal Procedures

G. Section 01 35 43 – Environmental Procedures

H. Section 01 41 00 – Regulatory Requirements

I. Section 01 52 00 – Construction Facilities

J. Section 02 21 00 – Surveys

K. Section 02 51 00 – Equipment Decontamination

L. Section 02 61 00 – Removal and Disposal

M. Section 02 72 00 – Water Decontamination

N. Section 35 00 00 – Waterway and Marine Construction

O. Section 35 20 30 – Dredged Material Management and Processing

1.3 DESCRIPTION

A. Contractor shall provide all supervision, labor, tools, materials, equipment, services, and appurtenances necessary for, or incidental to, the dredging of sediment and related Work. The dredging shall be conducted as described in the Specifications, as shown on the Drawings, and based on the electronic Dredge Prism Files.

B. Contractor's base bid shall be based on mechanical dredging described herein. Contractor may provide an alternate approach to removing this material as an alternate bid proposal.

C. Contractor shall provide all supervision, labor, tools, materials, equipment, services, and appurtenances necessary to remove sediment to the required dredge cut and place the dredged material into water-tight dredged material transport scows, transfer the scows from the dredge area to the Sediment Unloading/Processing Area, and offload dredged material from the dredged material transport scows at the Sediment Unloading/Processing Area.

1.4 SUBMITTALS

A. Pre-construction

1. Contractor shall prepare and submit a Dredge Work Plan in accordance with Section 01 33 00 – Submittal Procedures, for review and approval. The Dredge Work Plan must be approved by Construction Manager prior to commencing dredging activities. At a minimum, the Dredge Work Plan shall include the following:

   a. Contractor's (and any subcontractors') business name, address, telephone number, on-site dredging representatives, and emergency contact phone numbers. If subcontractors are employed, describe the roles of each subcontractor.

   b. Details for the dredging equipment to be utilized to perform the dredging and related Work, including manufacturer, number, type, and size of the dredge(s), barges, tow/tug boats, dredged material transport scows, support vessels, containers, and other support equipment. If multiple vessels or pieces of equipment (e.g., dredges, barges, scows, or other) will be used for dredge activities, the Dredge Work Plan shall include the anticipated area and volume of sediment that each dredge plant will remove.

   c. A description of the startup operations that will be implemented by Contractor to verify proper operation of the equipment, processes, controls, and procedures used for dredging, dredged material transport, and unloading.

   d. A description of how Work will be performed to meet the project schedule requirements. Describe the sequence in which the Work will be performed. Note that Construction Manager reserves the right to alter the sequence of Contractor's Work as necessary to maintain compliance with Project requirements, enable access to the Contract Work Area by others, or as otherwise deemed necessary. Include a breakout of the specific area and volume of sediment planned for dredging each week. Include the estimated average hourly in situ sediment removal rate (in cubic yards per

hour) for each dredge. Identify assumptions made for effective/non-effective time and lost dredging time associated with high wave/storm conditions and other weather-related delays.

e. Description, dimensions, capacity, and drawings or photographs of the dredge buckets, or equivalent equipment, to be used for dredging. Include a description of the dredge bucket real-time kinematic (RTK) differential global positioning system (DGPS) and dredge cut visualization software to be utilized for removal, including manufacturer, make, and model. Describe measures to be used to minimize the entrainment of excess water and minimize resuspension during dredging.

f. Proposed approach and location(s) for deployment and inspection of equipment and personnel, including mobilization of dredges, barges, scows, and other ancillary equipment to the Site and daily deployment of personnel and vessels to verify soundness, water tightness, and fit for duty in accordance with Section 01 14 00 – Work Restrictions.

g. Delineation of the Work Areas to be used by Contractor, including the areas for marine equipment access, barge and scow docking, anchoring, and dredged material transport and unloading.

h. Detailed drawings and descriptions of the approach to completing the Work in accordance with Section 01 14 00 – Work Restrictions.

i. Proposed plan for debris survey with divers or other means to identify potential obstructions, to estimate the volume of debris to be removed prior to dredging, to confirm limits of removal, and to remove obstructions prior to dredging.

j. Proposed methods for avoiding or protecting utilities identified during utility locating procedures as specified in Section 01 18 00 – Project Utility Sources and Section 02 21 00 – Surveys.

k. Proposed procedure for dredging within the specified dredge tolerances and overdredge allowance. Describe methods for minimizing the extent of over-dredging while achieving the required dredge cut. Describe methods to provide quality control during dredging with a description of location control equipment.

l. Proposed plan including means and methods for dredging near existing structures to prevent movement, settlement, or collapse including means and methods for vibration monitoring and assessing movement.

m. Proposed methods, procedures, and equipment for debris removal prior to and during dredging, including the segmentation and transport of debris that may be encountered during dredging.

n. Proposed plan for transporting dredged material to Sediment Unloading/Processing Area. Include a description and the number, type, and sizes of barges, scows, and other vessels for dredged material

transport, including debris. Provide ullage tables (i.e., displacement table) for each sediment transport scow.

B. During Construction

1. Daily Activity Reports shall be completed each Work day by Contractor per Section 01 33 00 – Submittal Procedures and Section 01 31 13 – Project Coordination. At a minimum, the Daily Activity Report shall include the following information related to dredging activities:

   a. Description of general Work activities.

   b. Location of dredging operations, hours of dredge time, total area dredged, actual daily production rate, and name of dredge operator(s).

   c. Equipment performance, maintenance, hours of downtime, and cause(s) of downtime.

   d. Daily and cumulative area and volume of sediment dredged for the project.

   e. Daily and cumulative estimated volume and weight, and description of debris removed from the dredge area.

   f. A dredged material transport scow log that contains the following information: the scow number/name; cumulative project scow trip number; pre-load inspection of scow; pre-load draft (all four corners); dredge area where scow was loaded; dredge number/name loading scow; type of material loaded in the scow (i.e., sediment, debris); loaded draft (all four corners); freeboard; and unloaded draft (all four corners).

   g. Daily visual presentation of dredging progress that depicts the sediment thickness removed (an Isopach) compared to the pre-dredge survey. Contractor daily survey reports shall include:

      i. A color-coded Isopach figure depicting the thickness of sediment removed and the area of dredging and calculations of the daily dredging volume calculated to the nearest cubic yard.

      ii. Description and details of the daily quality control checks of all dredging equipment and positioning system sensors.

      iii. Delays encountered and relevant details of the delay, such as the cause, resolution, and measures implemented to avoid similar delays in the future and to make up lost time if necessary.

2. Submit updates to the Dredge Work Plan as requested by Construction Manager, as necessary, to account for different methods, procedures, or conditions as compared to those presented in the approved Dredge Work Plan.

3. Surveys

a. Provide pre-dredging debris survey results.

b. Provide interim surveys to document dredge progress per Section 02 21 00 – Surveys.

c. Provide final post-dredge survey for approval per Section 02 21 00 – Surveys before placing cap material on the post-dredge surface.

1.5 PERMITS

A. Contractor shall comply with all local, state, and federal permits obtained by or applied for by Owner outlined in Section 01 41 00 – Regulatory Requirements. Contractor shall also comply with all permits obtained directly by Contractor as required during the course of construction and as necessary to complete the Work.

B. Contractor shall comply with Work restrictions as outlined in the permits provided in Section 01 41 00 – Regulatory Requirements and as specified in Section 01 14 00 – Work Restrictions.

1.7 JOB SITE AND SUBSURFACE CONDITIONS

A. Data and information from previously conducted investigations are available for reference as described in Section 00 31 00 – Available Project Information.

B. The results of prior surveys and investigations are indicative of general conditions at their respective locations considering the sampling and survey equipment employed. Variations in the properties of the materials are to be expected. Information regarding the physical and chemical properties of materials to be removed or otherwise associated with the Work is provided in the supplemental reference information identified in Section 00 31 00 – Available Project Information. The information is based on field investigation and laboratory testing of the materials. The data and results of prior surveys and investigations reflect available information at the time of data collection, are approximate, and may have changed since the time of data collection. Although the results of such investigations are considered generally representative of conditions at their respective locations at the time of the investigation, local variations in the materials are to be expected and, if encountered, shall not be considered materially different within the purview of the Contract.

C. Contractor shall coordinate a utility-locate service and coordinate utility identification and location with Construction Manager to check all dredge areas in accordance with Section 01 18 00 – Project Utility Sources.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 SECTION INCLUDES

A. General Execution of the Work

B. Debris Survey and Removal

C. Quality of Materials and Equipment

D. Environmental Protection Requirements

E. Final Examination and Acceptance

3.2 GENERAL EXECUTION OF THE WORK

A. Contractor shall conduct all dredging operations in accordance with the water quality regulations specified in the permits. Contractor shall install marine resuspension control systems, as specified in the Drawings and Section 01 57 30 – Marine Resuspension Controls. Resuspension controls shall be installed per manufacturer's specifications and in accordance with Contractor's Resuspension Control Plan prior to the start of marine Work, including debris removal.

B. Contractor shall complete all dredging Work described herein in accordance with the approved Dredge Work Plan and per Section 01 14 00 – Work Restrictions. Significant changes to operating procedures or equipment, such as proposed dredge production rates or changes to the duration of Work, must be reviewed and approved by Construction Manager.

C. Equipment operators shall have the required experience and training to execute precise and non-abrupt maneuvers for the various activities to be performed.

D. During dredging operations, implement measures to address and control sheens (if any) on the water surface in accordance with Section 01 35 43 – Environmental Procedures.

E. Contractor's dredge shall be equipped with a bucket closing device to minimize the re-suspension of sediments. The closing device shall be inspected daily for functionality and tightness.

F. Conduct dredging to the required dredge cut. Verification of completion of dredging shall be by surveys as described in Section 02 21 00 – Surveys.

G. Contractor shall place mechanically dredged material into water-tight dredged material transport scows and transport the scows to the Construction Manager approve Sediment Unloading/Processing Area. The bucket shall be positioned directly above the barge, as near as possible to the bottom of the barge, before opening and emptying the bucket. Contractor shall unload the dredged material from the scows in accordance with Section 35 20 30 – Dredged Material Management and Processing.

H. Contractor shall visually inspect the dredge bucket after dredged material has been placed into the dredged material transport scows before re-submerging to validate that the bucket is empty. If sediment or debris is adhered to the bucket, the dredge bucket shall be washed or otherwise cleaned to remove the sediment/debris.

I. The overdredge allowance within the dredge area is 6 inches below the required dredge cut presented in the Dredge Prism XYZ File. Contractor shall minimize overdredge to the maximum extent possible. No payment shall be made for the removal, management, transportation, or disposal of material beyond the lateral limits of dredging or beyond the vertical overdredge allowance, unless approved or directed in writing by Construction Manager.

J. Contractor shall be responsible for constructing stable internal and external side slopes and, at a maximum, meet all internal and external side slope grades per the Drawings.

K. Contractor shall conduct interval dredging adjacent to upland structures as shown on the Drawings. Contractor shall determine the slot width and approach so as to not destabilize these areas. Contractor shall be responsible for any damage done to structures and shall repair or replace to existing conditions, subject to Construction Manager approval, at no additional cost to Owner.

L. Contractor shall verify, via hydrographic surveys per Section 02 21 00 – Surveys, that the extent of dredging activities is in accordance with the limits shown on the Drawings and the Dredge Prism XYZ File. Surveys must be reviewed and approved by Construction Manager before Work will be considered complete. Construction Manager will determine if the required dredge cuts have been met. If high spots remain above the required dredge cut lines, Contractor shall remove such high spots at no additional cost to Owner and confirm final required dredge cut lines are achieved within dredging tolerances using subsequent survey activities per Section 02 21 00 – Surveys.

M. Contractor shall establish in-water access at a location outside of the project limits for personnel or equipment loading and offloading, the location(s) shall be identified in the Contractor's Dredge Work Plan and be subject to review and approval by Construction Manager. Contractor shall secure all permits and approvals (including any associated fees) to access those location(s) and obtain approval by Construction Manager.

N. Contractor's dredging shall minimize disturbance of sediment to reduce, to the extent practical, sediment resuspension or mudwaving that would create movement of contaminated sediment outside the dredge area or exceed water quality requirements specified in the permits. Contractor shall implement operational controls and best management practices (BMPs) to minimize sediment resuspension and maintain compliance with the water quality requirements. Dredging best management practices (BMPs) shall include the following:

1. Dredge at an appropriate rate and steadiness to minimize the movement of contaminated sediment outside the dredge area, which is subject to further modification by Construction Manager if deemed excessively rapid for avoiding spillage or other losses, emissions, or discharges.

2. Contractor shall not stockpile dredged material outside of the sediment transport scows or the sediment processing area (SPA). No dredged material stockpiling in the water is permitted.

3. Contractor shall not use the excavator bucket to smooth the bottom surface; areas not meeting the required dredge cut line shall be re-dredged at no additional cost to Owner.

4. Contractor shall place dredged material in sediment transport scow after each dredge attempt regardless of volume of dredged material in the dredge bucket; multiple attempts to re-fill the excavator bucket is not permitted.

5. The dredge bucket shall be equipped with a lid that is used to close the bucket before the bucket is brought to the surface.

6. Contractor shall conduct vessel operations in a manner to minimize potential resuspension due to vessel propeller wash.

O. Construction Manager may direct Contractor to perform excess dredging beyond the dredge area limits as shown on the Drawings, or deeper than the required dredge cut plus overdredge allowance, to remove additional material based on observations in the field. Measurement of excess dredging directed by Construction Manager shall be in accordance with Section 01 20 00 – Price and Payment Procedures.

P. Post-dredge elevations shall be surveyed and compared to pre-dredge survey data and the Dredge Prism XYZ File as outlined in Section 02 21 00 – Surveys. Contractor may choose to conduct their own measurements for the purposes of estimating quantities of sediments removed daily and verifying dredge cut lines; however, Contractor shall conduct all surveying for decisions regarding completion of dredging and payment per Section 02 21 00 – Surveys.

Q. Contractor shall furnish, set, and maintain ranges, buoys, and markers needed to define the Work and to facilitate inspection per Section 35 00 00 – Waterway and Marine Construction.

R. Contractor shall perform the Work in a manner to prevent damage and maintain the stability of structures adjacent to the Work, insofar as structures may be jeopardized by dredging or associated Contractor operations. Contractor shall repair damage resulting from dredging operations or other Contractor Work activities. Repairs shall, at a minimum, match pre-Work conditions. Repairs will be subject to review and approval by Construction Manager. Owner shall bear no costs associated with damage to such structures.

S. Contractor shall repair any damages caused by non-compliance with the Work in the Drawings and Specifications at no additional cost to Owner.

T. Loading Dredged Material Transport Scows

1. Contractor shall load dredged materials on material scows evenly, using methods that do not create an unsafe situation or a situation causing spillage or submergence (tipping) of the scow.

2. The scows used for dredged material transport shall be water tight. Any water pumped from the dredged material transport scows shall be treated and discharged in accordance with applicable permits.

3. Contractor shall remove all visible sediment and debris from the outside surface of the dredged material transport scows prior to moving it from the dredging location.

4. Limit the loading of dredged sediments to no more than 90% capacity of the barges/scows to prevent them from overflowing.

5. Overflow of sediment or water from dredged material transport scows is prohibited.

U. Contractor shall conduct the Work while minimizing interference with navigation. Work shall be conducted in accordance with Section 35 00 00 – Waterway and Marine Construction.

V. Conduct equipment decontamination in accordance with Section 02 51 00 – Equipment Decontamination.

W. After Construction Manager determines that the required dredge cuts have been achieved within the specified tolerances, Contractor shall place cap material in accordance with Section 35 20 50 – Capping.

3.3 DEBRIS SURVEY AND REMOVAL

A. Prior to the start of dredging, Contractor shall perform a debris survey in accordance with Section 02 21 000 – Surveys. Contractor shall use the debris survey findings to evaluate the locations, types, and sizes of debris and other obstructions and determine whether pre-dredging removal is needed to facilitate the dredging operation.

B. Contractor shall install marine resuspension controls per Section 01 57 30 – Marine Resuspension Controls prior to initiating debris removal activities.

C. Contractor methods for removing debris and obstructions, once identified, shall be approved by Construction Manager prior to commencing removal.

D. Visual shoreline observations, geophysical surveys, and observations/photographs of existing features, were conducted to assist Contractor in evaluating the potential nature and extent of debris and structural condition of infrastructure within and adjacent to the Dredge Area. This information should be used for informational purposes only. Contractor shall verify the surveys and observations conducted and satisfy himself regarding infrastructure structural conditions and the nature and extent of materials present at the Site.

E. Contractor shall remove all debris that will interfere with dredging operations, including full penetration or retrieval of the dredge bucket. Contractor shall remove debris and obstructions as necessary to facilitate dredging to the required dredge cuts. Debris removal may be conducted prior to dredging or as part of dredging. It is expected that large debris (if present) will require removal prior to dredging. If debris cannot be removed using the dredge bucket, Contractor shall be prepared to use and implement alternate procedures and/or equipment (e.g., grapplers) to remove debris as necessary to facilitate dredging to the required dredge cuts.

F. Removal of debris or obstructions shall not occur outside established Work Areas unless approved in writing by Construction Manager.

G. Contractor shall remove debris from the seabed in a slow and steady manner to minimize resuspension of sediments.

H. Debris may be transported to the Sediment Unloading/Processing Area in the same scow as dredged sediment, but must be segregated within the hold of the scow to allow for unloading separately.

3.4 QUALITY OF MATERIALS AND EQUIPMENT

A. The specifics of Contractor's dredging approach and methodology shall be included in the Dredge Work Plan. Contractor's dredging operations must conform to the requirements specified herein and in Section 01 35 43 – Environmental Procedures. Dredge equipment shall be selected, and methods of removal shall be implemented, in compliance with permits and such that dispersion of re-suspended sediments, losses from spillage, vapor/odor emissions, and entrainment of surface water in dredged material are minimized.

B. Contractor shall use mechanical dredging equipment with an enclosed clamshell bucket system as approved by Construction Manager. Dredge buckets must include monitoring capabilities to inform the dredge operator if the bucket is not completely closed. The dredge bucket shall be designed to maintain enclosure of sediments to minimize, to the maximum extent practical, the generation of suspended sediments during bucket lowering, closing, and raising in the water column.

C. Dredge buckets shall be adequately maintained during all dredging operations to minimize potential lost production or downtime. This includes, but is not limited to, maintaining all bucket seals, vents, flaps, valves, and other design features at the original condition if present, maintaining bucket lips such that they remain in alignment, maintaining the integrity of the bucket such that no cracks or holes exist, and maintaining the closing mechanism such that enough closing force is exerted to hold a full bucket of dredged sediment. Dredge buckets shall be inspected at least once per shift, and any deficiencies in bucket condition shall be noted on the Daily Activity Report.

D. Contractor shall operate all marine equipment so as to maintain a draft suitable to avoid running aground.

E. Contractor shall maintain floating platforms, material scows, and associated equipment to meet the requirements of the Work and all applicable marine regulations, including the prompt repair of equipment failures.

F. Dredge shall be equipped with RTK-DGPS and the necessary sensors to enable accurate positioning of the dredge bucket and for Contractor to continuously monitor and track the location of the dredge bucket in accordance with Section 02 21 00 – Surveys.

G. All tow/tug boats used for propelling scows and other equipment shall be equipped with GPS navigational equipment, radar, corrected compass, at least two marine very high frequency (VHF) radios approved for Site use by Construction Manager, and depth-sounding equipment, which is to be maintained in good operating condition during execution of the Work. The tow/tug boats utilized by Contractor for this purpose shall be of a size adequate for pushing the anticipated load and have necessary reserve power for maneuvering with material scows under emergency conditions as well as for control of material scows at the approved Sediment Unloading/Processing Area.

H. Equipment shall be maintained in good working order at all times.

I. Sediment Transport Scows

1. Contractor shall provide water-tight dredged material transport scows that are adequately sized based on the selected loading and unloading equipment. Scows shall be in a condition approved by Construction Manager and shall be free of leaks and other damage.

2. Sediment transport scows shall be inspected at least daily for signs of damage or leaks, and any deficiencies shall be repaired prior to use.

3. Contractor shall place dredged material into dredged material transport scows in a manner that prevents overfilling or destabilizing the scow. No dredged material and associated dredged water shall be allowed to re-enter the water once it is placed in the scow. Contractor shall remove any dredged material that spills once it is placed in the scow at no additional cost to Owner.

4. Contractor shall provide and maintain markings on all dredged material transport scows clearly indicating the draft of the scow. Each scow shall be used with an ullage table to provide required information regarding tonnage of material in the scow. Contractor shall load the scows evenly to maintain the stability of the scow. During sediment removal/loading operations, Contractor shall measure and record in the Daily Activity Report the tonnage of each dredged material on each scow using an ullage table. The tonnage reporting (displacement) shall be documented and recorded upon the departure of the scow from the dredge area and after the removal of dredged material from the transport scow following arrival at the Sediment Unloading/Processing Area.

5. Contractor shall provide and maintain sufficient lighting, as necessary, to permit the reading of the draft on the sides of sediment transport scows at the bow and stern from the tow boat when visibility is impaired and at night. Contractor shall ensure that adequate time is allowed by the tow boat captain for these readings to be obtained.

J. Contractor shall provide lights for floating equipment, dredges, and sediment transport scows during periods of restricted visibility in accordance with Section 01 52 00 – Construction Facilities and Section 35 00 00 – Waterway and Marine Construction.

3.5 ENVIRONMENTAL PROTECTION REQUIREMENTS

A. For all dredging, Contractor shall provide, maintain, and deploy re-suspension control systems in accordance with Section 01 57 30 – Marine Resuspension Controls, and spill control and containment kits and other oil sorbent materials as required in Section 01 35 43 – Environmental Procedures.

B. Contractor shall clean and decontaminate any and all equipment that has become exposed to contaminated materials or oily fluids prior to using this equipment for cap placement or to conduct any other construction activities in accordance with Section 02 51 00 – Equipment Decontamination. Cleaning shall be conducted in a designated location approved by Construction Manager and all decontamination water shall be collected and

treated per Section 02 72 00 – Water Decontamination or disposed of in accordance with Section 02 61 00 – Removal and Disposal.

3.6 FINAL EXAMINATION AND ACCEPTANCE

A. Upon examination and acceptance of the final survey by Construction Manager, the dredging Work will be accepted as complete. Final payment shall be subject to deductions or correction from Work that is non-compliant or otherwise completed or additions for approved extra work in an unauthorized manner.

END OF SECTION

SECTION 35 20 30 – DREDGED MATERIAL MANAGEMENT AND PROCESSING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Referenced Sections

B. Description

C. Submittals

1.2 REFERENCED SECTIONS

A. Section 01 33 00 – Submittal Procedures

B. Section 01 35 43 – Environmental Procedures

C. Section 02 61 00 – Removal and Disposal

D. Section 02 72 00 – Water Decontamination

1.3 DESCRIPTION

A. Contractor shall furnish all supervision, labor, materials, tools, equipment, services, accessories, and appurtenances necessary for, or incidental to, the management of dredged materials and water and related Work. This includes, but is not limited to processing and unloading sediment, debris, and water from dredged material transport scows; transporting and placing the dredged material into Construction Manager-approved Sediment Unloading/Processing Area; segregating and handling materials to be disposed of at respective disposal facilities; and containing and collecting water generated for treatment in accordance with Section 02 72 00 – Water Decontamination.

B. Contractor shall be responsible for the selection, design, furnishing, construction, installation, commissioning, testing, operation, and maintenance of all equipment, materials, containment and staging areas, access ways, and other supporting features necessary to complete the Work specified herein.

C. Contractor shall select the means and methods to unload, handle, process, transport, and place the dredged material into appropriate containers for disposal.

1.4 SUBMITTALS

A. Pre-construction

1. Contractor shall prepare and submit a Dredged Material Management and Processing Plan to Construction Manager for review and approval in accordance with Section 01 33 00 – Submittal Procedures. The Dredged Material Management and Processing Plan must be approved prior to initiation of any Work that requires

materials to be processed. At a minimum, the Dredged Material Management and Processing Plan shall include the following:

a. Proposed location for the Sediment Unloading/Processing Area.

b. A written description of the major elements of Work involved and the operation and maintenance procedures at the Sediment Unloading/Processing Area with emphasis on sediment and debris unloading/conveyance, water management, and environmental controls and protection measures.

c. A detailed description of the means and methods, including all equipment and personnel, for dredged material unloading, processing, conveyance, and preparation for disposal.

d. Details regarding the types, sizes, and quantities of equipment Contractor proposes to utilize for dredged material unloading, processing, conveyance, and preparation for disposal. Include detailed specifications on the proposed equipment (e.g., unloading equipment, buckets, grapplers, screens).

e. A flow chart depicting the processing steps and illustrating the various process streams, including all inputs and outputs and an overall material balance.

f. Drawings showing the locations, sizing, arrangement, and layout of each component of the Sediment Unloading/Processing Area.

g. Details related to Contractor's proposed dewatering means and methods. Contractor shall describe the use of any and all proposed sediment additives, indicate the percent by weight of such materials to be added to satisfy disposal facility requirements, describe the mixing procedures to be used, and describe the measures for controlling/mitigating dust generation. Contractor must also include all calculations and assumptions associated with the selection of the stabilization agent(s), quantity of stabilization agent(s) to be used by weight, and mixing procedures. If Contractor elects to propose using alternate stabilizing agents, such proposed agents must be clearly specified in an alternate bid for the project.

h. Safety Data Sheets (SDSs) for all proposed dewatering and stabilization agents.

i. Results of any supplemental dewatering testing/studies to support Contractor's proposed dewatering activities.

j. Design details for the drip apron and any other control measures (e.g., spill plates, splash shields) proposed by Contractor.

k. Approach for transporting dredged material in sediment transport scows, offloading dredged material from the scows, dewatering dredged material

using gravity dewatering and sediment additives. If Contractor provides an alternate approach to dredged material processing and management, or plans to stockpile other materials, Contractor shall describe the means and methods for stockpile management and processing (e.g., use of wind rows, intermodal containers, and/or other means of segregation).

l. Describe the means and methods to securely cover stockpile(s), if applicable, with sheeting material to the satisfaction of Construction Manager.

PART 2 PRODUCTS

2.1 SECTION INCLUDES

A. General Materials

2.2 GENERAL MATEIALS

A. Contractor shall be responsible for the selection of all types, sizes, and quantities of equipment and vessels to perform the Work. Equipment shall meet the minimum specified requirements and meet the production requirements of the Work.

PART 3 EXECUTION

3.1 SECTION INCLUDES

A. Mobilization

B. Dredged Material Management

C. Dredged Material Unloading

D. Water Management

E. Protection of Site and Water Resources

3.2 MOBILIZATION

A. Mobilization activities shall commence only after approval by Construction Manager of the required pre-construction submittals described in these Specifications. Any mobilization delays related to submittal approvals shall not allow the construction schedule to be extended and shall not be reason to increase the Contract price.

3.3 DREDGED MATERIAL MANAGEMENT

A. Contractor shall provide all labor, equipment, and materials to characterize, handle, load, dewater, properly store, and transport dredged materials and miscellaneous debris in accordance with Section 02 61 00 – Removal and Disposal. The above activities include, but are not limited to, the following:

1. Dewatering of dredged material in preparation for off-Site transport. For the purposes of this bid, Contractor shall assume 8% Portland Cement addition for dewatering; however, Contractor shall coordinate with approved Disposal Facility regarding requirements for disposal.

2. Stockpiled material shall be securely covered with impermeable material in accordance with the Drawings and to the satisfaction of Construction Manager to prevent wind damage and water infiltration at the end of each Work day, when materials are not actively being placed or removed, during precipitation events, or within 30 minutes of notification from Construction Manager. Such covering activities shall be conducted as requested at no additional cost to Owner.

3. Loading of material for off-Site transport for disposal per Section 02 61 00 – Removal and Disposal.

4. The decontamination of miscellaneous debris, if directed by Construction Manager due to contact with dredged material, removed prior to or during dredging activities and the subsequent segregation by material type, stockpiling, and off-Site transport of debris for disposal at approved disposal facility per Section 02 61 00 – Removal and Disposal.

3.4 DREDGED MATERIAL UNLOADING

A. Contractor shall ensure that the drip apron(s) is in place prior to unloading dredged material transport scows.

B. Contractor shall continuously monitor for any spillage or misplaced material during unloading operations.

C. Contractor shall unload dredged sediment and debris from dredged material transport scows at a rate sufficient to maintain the production requirements and the approved project schedule.

1. Dredged material transport scows shall be unloaded in a manner that does not cause damage to the scow.

2. Dredged material transport scows shall be unloaded evenly in a manner that does not create an unsafe situation or cause spillage of the dredged material into the water.

3. A drip apron(s) and other shields shall be maintained to prevent sediment from being spilled into the water during unloading.

4. Dredged material transport scows shall be maneuvered to facilitate the removal of sediment and from the dredged material transport scows. The unloading equipment shall not be used to hold, index, tip, level, or move the dredged material transport scows.

5. For scows dedicated to the project doing multiple return trips from the sediment offloading facility, sediment and debris may remain in dredged material transport scows after unloading as Contractor deems appropriate for efficient dredging,

dredged material transport, and unloading operations. For scows that are not returning to the project, or at the end of the project or if Work is discontinued for more than 2 days, all dredged sediment, debris, and water must be unloaded from the dredged material transport scows.

6. The exterior deck of dredged material transport scows shall be clean and free of sediment and debris before departing the Sediment Unloading/Processing Area.

D. The drip apron shall be cleaned after unloading each dredged material transport scow.

E. The drip apron and its components shall be inspected daily at a minimum or as directed by Construction Manager. Any necessary repairs or replacement shall be implemented immediately to the satisfaction of Construction Manager. Construction Manager may elect to Stop Work activities at the Site in the event the drip apron and its components do not meet the satisfaction of Construction Manager.

3.5 WATER MANAGEMENT

A. Contractor shall manage construction water from the dredged material dewatering process; runoff collected from the drip apron and sediment transport scows; and water from other water-generating activities conducted. This water shall be collected, treated, and discharged in accordance with all permits and specifications.

3.6 PROTECTION OF SITE AND WATER RESOURCES

A. Contractor shall comply with applicable local, state, and federal laws, ordinances, and regulations concerning the control and abatement of water pollution in accordance with Section 01 35 43 – Environmental Procedures during dredged material management and processing activities.

END OF SECTION

SECTION 35 20 50 – CAPPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Referenced Sections

B. Description

C. Definitions

D. Submittals

1.2 REFERENCED SECTIONS

A. Section 01 14 00 – Work Restrictions

B. Section 01 31 13 – Project Coordination

C. Section 01 33 00 – Submittal Procedures

D. Section 01 35 43 – Environmental Procedures

E. Section 01 52 00 – Construction Facilities

F. Section 02 21 00 – Surveys

G. Section 02 51 00 – Equipment Decontamination

H. Section 31 05 13 – Soils and Aggregates

I. Section 35 00 00 – Waterway and Marine Construction

J. Section 35 20 23 – Dredging

1.3 DESCRIPTION

A. Contractor shall provide all labor, materials, tools, equipment, and appurtenances necessary for or incidental to the placement of cap material in the areas shown on the Drawings. Contractor shall be responsible for sourcing the specified cap materials, transporting the materials to the capping areas, and placing the cap materials in accordance with the Drawings and Specifications.

1.4 SUBMITTALS

A. Pre-construction

1. Contractor shall prepare and submit a Cap Plan to Construction Manager in accordance with Section 01 33 00 – Submittal Procedures. At a minimum, the Cap Plan shall include:

   a. Details of the equipment to be used for cap material transport and placement and related Work, including manufacturer, number, type, and size of the equipment to be used (e.g., cranes, conveyors, loaders, barges, tow/tug boats, support vessels, containers, and other support equipment).

   b. Identification of the planned source(s) of cap materials and written confirmation that the materials meet the required criteria per Section 31 05 13 – Soils and Aggregates. Contractor shall coordinate with and assist Construction Manager in collecting samples for independent testing of any materials upon Construction Manager's request.

   c. Location(s) of cap material sources along with transportation methods, schedule, and routing to the point of placement. Evidence of required permits and/or other necessary approvals shall be provided. If such approvals are not in place, the process and schedule for obtaining permits and/or other approvals shall be provided.

   d. Details for material transport, which shall include, at a minimum, the types of equipment and procedures to be used to transport material from the source to the location of placement. If temporary material stockpiling of the material occurs, identify the locations, sizes, traffic routing, and controls for temporary material stockpile operations.

   e. A Site plan(s) for the proposed use and layout of any barge loading area. The Site plan shall include a plan (drawn to scale) showing the location of all material stockpile areas, any temporary offices, any fixed or stationary equipment, and proposed traffic patterns.

   f. Procedures, means, and methods for placement and assuring accuracy of placement of the cap material with the specified tolerances, including sequencing of Work and coordination with Section 02 21 00 – Surveys.

   g. Estimated cap placement production rates, including the estimated area and volume of cap placement planned for each week and the estimated average hourly cap placement rate (in cubic yards per hour) for the equipment. Identify assumptions made for effective/non-effective time and lost time associated with high wave/storm conditions and other weather-related delays.

   h. Proposed approach and location(s) for deployment and inspection of equipment and personnel, including mobilization of equipment, barges, and other ancillary equipment and daily deployment of personnel and

vessels to verify soundness and water tightness, and whether they are fit for duty in accordance with Section 01 14 00 – Work Restrictions.

i. Delineation of the Work Areas to be used by Contractor, including the areas for marine equipment access, anchoring, and cap material transport/staging.

j. A description of procedures to be used by Contractor to verify specified lateral extents of cap placement and thickness per Section 02 21 00 – Surveys. Contractor shall provide details regarding monitoring cap material placement performance for the duration of the Work, including methods of survey control and material volume and/or weight monitoring and the use of electronic bucket positioning and software specifications including, but not limited to, manufacturer, make, and model. The Cap Plan shall also specify how Contractor will document that the specified cap requirements have been met, and a description of contingency actions should cap placement verifications document unacceptable conditions.

B. During Construction

1. Daily Activity Reports shall be completed each Work day by Contractor per Section 01 33 00 – Submittal Procedures and Section 01 31 13 – Project Coordination. At a minimum, the Daily Activity Report shall include the following information related to capping activities:

a. Description of the cap Work activities.

b. Drawings in AutoCAD Civil 3D (2014 or later) format or compatible Digital Terrain Model (DTM) of the survey to show the capping progress.

c. Copies of the tared weight slips of transport trucks of delivery of cap material from off-site sources.

d. Estimated daily and cumulative volume of cap material placed.

e. List of labor and equipment employed to capping activities.

f. Equipment performance, maintenance, hours of downtime, and cause(s) of downtime.

g. Delays encountered and relevant details of the delay, such as the cause, resolution, and measures implemented to avoid similar delays in the future and to make up lost time if necessary.

h. Final surveys for approval per Section 02 21 00 – Surveys.

PART 2 PRODUCTS

2.1 SECTION INCLUDES

A. Cap Materials

2.2 CAP MATERIALS

A. Construction material types shall be as shown on the Drawings and as specified in Section 31 05 13 – Soils and Aggregates.

B. Use only approved cap materials per Section 31 05 13 – Soils and Aggregates.

PART 3 EXECUTION

3.1 SECTION INCLUDES

A. Equipment

B. General

C. Cap Installation

D. Cap Verification

E. Final Examination and Acceptance

3.2 EQUIPMENT

A. Contractor shall select the means and methods for cap placement to achieve the required limits and elevations as required on the Drawings and in the Specifications. The means and methods shall be approved by Construction Manager through the pre-construction submittal process.

B. Any equipment previously used for dredging or handling of contaminated material shall be decontaminated per Section 02 51 00 – Equipment Decontamination, prior to use for capping.

C. Contractor is responsible for selecting the appropriate vessel-anchoring means and methods.

D. Contractor shall operate all marine equipment so as to maintain a draft suitable to avoid running aground. Any grounded barge shall be immediately reported to Construction Manager.

E. Contractor shall maintain floating platforms, material scows, and associated equipment to meet the requirements of the Work and all applicable marine regulations, including the prompt repair of equipment failures.

3.3 GENERAL

A. Contractor shall conduct all capping operations in accordance with the water quality regulations outlined in Section 01 35 43 – Environmental Procedures and Section 01 57 30 – Marine Resuspension Controls. Contractor shall not commence capping Work until the above-mentioned controls are in place to the satisfaction of Construction Manager. If water quality standards are exceeded, Contractor will be notified and shall immediately

implement measures to mitigate the water quality impacts, potentially including cessation of Work if directed by Construction Manager.

B. Contractor shall provide for secure transportation and storage of cap materials. Cap materials shall be segregated from any contaminated material.

C. Contractor shall be responsible for delivery to and/or return from the Site of all materials and equipment necessary to perform the Work and shall pay all freight and handling charges for same. All unloading, storing, and reloading necessary shall be the responsibility of Contractor and at no additional cost to Owner.

D. Owner assumes no responsibility for damage, deterioration, or theft of stored materials, equipment, tools, and supplies. Contractor shall assume full responsibility for the storage and protection of all materials brought to the Site. Materials that become damaged, contaminated, deteriorated, destroyed, or stolen shall be repaired or replaced, at the discretion of Construction Manager, at no cost to Owner.

E. Contractor shall establish accurate and precise methods of horizontal and vertical control before capping commences. The proposed method and maintenance of the horizontal control system is subject to approval by Construction Manager and if, at any time, the method fails to provide accurate location for the capping operations, Construction Manager may suspend operations at no additional cost to Owner. Payment will not be made for any material that is deposited outside of the designated placement location or in excess of the allowable lines, grades, and tolerances, unless otherwise directed by Construction Manager. Contractor may be directed to remove misplaced material at no additional cost to Owner.

F. Contractor shall implement measures to prevent soil and aggregate materials from being misplaced on land or in the waterway during material delivery, storage, and loading and unloading. Contractor shall use spill plates and other approved equipment or controls to prevent the loss of materials when loading and offloading. All loss of materials shall be replaced and areas affected by the lost material shall be restored at no additional cost to Owner.

G. Should Contractor, during the execution of the Work, lose, dump, throw overboard, sink, or misplace any material, equipment, barge, scow, machinery, or appliance, Contractor shall promptly notify Construction Manager. Contractor may be required to retrieve the material at the discretion of Construction Manager at no additional cost to Owner.

H. Contractor shall review geotechnical properties of the existing sediment referenced in Section 00 31 00 – Available Project Information and implement measures, as needed, to avoid potential mixing of underlying sediment with cap materials and to limit cap placement-induced settlement/displacement of underlying materials.

I. Stockpiling and dragging of cap materials on the sediment surface is prohibited.

J. Contractor shall construct transitions between cap material types in the cap areas as shown on the Drawings.

K. Contractor shall place cap materials in accordance with the thicknesses and quality requirements specified herein and as shown on the Drawings.

L. Contractor shall conduct the Work while minimizing interference with navigation. Work shall be conducted in accordance with Section 35 00 00 – Waterway and Marine Construction.

M. Contractor shall place cap materials in accordance with the thicknesses and quality requirements presented herein and on the Drawings and may place additional material only if within overplacement allowances listed within this Specification.

3.4 CAP INSTALLATION

A. Contractor shall install the caps as shown on the Drawings and in accordance with Section 31 05 13 – Soils and Aggregates.

B. The caps shall be placed by Contractor following approval of dredging per Section 35 20 23 – Dredging and in accordance with Section 02 21 00 – Surveys. Contractor shall not proceed with cap placement until Construction Manager provides written notice to proceed.

C. Contractor shall place Cap Type A, Cap Type B, Cap Type C, and Cap Type C material in the Barge Demolition Restoration Areas as shown on the Drawings.

D. Contractor shall place cap material by bucket or grapple equipped with a positioning system, or other method proposed by Contractor in the Cap Plan and approved by Construction Manager.

E. Contractor shall place cap material in lifts no greater than 3 inches and placement shall be accomplished such that the material forms a continuous uniform layer of required thickness within the specified tolerances over the area designated for cap placement.

F. Placement method(s) shall minimize resuspension of bottom sediments, mixing of bottom sediments and cap material, and the loss of cap materials during placement. Placement methods shall also comply with the specified water quality requirements.

G. Cap design layer thicknesses, overplacement allowance, underplacement allowance, and minimum and maximum material placement thicknesses are shown in Table 1.

TABLE 1: CAP REQUIREMENTS

CAP TYPE	DESIGN LAYER THICKNESS	ALLOWABLE OVERPLACEMENT (90% Allowable) [1]	ALLOWABLE UNDERPLACEMENT (10% Allowable) [1]	MATERIAL THICKNESS
Cap Type A	18 inches	2 inches	1 inches	17 inches Minimum to 20” inches Maximum[2]

Cap Type B	18 inches	2 inches	1 inches	17 inches Minimum to 20" inches Maximum[2]
Cap Type C	18 inches	2 inches	1 inch	See Note 3
Cap Type C in Barge Demolition Restoration Area	See Note 4	2 inches	1 inch	See Note 5

[1] Allowable overplacement/underplacement percentages based on final surveyed top of cap elevation compared to Construction Manager-approved post-dredge survey.

[2] The final surveyed top of cap elevation within the area subject to elevation dredging to -16.5' NAVD88 as shown on the drawings shall not exceed -14.83 feet (NAVD88).

[3] The final surveyed top of cap elevation shall be no less than 1" and no greater than 2" from the pre-construction elevation based on Construction Manager-approved post-dredge survey.

[4] Contractor shall place Cap Type C material in the barge demolition restoration areas to match contours provided by Construction Manager pending development based on post-dredge survey.

[5] The final surveyed top of cap elevation shall be no less than 1" and no greater than 2" from contours provided by Construction Manager pending development based on post-dredge survey.

3.5 CAP VERIFICATION

A. After cap material placement, notify Construction Manager when areas are ready for post-cap survey. Contractor shall conduct post-cap surveys in accordance with Section 02 21 00 – Surveys. The post-cap survey results shall be provided to Construction Manager for a method of verification and approval of the placed cap material thickness.

B. Contractor shall coordinate with Construction Manager to facilitate cap placement quality assurance testing for verification of placement thickness with the use of pans, cores, or other methods. Contractor shall assist Construction Manager in the deployment of collection pans and core collection for verification of adequate cap placement.

C. If the verification methods show deviations from the cap placement requirements, Contractor shall implement corrective action as necessary, at no additional cost to Owner, to conform to the requirements of the Drawings and Specifications.

D. Approval for cap material placement will be determined by Construction Manager based on a comparison of the post-dredge and post-cap surveys and Construction Manager quality assurance testing to verify that the required thicknesses and elevations are achieved. Cap material placed outside of the cap area limits will not be eligible for payment and will be subject to removal at the discretion of the Construction Manager at no additional cost to the Owner.

3.6 FINAL EXAMINATION AND ACCEPTANCE

A. Upon examination and acceptance by Construction Manager (based on surveys completed by Contractor in accordance with Section 02 21 00 – Surveys and quality assurance testing performed by Construction Manager as specified herein), the cap work will be accepted as complete. Final payment shall be subject to deductions or correction from Work that is non-compliant or otherwise completed, or additions for approved extra Work in an unauthorized manner.

END OF SECTION

APPENDIX E

Operation, Maintenance and Monitoring Plan

Operation, Maintenance And Monitoring Plan

Sediment Portion of the Former Everett Staging Yard Disposal Site

1 Horizon Way, Everett, Massachusetts

Release Tracking Number 3-13341

Prepared by:

AMEC Massachusetts, Inc.
Chelmsford, MA 01824

June 2017

Project No. 3651160042

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FIGURES

TABLES

1.0 INTRODUCTION

1.1 Purpose and Scope

This Operation, Maintenance and Monitoring Plan (OMM Plan) has been prepared for the sediment portion of the Former Everett Staging Yard Disposal Site located at 1 Horizon Way, Everett, Massachusetts (the Disposal Site, shown on **Figures 1-1** and **1-2**). The Disposal Site has been given Release Tracking Number (RTN) 3-13341 by the Massachusetts Department of Environmental Protection (MassDEP). The sediment has been impacted by:

- Metals (arsenic, lead, mercury and vanadium) from historical chemical manufacturing processes and operations on the upland portions of the property,
- Phthalates and polychlorinated biphenyls associated with the historical operations on the adjacent Monsanto West property, and
- Low levels of polycyclic aromatic hydrocarbons and petroleum hydrocarbons attributable to other industrial and anthropogenic sources (e.g., stormwater runoff, industrial releases, and shipping-related impacts).

Method 3 Risk Assessments performed for the sediment portion of the Disposal Site as part of previous Massachusetts Contingency Plan investigations concluded:

- No Significant Risk to human health,
- No Significant Risk for ecological receptors exposed to surface water, and
- No Significant Risk for birds and mammals exposed to shoreline sediment.

The present Stage I Environmental Screening concludes that there are potentially significant exposure pathways with respect to the benthic community exposed to sediment. The present Stage II Ecological Risk Characterization concludes that a condition of No Significant Risk does not exist for benthic organisms exposed to sediment. Therefore, remedial actions are necessary to address exposure to impacted sediments by benthic organisms in order to achieve a condition of No Significant Risk. The selected remedial action alternative includes dredging and installation of a clean cap over the dredged areas and other impacted sediment. Dredging and installation of the cap is anticipated to be completed between September 2017 and February 2018.

This OMM Plan is an integral part of the Phase IV Remedy Implementation Plan (Phase IV RIP) as the MCP requires such a plan when OMM activities are required to ensure the effective performance and integrity of the remedial action and/or the achievement of remedial goals (310 CMR 40.0874(3)(d)). The primary objective of the OMM Plan is to assess the integrity of the cap after installation and ensure the thickness of the cap is maintained.

The specifications included with the Phase IV RIP provide details on materials to be used, testing required to verify proper materials are used, tolerances for placement, and methods to be used to verify proper material thicknesses and characteristics are actually placed. The OMM Plan will:

- Verify the presence and physical integrity of the cap material; and

- Provide for repairs and maintenance to the cap(s) if monitoring efforts indicate that such activities are necessary.

Verification of the thickness and stability of the cap will be done by monitoring and maintenance including the following:

- Periodic physical monitoring of the capped area;
- Event-based physical monitoring of the capped area;
- Additional monitoring based on the results of periodic and event-based monitoring, if appropriate; and
- Cap maintenance activities, performed as needed based on the monitoring results.

This OMM Plan summarizes the monitoring and maintenance activities to be performed by Wynn MA, LLC and Everett Property, LLC (collectively, Wynn), the current owners of the property.

1.2 Relevant Contacts

The following is a list of relevant contacts for the proposed remediation as required by 310 CMR 40.0874(3)(a):

Potentially Responsible Party/Site Owner:	Wynn MA, LLC Everett Property, LLC 101 Station Landing, Suite 2200 Medford, MA 02155 Contact: Jacqui Krum Telephone: 857-770-7000 E-mail: jacqui.krum@wynnmass.com
Licensed Site Professional (LSP):	Matthew J. Grove, PhD, LSP LSP No. 9932 Amec Foster Wheeler (AMEC Massachusetts, Inc.) 271 Mill Rd., 3rd Floor Chelmsford, MA 01824 Telephone: 978-392-5398 Fax: 978-692-6633 E-mail: matt.grove@amecfw.com
Remedy Design and Implementation Engineer	Danielle Ahern, P.E. Amec Foster Wheeler 271 Mill Rd., 3rd Floor Chelmsford, MA 01824

Person(s) Monitoring OMM Activities	Amec Foster Wheeler 271 Mill Rd., 3rd Floor Chelmsford, MA 01824

2.0 REMEDIATION SUMMARY

Sediment remediation will be accomplished through the dredging and capping or capping of contaminated sediments. Dredged materials will be transported off-site for reuse or disposal. These remedial actions will address sediment contamination associated with Disposal Site-related metal contamination (arsenic, lead, mercury and vanadium) as well as non-Disposal Site contamination (other metals, petroleum hydrocarbons, phthalates, polycyclic aromatic hydrocarbons, and polychlorinated biphenyls).

Successful implementation and completion of the remedial action will be achieved when a clean surficial sediment layer (within the top 18 inches) is present across the Remediation Area. Remediation activities include the demolition and removal of five deteriorated barges, dredging and capping both dredged and non-dredge portions of the Remediation Area with three different caps:

- Navigation Subtidal Cap – a 2-layer cap composed of a layer of coarse sand capped with a medium gravel material to resist propeller induced erosion.
- Subtidal Cap – capped with a coarse sand material for stability and to resist propeller induced erosion in the channel.
- Intertidal Cap – capped with a silty sand to match existing material.

Following completion of the Wynn Boston Harbor development, the area will be an active waterfront. Floating docks are proposed along the northern and western sides of the cove to allow vessel berthing. The desired engine size would not exceed 1,000 horse power (hp) assuming 20% power is used during docking and maneuvering to protect the cap in the docking and turning basin area. Anchoring is not allowed under any circumstances within the cap limits.

3.0 INSPECTION AND MONITORING ACTIVITIES

Physical monitoring of the cap will be performed to verify the presence and stability of the cap material. Bathymetric and topographic survey will be conducted upon the completion of the remediation to establish “as-built” conditions, as specified in the Specifications and Contract Drawings issued for construction. The results of this survey will establish baseline post-construction conditions for comparison to information collected during long-term monitoring of the OMM Plan.

3.1.1 Surveys

Bathymetric and topographic surveys will be performed to monitor the elevation of the sediment cap surface within the remediation areas. Surveys will be conducted in a manner that will provide

resolution and accuracy consistent with the procedures followed to perform the “as-built” survey. Specifications for topographic and bathymetric surveying, including the development of a Survey Work Plan (to be prepared by the remediation contractor and submitted for approval), are presented in the documents issued for construction. The methodology specified in the Survey Work Plan to perform the as-built survey (or equivalent) will be used to perform the OMM surveys.

3.1.2 Sediment Cores

Sediment cores may collected to address data gaps in bathymetric and topographic surveys if those data gaps represent more than 10 percent of the area of the intertidal silty sand or subtidal sand cap. Sediment cores may also be collected to assess whether changes in cap elevation are due to erosion, subsidence, or compaction. Cores will be progressed via push or vibratory methods to a depth sufficient to obtain both cap material and native sediment based on final as-built cap thickness or the most recent survey data, as applicable. A minimum of 80% recovery is required to consider the core acceptable for comparison. The core will be split and layers measured to verify cap thickness.

3.1.3 Data Evaluation

The sediment surface elevations will be compared to the as-built bathymetric survey elevations and/or the most recent previous survey. Areas where sediment surface elevations are 3 inches or more below the as-built bathymetric elevations will be targeted for further evaluation and possible corrective actions. Consolidation that may have occurred after construction will need to be considered in this assessment during the initial events. Supplemental data may be collected and evaluated to provide an understanding of the elevation of, and fluctuations in, the cap.

3.2 Monitoring Schedule

Bathymetric and topographic surveys will be conducted annually for the first 5 years, with the first round conducted approximately 1 year following installation (i.e., monitoring in Years 1, 2, 3, 4, 5). Three rounds of monitoring will be conducted at 2-year intervals after the initial 5 years (i.e., monitoring in Years 7, 9, 11). Subsequent rounds of monitoring (if necessary) will be conducted at 5-year intervals. The scope and frequency of scheduled monitoring events may be adjusted if the initial monitoring events indicate that the cap is functioning in accordance with the design or that more frequent monitoring is required.

In addition, event-based bathymetric and topographic surveys will be conducted after the following specific events, should they occur:

- Greater than or equal to a 10-year recurrence interval episodic storm based on rainfall amount or wind speed and direction.
- Reports from the owner, harbormaster, or other reputable source(s) that erosion from storms may have impacted the cap area.
- Reports from the owner, harbormaster, or other reputable source(s) that vessels may have impacted the cap area.

Similar to the routine surveys, the event-based monitoring scope and frequency will be re-evaluated every 5 years depending on the actual occurrence.

3.3 Corrective Measures

In the event that the bathymetric or topographic surveys identify areas where the sediment elevation is significantly different from the post-construction elevation (or the most recent survey), then additional data will be collected (e.g., re-survey, sediment cores, underwater video surveying, or diver survey) and response actions will be taken, as appropriate, to repair or enhance the cap.

If the periodic surveys indicate the cap thickness criteria are not met, but inspection results indicate that substrate settlement has occurred rather than loss of cap thickness, such settlement would not trigger maintenance activities. The settled surface elevations would serve as the new baseline for future monitoring comparisons. If results indicate loss of cap thickness, one of the following response actions would be conducted:

- Repair the area where unacceptable loss of material was observed through addition of material to the cap area; or
- Increase armoring in the area where unacceptable loss was observed with larger material type or a thicker layer of material, and consider similar changes in areas that may be susceptible to similar damage in the future.

Corrective measures will be implemented under appropriate approvals and permits issued by federal, state, and local agencies as required.

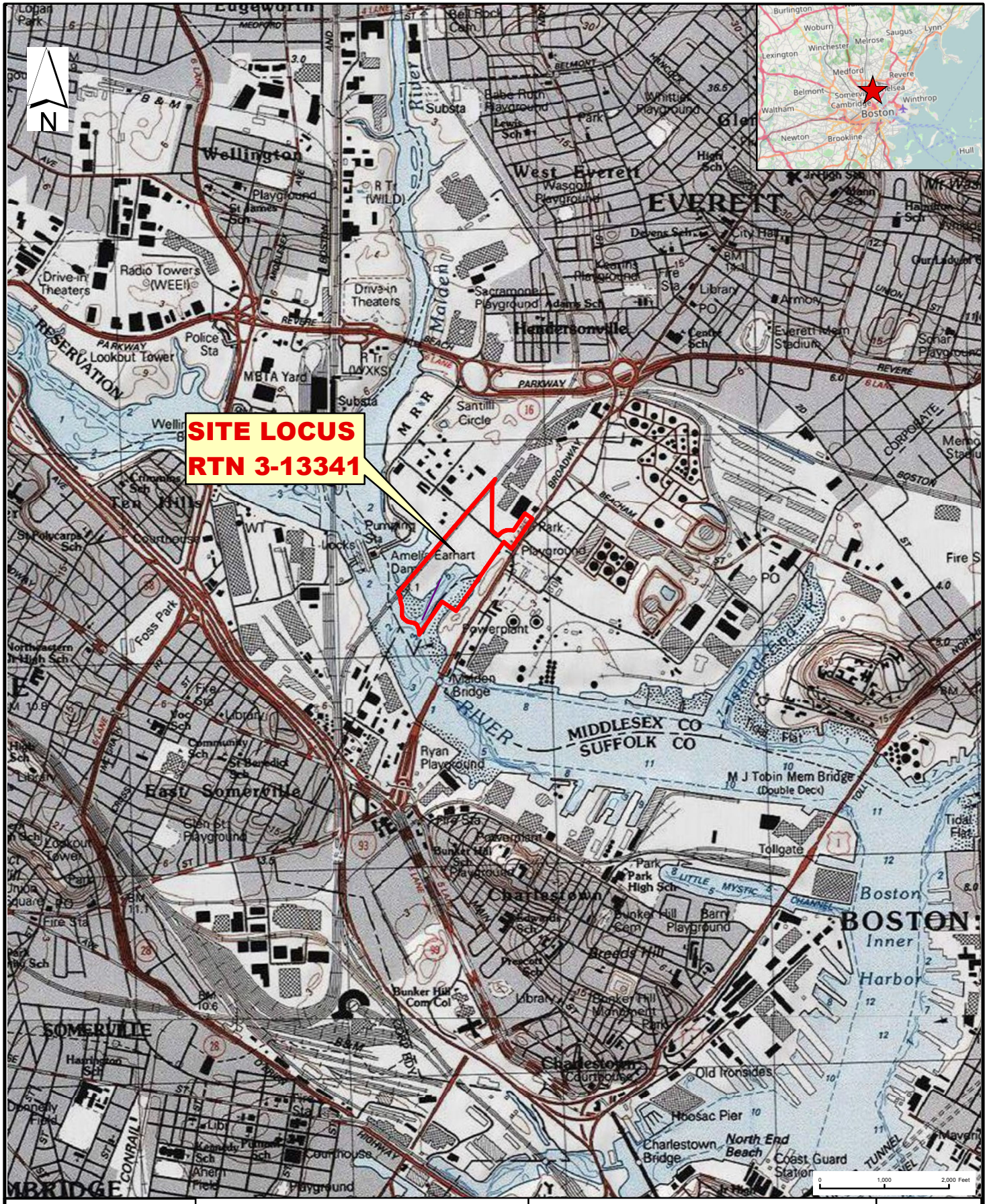
4.0 RECORD-KEEPING AND REPORTING

A memorandum will be developed by Wynn on an annual basis that presents the results of the monitoring activities performed during the previous year and will include an assessment of the performance of the cap, as well as provide recommendations for additional data collection or cap maintenance activities (if appropriate).

Wynn will also maintain electronic copies of all bathymetric and topographic surveys conducted during the OMM period.

5.0 REFERENCES

AMEC, 2017. Phase III Remedial Action Plan, Phase IV Remedy Implementation Plan, Sediments Adjacent to the Former Everett Staging Yard, 1 Horizon Way, Everett, Massachusetts, Release Tracking Number 3-13341. June 2017.



amec foster wheeler

SITE:
Former Everett Staging Yard
1 Horizon Way, Everett, MA
RTN 3-13341

Approximate Parcel Boundary

TITLE:
Site Location Map

SCALE:	DATE:	PROJECT:
1 inch = 2,000 feet	12/23/2016	3651160042.003

DRAWN BY: M. Martin **CHECKED BY:** C. Platt

LOCATION: P:\Comm-Ind\Projects\Clients T to Z\Wynn\3651160042\GIS

1-1

Disposal Site Boundary

Limit of Sediment Posing Significant Risk

Limit of Sediment Posing Significant Risk

Low pH Area

CES Area (High Arsenic Area)

Limit of Sediment Posing Significant Risk and Disposal Site Boundary

0 100 200 Feet

Source:
1) The base map was developed from plans or electronic files provided by"Feldman Land Surveyors" entitled " Existing Conditions" Dated 02-20-2015, Original scale 1"=20', Drawing NO. 14517, CAD file, "14517-EX-DRAFT-03-20-15.DWG
2)The locations and elevations of the corings, sampling locations, selected site features and explorations were approximatly determined by GPS. This data should be considered accurate only to the degree implied by the method used.
3) The base data and map package were provided by GZA GeoEnivronmental, Inc.

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- Approximate Parcel Boundary
- Limit of Sediment Posing Significant Risk
- Disposal Site Boundary
- AMEC Sediment Sample Locations
- GZA Sediment Sample Locations
- Mean High Water
- Mean Low Water
- Bathymetric Contour (<0) NAVD88
- Topographic Contour (>0) NAVD88
- CES Area (High Arsenic Area)
- Low pH Area
- Salt Marsh

Site Plan
Former Everett Staging Yard
1 Horizon Way, Everett, MA
RTN 3-13341

Drawn By: E. Flanary	Checked By: D. Ahern
PROJECT NO: 3651160042.003	Date :6/21/2017

FIGURE NO: **1-2**

Document Path: P:\BOS\Wynn Design & Development\3651160042 - Wynn Everett Sediments\7.0 Drawings\7.3 GIS\Figure_site_plan_3-24-2017.mxd

APPENDIX F

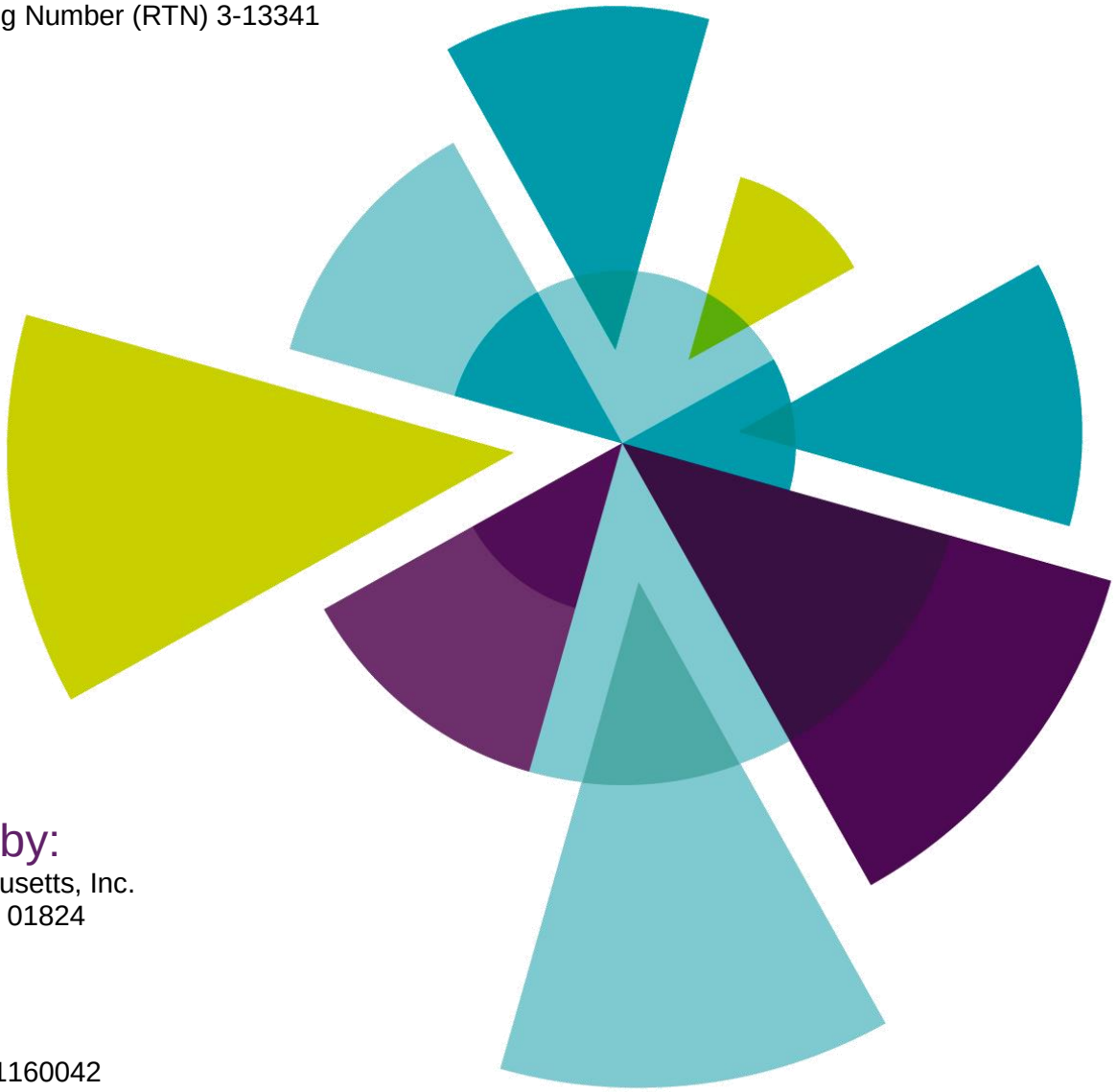
Health and Safety Plan
for
Construction Quality Assurance and LSP Oversight

HEALTH AND SAFETY PLAN
For Construction Quality Assurance and LSP Oversight

Sediment Portion of the Former Everett Staging Yard Disposal Site

1 Horizon Way, Everett, Massachusetts

Release Tracking Number (RTN) 3-13341



Prepared by:

AMEC Massachusetts, Inc.
Chelmsford, MA 01824

June 2017

Project No. 3651160042

HEALTH AND SAFETY PLAN

FOR CONSTRUCTION QUALITY ASSURANCE AND LSP OVERSIGHT

Sediment Portion of the Former Everett Staging Yard Disposal Site

1 Horizon Way, Everett, Massachusetts

Submitted by:

AMEC Massachusetts, Inc.
271 Mill Road, 3rd Floor
Chelmsford, MA 01824

Project No. 3651160042

June 2017

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Health and Safety Approval

Prepared by: Annette McLean | Amec Foster Wheeler Managing Office: Chelmsford MA

Approved by:

Matt Grove
Project Manager | Date

Cindy Sundquist
Health, Safety, Security and Environmental (HSSE) Manager | Date

Date of Amendment(s):

FIELD TEAM REVIEW: I acknowledge that I understand the requirements of this HASP, and agree to abide by the procedures and limitations specified herein. I also acknowledge that I have been given an opportunity to have my questions regarding the HASP and its requirements answered prior to performing field activities. Health and safety training and medical surveillance requirements applicable to my field activities at this site are current and will not expire during on-site activities.

Name:	Date:
Name:	Date:
Name:	Date:
Name:	Date:
Name:	Date:
Name:	Date:
Name:	Date:
Name:	Date:
Name:	Date:

1.0 INTRODUCTION

Amec Foster Wheeler's client, Wynn MA, LLC and Everett Property, LLC (collectively, Wynn) are the developers of the Wynn Boston Harbor casino and resort project ("the Project") located at 1 Horizon Way in Everett, Massachusetts. The Wynn property encompasses approximately 35 acres, which includes an upland portion (approximately 22 acres) and a portion of the adjacent Mystic River to the southwest (approximately 13 acres). Sediment remediation will be conducted on a portion of the embayment ("the Remediation Area"). A map showing the property and the Remediation Area is provided in the Phase III Remedial Action Plan and Phase IV Remedy Implementation Plan (RIP) developed by Amec Foster Wheeler. The Disposal Site, or more formally the Former Everett Staging Yard Disposal Site, includes the uplands where chemical manufacturing occurred and the portion of Mystic River sediment which has been impacted by chemicals from the uplands. Wynn will complete remedial actions within the sediment portion of the Disposal Site in order to comply with the requirements of the Massachusetts Contingency Plan (MCP).

Remediation activities include the demolition and removal of five deteriorated barges, dredging and capping both dredged and non-dredge portions of the Site with three different materials as explained in the Phase IV RIP. These remedial actions will address sediment contamination associated with Site-related metal contamination (arsenic, lead, mercury and vanadium) as well as non-Site contamination (other metals, petroleum hydrocarbons, phthalates, polycyclic aromatic hydrocarbons, and polychlorinated biphenyls). Successful implementation and completion of the remedial action will be achieved when a clean surficial sediment layer (within the top 18 inches) is present across the Remediation Area.

This HASP was developed to cover the Amec Foster Wheeler's oversight/observation activities during sediment remediation. Amec Foster Wheeler will observe a general contractor (To be determined) conducting sediment remediation activities which may include the following tasks:

- Debris and barge removal
- Dredging
- Dewatering, stabilization and offload
- Capping
- Monitoring and maintenance of the cap

This Health and Safety Plan (HASP) was developed to support Amec Foster Wheeler observing/overseeing the sediment remediation activities as described above and in detail in the Phase IV RIP. Amec Foster Wheeler's HASP is meant to describe the site hazards in general and provide site information to the general contractor. This HASP is not designed to cover the general contractor personnel or their subcontractors performing their activities.

The general contractor is responsible for conducting the sediment remediation activities above (and in the Phase IV RIP) in accordance with their own corporate health and safety program and health and safety plan, but are expected to comply with this Site HASP as applicable under OSHA regulations. Prior to initiation of Site work, Amec Foster Wheeler shall provide a copy of the HASP to the general contractor.

1.1 General Information

Client:
Wynn, MA LLC
Everett Property, LLC

Client Contact:
Robert DeSalvio
Jacqui Krum

Client Project Manager/Construction Manager:
Natalie Brown
857-770-7856 (office)
617-417-6950 (cell)

Site Name & Location:
Sediment Portion of the Former Everett Staging Yard Disposal Site
1 Horizon Way, Everett, Massachusetts

Client Contractors:
TBD

Project Manager:
TBD

Field Manager:
TBD

Amec Foster Wheeler Contacts

Project Manager/LSP:
Matt Grove
978-392-5398 (office)
978-265-1458 (cell)

Remediation Engineer:
Danielle Ahern
978-392-5302 (office)
603-475-5669 (cell)

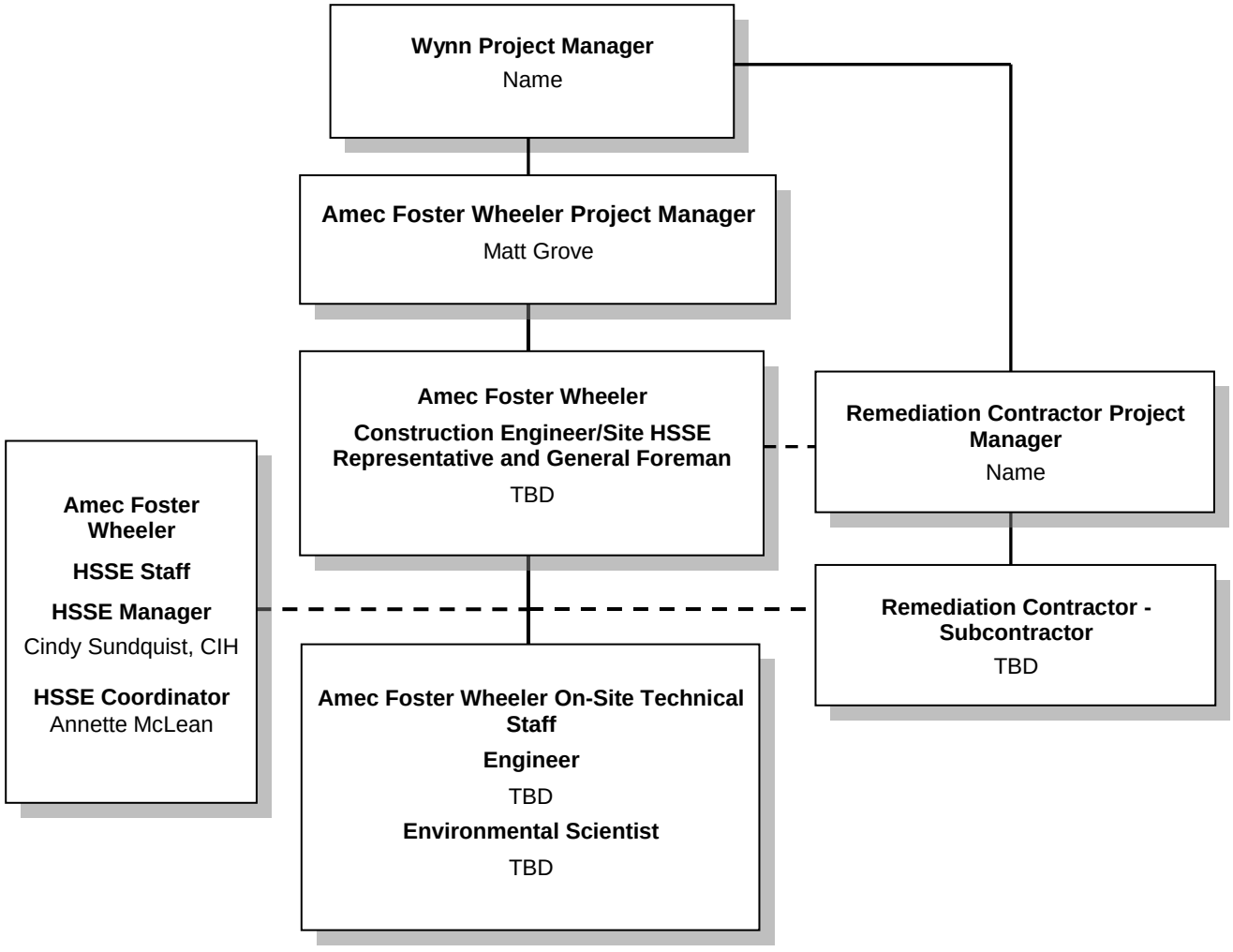
Construction Engineers/HSSE Representatives
TBD
978-#### (cell)
(See also Emergency Call List in Section 9.5)

1.2 Lines of Authority

Wynn has contracted Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) as the Remediation and Construction Engineer for the sediment remediation. The remediation contractor will be selected by Wynn with input from Amec Foster Wheeler, from a qualified list of bidders to conduct the sediment remediation activities as described in the Phase IV RIP and in construction specification documents.

Amec Foster Wheeler and oversee sediment remediation activities as the design engineer and LSP for the remediation.

RELATIONSHIP /LINES OF AUTHORITY FOR PROJECT SAFETY



1.3 Site Description and Features

For the purposes of this HASP, the "property" refers to the combined areas of land and water which are currently owned by Wynn and are located at 1 Horizon Way in Everett and an unnumbered parcel on Alford Street in Boston (Figure 1-1). The Wynn property encompasses approximately 35 acres, which includes a 22-acre upland portion and a 13-acre sediment portion of the adjacent Mystic River to the southwest. The upland portion of the property is roughly bounded by Alford Street/Broadway (Route 99) to the east, Massachusetts Bay Transit Authority (MBTA) railroad tracks to the west, an MBTA bus repair and maintenance facility to the north, and the Mystic River to the south. The sediment portion is an embayment of the Mystic River bounded to the northwest and north by the upland portion of the property and to the northeast and east by the Boston Water and Sewer Commission's Material Handling Facility (180-220 Alford Street).

The Former Everett Staging Yard Disposal Site ("the Disposal Site"), includes the uplands where chemical manufacturing occurred and the portion of Mystic River sediment which has been impacted by chemicals from the uplands. Figure 1-2 is a detailed plan for the sediment portion of the property, and depicts physical features, and sampling locations. Additional details of the Disposal Site, its features, and the planed remediation are included in the Phase IV RIP.

1.4 Background/Site History

Potential Sources and Release Mechanisms

The Disposal Site includes both an upland area and sediments in an embayment of the Mystic River. The upland portion was the location of chemical manufacturing facilities (primarily sulfuric acid and alcohols) for over 100 years. Portions of the upland property were also filled at various times with dredged materials (and potentially manufacturing wastes) which resulted in the current configuration. Chemical manufacturing operations began in the 1800s and continued through the late 1960s. The buildings on the property were demolished in the late 1960s and 1970s and the property was generally vacant by about 1980. Beginning in the mid-1990s, the upland areas were used as a material storage and staging yard.

Historical manufacturing operations and processes resulted in the release of metals to the upland portion of the Site, evidenced by the presence of impacted subsurface soil. Specific metals of concern are arsenic, lead and vanadium. In addition, the production of sulfuric acid on the upland portion of the Site resulted in areas of low pH in groundwater. Remediation of the upland portion of the Site is currently being completed under a Release Abatement Measure (RAM). Spillage during loading and unloading of raw materials on and near the water, principally along the northern and northeastern side of the embayment, likely contributed contaminants directly to sediment.

A secondary area of high metals concentrations has been observed along a tidal channel in the flats on the south side of the embayment. This is likely associated with historical discharges from a drain pipe outlet located on Boston Water and Sewer Commission property to the south.

Phthalates (e.g., bis2-ethylhexyl)phthalate or BEHP) and polychlorinated biphenyls (PCBs) associated with the historical operations on the adjacent Monsanto West property have also been detected in sediments on the property. However, the spatial distribution of phthalates and PCBs in sediments is different than that of the metals which are attributed to Disposal Site operations. The distribution of phthalates and PCBs is consistent with a different (non-Site) source of these chemicals.

The widespread presence of low levels of polycyclic aromatic hydrocarbons (PAHs) and petroleum hydrocarbons in sediments on the property can, at least partially, be attributed to other industrial and anthropogenic sources (e.g., stormwater runoff, industrial releases, and shipping-related impacts). The Mystic River is a very urbanized watershed and the river and adjacent land areas have a very long history of commercial and industrial uses.

Regulatory History and Status

O'Donnell Sand & Gravel, Inc. (O'Donnell) submitted the initial notification of a release to the Massachusetts Department of Environmental Protection (MassDEP) in January 1996

based on the presence of elevated concentrations of certain metals and petroleum hydrocarbons in soil as well as areas of low pH. A Phase I Initial Site Investigation and Tier Classification (classifying the Site as Tier II) were submitted for the Site in January 1997. Following the 2001 purchase of the property by Mystic Landing, LLC (Mystic Landing), additional subsurface and sediment investigations were completed and a Phase II Comprehensive Site Assessment (Phase II CSA) Report was submitted in December 2007. FBT Everett Realty, LLC (FBT) purchased the property from Mystic Landing in 2009. In February 2012, a Phase II CSA along with a Notice of Delay for the Phase III and IV reports were submitted, which attributed the delays to a property access dispute. FBT subsequently submitted additional Notices of Delay since the selected remedial approach could vary depending on whether the construction of casino on the property was approved.

Wynn purchased the property in January 2015 and in February 2015 an Eligible Person Certification and Revised Tier II Classification were submitted on Wynn's behalf. MassDEP issued a Notice of Responsibility ("NOR") in March 2015 which established interim deadlines for supplemental Phase II and Phase III reports for the Mystic River portion of the property. In December 2015, a Supplemental Phase II Report was submitted which contained the results from a sediment sampling program as well as an updated Site boundary and risk characterization. In May 2016, MassDEP issued a letter containing questions they had with the Supplemental Phase II Report, requesting additional assessment and/or data review, and establishing interim deadlines for submittal of a Revised Phase II Report, Phase III and Phase IV reports, and a Permanent or Temporary Solution or Remedy Operation Status (ROS). MassDEP supplied additional comments via email in June 2016 following GZA's submittal of a sediment conceptual site model.

In September 2016, Wynn proposed an alternative approach to characterizing the Site and potential risks and supplied additional information requested by MassDEP. In November 2016, MassDEP and Wynn agreed upon an approach which would allow the project to move forward. On December 30, 2016, a revised Supplemental Phase II CSA Report was submitted to MassDEP. This report responded to MassDEP comments and provided an alternate approach to Site assessment and closure. On March 31, 2017, MassDEP issued a letter identifying new interim deadlines for the sediment portion of the Site including a Supplemental Phase III RAP and Phase IV RIP to be submitted by September 15, 2017 and Permanent Solution, Temporary Solution, or Remedy Operation Status by June 30, 2019.

1.5 Scope of Work/Planned Site Activities

Field activities conducted to date include the pre-remediation sediment sampling activities.

The planned remediation activities include:

- **Debris and barge removal.** Amec Foster Wheeler will observe a contractor conducting a debris survey, and removing and placing the debris on a barge for stockpiling prior to removal off site. Five sunken and/or grounded barges are present in the remediation area. Since these barges are not intact, a contractor will

dismantle them in place and load the pieces onto a combination of barges and/or trucks and disposed of off-site. Due the potential for the presence of asbestos, lead paint and other hazardous materials, samples may be collected and analyzed to the extent possible prior to dismantling of the barges to determine the appropriate procedures for disposal. Buried debris encountered during the dredging works will be segregated and handled in a similar manner.

- **Dredging:** Amec Foster Wheeler will observe a contractor conducting a pre-dredge bathymetric survey to document existing contours prior to dredging. For dredging, heavy equipment (various sizes of excavators and cranes) are mounted onto a barge and used to excavate the area of concern using precise global positioning system (GPS) guided equipment for horizontal and vertical accuracy. Removed sediments are placed on a materials barge where they are temporarily stockpiled to allow waters to drain out. The amount of sediment to be removed is approximately 27,540 CY within an area encompassing approximately 4.3 acres.

- **Dewatering, Stabilization and Offload**: As described above, the dredged sediment will be transferred into a hopper barge or scow. Once the material is loaded into the receiving vessel, the contractor will have the option to decant water within the limit of work or to decant the effluent once the material has reached the contractor's offloading facility. It is anticipated that the contractor will decant the free water from the sediment in the scow within a turbidity curtain within the limit of work. Depending on the scow size and set-up, decant water will be pumped from the internal scow sump through a geotextile liner placed in the scow, or using a screened suction hose to minimize passing of solids. It is anticipated that the dewatered sediment will be transported to a local processing and receiving facility. An 8% Portland cement addition is proposed for additional dewatering at the processing facility to allow the sediment to meet the processing facilities requirements to be off-loaded and acceptable for transportation and disposal.

- **Capping:** Clean backfill material will replace the removed sediment to restore existing elevations. Clean fill is loaded onto a material barge at a landside transfer facility and transported to the site. Material can be placed by a mechanical excavator, broadcast spreader, conveyor belt or other suitable method. Sand is anticipated to be the primary component of the cap throughout. However, gravel will be used as the upper layer in the turning basin and a silty sand will be used in the intertidal areas. The total amount of cap material is approximately 21,120 CY within an area of approximately 7.3 acres.

Oversight activities may require Amec Foster Wheeler personnel to access a contractor's barge, and work around heavy equipment and vehicles.

1.6 Scheduled On-site Personnel

All personnel arriving or departing the site should log in and out on the Daily Employee/Visitor log. All personnel requiring access to controlled work areas must have completed the training and medical administrative control requirements.

1.7 Personnel Responsibilities

Site Health and Safety Coordinator (SHSC) - Reports jointly to the Health, Safety, Security and Environmental (HSSE) Manager and the Field Manager (FM)/Project Manager (PM) for all aspects of the project and is the primary contact for health and safety during all field activities. On this project, the SHSC also serves as the General Foreman (a/k/a Site Foreman or Superintendent) for Amec Foster Wheeler.

The SHSC is responsible for executing the work in compliance with Amec Foster Wheeler HSSE requirements as described in Amec Foster Wheeler's Health, Safety, Security and Environmental (HSSE) manuals. The SHSC establishes the work zones, evacuation routes, and assembly areas. The SHSC makes the day-to-day decision to modify levels of protection provided in the HASP based on site conditions or monitoring data. The SHSC provides necessary support to the Emergency Coordinator (see Project or Field Manager below). The SHSC has the authority to stop all work if conditions are judged to be hazardous to onsite personnel or the public, and reports and investigates accidents and near-misses. Other specific responsibilities are detailed within the Amec Foster Wheeler HSSE Manual.

The SHSC or designee must carefully document the implementation of this HASP by maintaining the Project Health and Safety Files in accordance with the Amec Foster Wheeler requirements.

HSSE Manager - The HSSE Manager is responsible for the review and implementation of the HASP in accordance with the applicable requirements of the Amec Foster Wheeler HSSE Manual and is responsible for approval of all changes made to this HASP.

HSSE Coordinator - The HSSE Coordinator is responsible for the review and revision of the HASP and coordinating the implementation of health and safety procedures through supervision/direction of the SHSC.

Project or Field Manager (PM or FM) or Designee/Representative - The project or field manager (PM or FM or his/her Designee), also referred to as the Site Superintendent, has responsibility for all field activities, enforcement of safe work practices, and ensuring that

daily tailgate meetings are conducted (either by the PM or FM, SHSC, or a rotation of field team members and subcontractor team members). The PM/FM serves as the Emergency Coordinator (EC) in emergency situations. The PM/FM assumes (or assigns to a qualified person) the SHSC duties and responsibilities when the SHSC is not onsite.

Technical Staff - All Amec Foster Wheeler and Amec Foster Wheeler subcontractor personnel are responsible for compliance with this HASP in its entirety. They are responsible for taking all reasonable precautions to prevent injury to themselves and to their fellow employees and for being alert to potentially harmful situations. Technical staff members are expected to perform only those tasks that they believe can be done safely and to immediately report any accidents, near misses, and/or unsafe conditions to the SHSC or the FM.

Amec Foster Wheeler Subcontractors - Responsible for the conduct of their personnel while onsite and ensuring their compliance with this HASP and applicable requirements contained in their company HSSE program, notifying the SHSC of any special medical conditions that could be affected by site conditions (e.g., allergies, diabetes, etc.), and correcting any unsafe acts/conditions that are identified by themselves or the PM or FM or SHSC.

1.8 Required On-site Signage and Postings

The following information is required to be posted in a conspicuous area:

- Federal Occupational Safety and Health Administration (OSHA) Poster or state equivalent (8½ x 14 inches minimum)
- Hospital Route Map
- Emergency Call List

Applicable Safety Data Sheet (SDS) for all chemicals brought to the site will also be made available on site.

2.0 HAZARD EVALUATION

Chemical, physical, energy, biological, and operational safety hazards anticipated during this project will be evaluated in the following tables and the sections that follow Section 3.1. The tables provide details that support the task-specific hazard analyses. Table 1 provides a site characterization overview of the contaminants of concern; Table 2 provides chemical properties and exposure assessment data; and Table 3 summarizes the physical and operational safety hazards and control measures identified for this project. A complete hazard analysis of each site work task and the list of protective measures complete this section of hazard evaluation. Further details of specific control measures for these hazards are presented in Section 3.0, Personnel Protection.

2.1 Chemical Exposure

The primary entry routes of potential contaminants and hazardous materials on the site when exposed to sediment and/or surface water include skin contact with impacted sediment and ingestion of airborne dusts or materials from hand-to-mouth contact due to inadequate personal hygiene. The generation of airborne dusts is not likely to be an exposure issue due to the impacted sediments being saturated (wet).

All required personal protective equipment (PPE) as specified in Section 2.4, Hazard Analysis of Each Site Work Task, will be worn, and personal hygiene will be carefully monitored. The following categories of chemicals of concern under investigation may be present at the site in sediment:

Metals	**Semi-Volatiles**	**Other**
Arsenic	Bis(2-ehtylhexyl) phthalate	Polychlorinated biphenyls (PCBs)
Lead	Naphthalene	
Mercury	Polycyclic Aromatic Hydrocarbons (PAHs)	
Vanadium		

Table 1

SITE CHARACTERIZATION

ANTICIPATED PHYSICAL STATE OF CONTAMINANT(S):

( ) Liquid
(✓) Solid
( ) Sludge
( ) Gas/Vapors
( ) Unknown
( ) Other _____

Notes: metals, semi-volatiles and PCBs in sediment

MATRIX:

( ) Soils
(✓) Sediment
( ) Surface water
( ) Groundwater
( ) Free product (NAPL)
( ) Other _____

Notes:

POTENTIAL HAZARDOUS PROPERTIES:

( ) Corrosive
(✓) Toxic
( ) Inert
( ) Asphyxiant
( ) Flammable/Combust.
(✓) Volatile
(✓) Carcinogenic
( ) Compressed gas
( ) Radioactive
( ) Reactive
( ) Unknown
( ) Other _____

Notes:

CONTAINER/STORAGE SYSTEM INFORMATION:

( ) Tanks _____
( ) Drums _____
( ) Pipes _____
( ) Quantity _____
( ) Landfills/Dumps
( ) Impoundments
( ) Size/capacity _____
( ) Surface
( ) Subsurface
( ) Uncontainerized
( ) In-Service
(✓) Other subsurface derelict barges and associated debris

Notes: There are submerged/grounded barges that will be dismantled and removed by contractor

CONDITION OF CONTAINER/STORAGE SYSTEM(S):

( ) Sound/Undamaged
(✓) Deteriorated/Unsound
( ) Unknown
( ) Other _____
( ) Confirmed leaks
( ) N/A
( ) Suspected leaks

Notes: The derelict barges and associated debris/materials may be rusted, and have sharp/burred edges. AMEC personnel will not handle or go near these materials.

Table 1 (Continued)

SITE CHARACTERIZATION

ORIGIN OR INDUSTRIAL APPLICATION OF CHEMICALS OF CONCERN:

Industrial Process

(✓) Manufacturing
( ) Maintenance/Repair
( ) Painting/Coating
( ) Power Generation
(✓) Prev. Use
(✓) Storage
(✓) Other:
( ) N/A

Notes: Formally the Former Everett Staging Yard Disposal Site, includes the uplands where chemical manufacturing occurred and the portion of Mystic River sediment which has been impacted by chemicals from the uplands.

Chemicals Used or Identified

( ) Acids
( ) Caustics
( ) Halogen
(✓) Metals
( ) Pesticides
(✓) PCBs
( ) Phenols
( ) Paints
( ) Solvents
(✓) Other: semi-volatile (Bis(2-ehtylhexyl) phthalate, Naphthalene, Polycyclic Aromatic Hydrocarbons (PAHs)

Notes:

Oils/Fuels

( ) Fuel Oil
( ) Waste Oil
( ) Hydraulic Oil
( ) AVGAS
( ) MOGAS
( ) Jet Fuel
( ) Gasoline
( ) Leaded
( ) Other: _____

Notes:

Sludges

( ) Metal sludges
( ) Oily sludges
( ) Septic sludges
( ) Other:

Notes:

Solids

( ) Asbestos
( ) Sandblast grit
( ) Landfill refuse
( ) Other:

Notes:

GENERAL NOTES:

Table 2
Chemical Hazard Properties and Exposure Information

CHEMICAL NAME/ SYNONYM	ACGIH TLV TWA	Notations	TLV Basis	OSHA PEL	STEL (ST) Or CEILING	IDLH	IP(eV)	LEL/ UEL	ROUTE/ SYSTEMS**	
									Route	Symptoms
Hydrocarbons, Polynuclear										
Naphthalene	10 ppm	Skin	Irritation; ocular; blood	10 ppm	15 ppm	250 ppm	8.12	0.9%/ 5.9%	Inh Abs Ing Con	Irrit eyes; head, conf, excitement, mal; nau, vomit, abdom pain; irrit bladder; profuse sweat; jaun; hema, hemog, renal shutdown; derm; optical neuritis, corn damage
Metals										
Arsenic	0.01 mg/m^3	BEI	Lung cancer	0.01 mg/m^3		5 mg/m^3	N/A	N/A	Inh Abs Ing Con	Ulceration of nasal septum, derm, GI disturbances, peri neur, resp irrit, hyperpig of skin, carcinogen
Lead	0.05 mg/m^3	BEI	CNS & PNS impair; hematologic	0.05 mg/m^3		100 mg/m^3	N/A	N/A	Inh Abs Ing Con	Lass, insom; facil pallor; anor, low-wgt, malnut; constip, abom pain, colic; anemia; gingival lead line; tremor; para wrist, ankles; encephalopathy; kidney disease; irrit eyes; hypotension
Mercury	0.025 mg/m^3	Skin/ BEI	CNS impair; kidney damage	C0.1 mg/m^3		10 mg/m^3	N/A	N/A	Inh Abs Ing Con	Irrit eyes, skin; cough, chest pain, dysp, bron, pneu; tremor, insom, irrity, indecision, head, lass; stomatitis, salv; GI dist, anor, low-wgt; prot
Vanadium	NE	NE	NE	NE	NE	NE	N/A	N/A	N/A	Vanadium is a naturally occurring element that is widely distributed in the environment. Exposure to the levels of vanadium that are naturally present in food and water are not considered to be harmful (ATSDR).
Semivolatile Organics										
Bis(2-ehtylhexyl) phthalate	NE	NE	NE	NE	NE	NE	N/A	N/A	N/A	Bis(2-ethylhexyl) phthalate (DEHP) is used in the production of polyvinyl chloride (PVC). It exhibits low toxicity from acute (short-term) and chronic (long-term) exposures. Acute exposure to large oral doses of DEHP can cause gastrointestinal distress in humans. No information is available on the chronic, reproductive, developmental, or carcinogenic effects of DEHP in humans (USEPA).
Naphthalene	10 ppm	Skin	URT irr; cataracts; hemolytic anemia	10 ppm	NE	250 ppm	8.12	0.9%/ 5.9%	Inh Abs Ing Con	Irrit eyes; head, conf, excitement, mal; nau, vomit, abdom pain; irrit bladder; profuse sweat; jaun; hema, renal shutdown; derm, optical neuritis, corn damage
Polycyclic Aromatic Hydrocarbons (PAHs) (as coal tar pitch volatiles)	0.2 mg/m^3	BEI	Cancer	0.2 mg/m^3	NE	80 mg/m^3	Not listed	Not listed	Inh Con	Derm, brom [carc]
Polychlorinated biphenyls (PCBs)	0.5 mg/m^3	Skin	URT irr; liver damage; chloracne	0.5 mg/m^3	NE	5 mg/m^3	Unk	N/A	Inh Abs Ing Con	Irrit eyes, chloracne; liver damage; repro effects; carcinogen

NOTES:

ACGIH	American Conference of Governmental Industrial Hygienists	NE	None established	TLV	ACGIH Threshold Limit Values
ATSDR	Agency for Toxic Substances and Disease Registration	NIOSH	National Institute of Occupational Safety and Health	TWA	Time weighted average

IDLH	Immediately dangerous to life and health	OSHA	Occupational Safety and Health Administration	UEL	Upper explosive limit
IP	Ionization potential	PAH	Polynuclear aromatic hydrocarbon	Unk	Unknown
LEL	Lower explosive limit	PEL	OSHA Permissible Exposure Limit	USEPA	United States Environmental Protection Agency
mg/m^3	Milligrams per cubic meter	ppm	Parts per million		
NA	Not applicable	STEL	Short-term exposure limit		

Sources: The above information was derived from NIOSH Pocket Guide to Chemical Hazards, (September 2005). ACGIH Threshold Limit Values (2016).

2.2 Hazard Communication

In addition to the contaminants of concern, the following hazardous substances are anticipated to be brought on the site to supplement remediation activities:

- Isopropyl alcohol (IPA) for potential field equipment decontamination
- Liquinox detergent (or equivalent) for potential field equipment decontamination
- Gasoline (for generator use)
- Nonflammable Gas Mixture: Isobutylene/Nitrogen/Oxygen for air monitoring equipment calibration

These hazardous materials are subject to the Hazard Communication Standard (29 CFR 1910.1200); required Safety Data Sheets (SDSs) are presented in Appendix 1. The hazardous materials must also be properly labeled with the name of the chemical (product identifier), signal word, hazard statement, pictogram(s), precautionary statement, and name, address, and telephone number of the chemical manufacturer, importer, or other responsible party. The above list must be updated by the SHSC and SDSs must be obtained and filed for any additional hazardous substances brought on-site.

The SHSC must give all site employees a hazard communication orientation about hazardous chemicals brought on-site. This briefing will include health and physical hazards, precautionary measures to be taken during normal operations and foreseeable emergencies, labeling practices, and location of SDSs.

The FM shall ask the client for copies of SDSs for any hazardous materials in use by the client's employees at the site. The SHSC shall orient Amec Foster Wheeler employees/subcontractors as described above.

2.3 Physical or Operating Hazards and Control Measures

Physical or operating hazards identified or reasonably anticipated to be associated with site work tasks are provided in Table 3, along with a summary of specific control measures. More detailed discussions are provided in the Amec Foster Wheeler HSSE and Emergency

Response SOPs in *Section H – Health, Section S – Safety*, and *Section ER – Emergency Response* of the Amec Foster Wheeler HSSE Manual.

Table 3
PHYSICAL AND OPERATING HAZARDS

Hazards	Preventative measures
Cold stress **References:** Health SOP H-3, Cold Stress Control	During tailgate safety meetings, train workers to recognize the signs and symptoms of cold stress illnesses: • Frostbite - Skin color changes to white to reddish, pain followed by cold and numbness in the affected area(s); blisters may appear later. • Hypothermia - Uncontrollable shivering, a sensation of feeling cold, a slowed and sometimes irregular heartbeat, a weakened pulse, and changes in blood pressure. More severe cases can result in slurred speech, memory lapses, incoherence, and drowsiness. <u>First Aid</u> • Frostbite - Cover the frozen body part, provide extra clothing and blankets, bring the victim indoors as soon as possible, place the frozen body part in warm water (~100°F) or rewarm with warm packs. Seek medical assistance as soon as possible. • Hypothermia - Get victim out of wind, snow, and rain. Keep person awake. Remove any wet clothing and replace with dry, warm clothing. Wrap blanket around victim. If conscious, give victim sweet warm non-caffeinated beverages. Seek medical attention as soon as possible. <u>Prevention</u> • Provide shelter away from rain, snow, or wind for breaks. • Institute a work-rest schedule in accordance with the standard operating procedure (SOP).
Ergonomic Stress **References:** Health SOP H-4, Ergonomic Program	Lift carefully with load close to body with the legs taking most of the weight. Get help with lifts greater than 40 lbs. Do not lift greater than 50 lbs by yourself. When working with a heavy tool or object, keep legs under the load and do not overreach or twist to the side. Reposition body to be more square to the load and work. Push loads, rather than pull, whenever feasible. Do not persist with lifting when the load is too heavy. Use a mechanical lifting aid or have a coworker assist with the lift. Rotate repetitive tasks to avoid soft-tissue fatigue.

Hazards	Preventative measures
Fire and explosion **References:** Emergency Response SOP ER-3, Fire Prevention for Field Work; Safety SOP S-8, Hot Work Permits	Make ABC fire extinguishers accessible in the work area. Store flammables in Underwriter's Laboratory and Occupational Safety and Health Administration (OSHA) approved metal safety cans equipped with spark arrestors. Store flammable containers more than 50 ft from the rig/heavy equipment. Store portable (flammable) tanks more than 100 ft from the rig. Keep exhaust equipment powered by internal combustion engines well away from flammables and combustibles. Secure hot work permits/approvals before welding or cutting. Store and use compressed gases in a safe manner. Never refuel equipment (e.g., generators) while it is in operation or hot enough to ignite fuel vapors. Conspicuously mark operations that pose fire hazards "No Smoking" or "Open Flames." Remove trash, weeds, and unnecessary combustibles from the Exclusion Zone (EZ).
Biological agents **References:** Emergency Response SOP ER-1, Bloodborne Pathogen Exposure Control, Poison Ivy, Oak, and Sumac Field Guide	Project work will not expose workers to infectious agents or wastes; however, responders to first aid incidents could contact bloodborne pathogens. Follow the Bloodborne Pathogen Control Plan in this Health and Safety Plan (HASP). Identify personnel who are highly sensitive or allergic to insect bites or stings during the "kickoff" meeting so that the appropriate emergency treatment can be made available on-site. Never try to capture wild or semi-wild animals—they may bite you or infect you with parasites. Poison Ivy, Oak, and Sumac • Review the Poison Ivy, Oak, and Sumac Field Guide during daily tailgate safety meetings. Worker must be familiar with the appearance of these poisonous plants. • If there is accidental contact, carefully remove affected clothing and wash skin with soap and warm water or poisonous plant wash such as Technu® or an equivalent, as soon as possible. Ticks • Tick parasites are commonly encountered in thick vegetation. • Check yourself and coworkers regularly for feeding ticks. • If a tick is located, remove it with tweezers and place in a vial. • If irritation is felt or observed at the bite site, seek medical attention. Bring in removed tick, if possible. • Tick bites can lead to local infections at the bite site or result in potentially severe illnesses, such as Lyme Disease or Rocky Mountain Spotted Fever. • Apply insect repellent prior to field work. If the ticks are prevelant in the area, apply a permethrin based repellent to your field clothing (while not wearing the clothing) and allow to dry, then don the treated field clothing.

Hazards	Preventative measures
Mobile and Stationary Mechanized Equipment **References:** Safety SOP S-13, Mobile and Stationary Mechanized Equipment	Owner/operator shall inspect equipment daily, including brakes, and keep daily logs. Correct all discrepancies before placing equipment in service. Keep blades, buckets, and other heavy equipment fully lowered when not in use. Parking brakes must be engaged. After working hours, bucket may be elevated if the locking pin is in place. All mobile equipment must be equipped with a horn distinguishable from the surrounding noise level and an automatic backup alarm. The backup alarm must be functional whenever the equipment is working. Chock or block the wheels of equipment parked on inclines. Set the parking brake. Never use equipment on unstable or unsafe inclines. Use hand signals, radios (as appropriate), and line-of-sight confirmation to communicate effectively with operators. Mobile mechanized equipment must be equipped with a fire extinguisher or a fire suppression system.
Inclement weather, shut-down conditions **References:** Emergency Response SOP ER-2, Emergency Action Plan for Field Operations	Poor visibility. Precipitation severe enough to impair safe movement or travel. Lightning in the immediate area. Steady winds in excess of 40 mph. Other conditions as determined by the SHSC, FM, or Corporate Vice President of Health, Safety, and Environment (Corporate VP of HSSE). Imminent threat of severe tropical storm or hurricane. (Also see Emergency Response section of this HASP and Emergency Action Plan SOP ER-2.) Work will resume when the conditions are deemed safe by the SHSC. Complete an Incident Analysis Report (Appendix 2) within 24 hrs for all work shutdowns.
Noise **References:** Health SOP H-10, Hearing Conservation Program	Wear hearing protection when speech becomes difficult to understand at a distance of 10 ft and while standing within 20 to 25 ft from heavy equipment, pneumatic power tools, steam cleaners, and other equipment in operation that can generate more than 85 decibels (A-weighted scale) (dBA). Label equipment as a noise hazard if it generates, or is capable of generating, more than 85 dBA.

Hazards	Preventive measures
Slips, trips, and falls **References**: Safety SOP S-11, Signs, Signals, and Barricades; Administrative SOP A-2, Housekeeping	Clear work area of obstructions and debris before setting up. Alter work areas as necessary to provide a safe, reasonably level area. All walking and working surfaces shall continually be inspected and maintained to be free of slip, trip, and fall hazards. When ascending or descending any steep river bank use a safety rope and carabineer attached to a fixed point. The rope must be inspected prior to each use. The inspection must be noted in the field logbook. Keep drill platforms, stairs, and immediate work areas clear. Do not allow oil, grease, or excessive mud to accumulate in these areas. Channel the discharge of drilling fluids and foam away from the work area to prevent ponding or slippery conditions. Backfill open boreholes immediately, or cap and flag them. Barricade open excavations or cover them with steel traffic plates. Eliminate slip, trip, and fall hazards or identify them clearly with caution tape, barricades, or equivalent means. Store loose or light material and debris in designated areas or containers. Secure tools, materials, and equipment subject to displacement or falling.
Drowning **References**: Safety Draft HSSE-P-2.1.2 (new draft procedure) Working Over or Near Water; Boating Safety Draft HSSE-P- HSSE-S-2.2.19	Employees conducting work activities within 6-feet of the edge of any open body of water such as rivers, bays, lakes or ocean shall wear PFDs. A safety line must also be attached to the employee if the body of water is fast moving such that if the employee falls into the water they could not easily extract themselves. Vessels must be equipped with 30-inch ring buoys (one every 100 ft.) with lines attached (at least 90 feet of rope) and located in readily visible and accessible places. Docks must be equipped with ring buoys at least every 200 feet. At least one lifesaving skiff must be immediately available. Lifesaving skiffs shall not be used for any other purpose except for rescue and shall be in the water or capable of being launched by one person. PFDs must be worn at all times when working in, on or near (within 6 feet of the water's edge) water. PFDs must be inspected before and after each use for defects and signs of wear that would alter their strength or buoyancy. Defective units will be destroyed or tagged out of service and not used. Vessels must be equipped with at least one portable or permanent ladder of sufficient length to allow employees to reach safety in the event they fall into the water. Use of ladders will follow established E&I procedure requirements. All operations involving use of a boat, with or without a motor, in navigable waters or water three feet or greater in depth requires the buddy system. If Amec Foster Wheeler operates a boat, the Project Manager must ensure that all affected employees have received Coast Guard approved safe boating training and are authorized to operate a boat. The Project Manager must also file a float plan and rescue plan.

2.4 Hazard Analysis of Each Site Work Task

JOB TASK NAME: OBSERVING THE DEBRIS SURVEY AND BATHYMETRIC SURVEYS

Equipment/tools: Boat, PFDs, throw ring, GPS unit, rope and anchors

Hazardous chemicals: See list of site contaminants in Table 2 of this HASP.

Potential hazards: Check or add all that apply to site conditions

( ) Ground intrusion (underline)	(✓) Chemical (underline)	(✓) Biological (underline)
Drilling Sampling	Vapor generation	Toxic or irritant plants
Excavation Direct push	Dust generation	Pathogens Insects
( ) Heavy equip. operation	Mat'l contact	( ) Fire/explosion (underline)
(✓) Physical exertion/strain	(✓) Electrical (underline)	Flammable materials
(✓) Slick/wet surfaces	Ovrhd./underg. utilities	Fuel lines
( ) Uneven terrain	Energized equipment	Hot work
( ) Falls from elev. >6 ft	Power tools	Compressed gases
( ) Trench collapse/engulf.	( ) Pedestrian traffic	(✓) Boat operation/usage
( ) Confined space/O_2 def.	( ) Vehicle traffic	(✓) Work over water
(✓) Heat stress	( ) Noise (>85 dBA)	( ) Explosive ordnance
(✓) Cold stress	( ) Ergonomic (lifting, repetitive motion)	( ) Other_____

Control and protective measures:

(✓) Equip. Operator Training ( ) Equip. Certific./Inspections (✓) PPE Level D

( ) Air Monitoring Equipment:

(✓) Specialized Training: USCG Boat Safety course if operating a boat. Water safety awareness prior to site assignment

(✓) Site Control/Safe Access: See HASP Section 4.0

(✓) SOPs/Guidelines: Safety Draft HSSE-P-2.1.2 (new draft procedure) Working Over or Near Water and Boating Safety Draft HSSE-P- HSSE-S-2.2.19

( ) Engineering Controls:

(✓) Safe Work Practices: See SOPs listed above, Section 3.1.4 and Table 3 of the HASP

(✓) Other: Amec Foster Wheeler will adhere to the contractor's HASP for all on-water/on-vessel work

Personal Protective Equipment (PPE)

Initial levels of protection were assigned to this work task based on the potential risk of exposure. These levels may be changed if warranted by monitoring data (see Action Levels) and site conditions (as determined by the SHSC). Any change to these initial levels must be noted here and documented with a completed ROC form.

EPA level of protection	( ) A (✓) D Modified	( ) B ( ) D	( ) C
Respirator (Level C and up)	( ) SCBA, airline ( ) P-100 Filter	( ) purif. resp. ( ) dust pre-filters	( ) OV/AG cart ( ) other_____
Protective clothing	( ) encap. suit ( ) Saranex ® or equiv.	( ) Tyvek ® or equiv. ( ) splash suit	( ) PE Tyvek ® or equiv. (✓) other: PFD
Head, face, eyes, ears	(✓) hard hat ( ) splash shield	(✓) safety glasses ( ) ear plugs/muffs	( ) goggles ( ) other _____
Gloves (outer) (inner)	( ) nitrile_____ (✓) nitrile _____	( ) neoprene ( ) vinyl	( ) other_____ ( ) other_____
Footwear	(✓) safety-toe leather ( ) hip waders	( ) overboots/covers ( ) shin/knee guards	( ) safety-toe rubber ( ) other _____

Modifications: Must wear USCG approved PFD while on-board vessel or working within 6 feet of the shoreline and must use safety rope when ascending and descending any steep slopes (river banks).

X = required PPE; * = modifications permitted; † =in case of upgrade.

TASK NAME: SEDIMENT PROCESSING/SAMPLING AT THE OFF-SITE SHIPPING YARD

Equipment/tools: Boat, GPS, Anchors, PFDs if working on or near water, and safety rope and carabiner when ascending/ descending steep slopes (river banks)

Hazardous chemicals: Metals, semi-volatiles and PCBs in sediment (see Table 2 of this HASP)

Potential hazards: Check or add all that apply to site conditions

(✓) Ground intrusion (underline)	(✓) Chemical (underline)	(✓) Biological (underline)
Drilling Sampling	Vapor generation	Toxic or irritant plants
Excavation Direct push	Dust generation	Pathogens Insects
(✓) Heavy equip. operation	Mat'l contact	(✓) Fire/explosion (underline)
(✓) Physical exertion/strain	(✓) Electrical (underline)	Flammable materials
(✓) Slick/wet surfaces	Ovrhd./underg. utilities	Fuel lines
(✓) Uneven terrain	Energized equipment	Hot work
( ) Falls from elev. >6 ft	Power tools	Compressed gases
( ) Trench collapse/engulf.	( ) Pedestrian traffic	(✓) Boat operation/usage
( ) Confined space/O_2 def.	(✓) Vehicle traffic	(✓) Work over/near water
(✓) Heat stress	(✓) Noise (>85 dBA)	( ) Explosive ordnance
(✓) Cold stress	(✓) Ergonomic (lifting, repetitive motion)	(✓) Other: Steep slopes/river bank

Control and protective measures:

(✓) Equip. Operator Training (✓) Equip. Certific./Inspections (✓) PPE Level D w/ reflective vest

(✓) Air Monitoring Equipment: Photoionization detector

(✓) Specialized Training: USCG Boat Safety course if operating a boat. Water safety awareness prior to site assignment

(✓) Site Control/Safe Access: ___See HASP Section 4.0.

(✓) SOPs/Guidelines: Safety Draft HSSE-P-2.1.2 (new draft procedure) Working Over or Near Water and Boating Safety Draft HSSE-P- HSSE-S-2.2.19 and Section, HSSE Manual Section 1.7 Safety Programs/Safe Work Practices/Standard Operating Procedures, Section 3.1.4 and Table 3 of the HASP

( ) Engineering Controls:

(✓) Safe Work Practices: Use safety rope and carabineer attached to a fixed point to ascend/descend steep river banks (if applicable)

( ) Other:

Personal Protective Equipment (PPE)

Initial levels of protection were assigned to this work task based on the potential risk of exposure. These levels may be changed if warranted by monitoring data (see Action Levels) and site conditions (as determined by the SHSC). Any change to these initial levels must be noted here and documented with a completed ROC form.

EPA level of protection	( ) A (✓) D Modified	( ) B ( ) D	( ) C
Respirator (Level C and up)	( ) SCBA, airline ( ) P-100 Filter	( ) purif. resp. ( ) dust pre-filters	( ) OV/AG cart ( ) other_____
Protective clothing	( ) encap. suit ( ) Saranex ® or equiv.	( ) Tyvek ® or equiv. ( ) splash suit	( ) PE Tyvek ® or equiv. (✓) other: PFD
Head, face, eyes, ears	(✓) hard hat ( ) splash shield	(✓) safety glasses (✓) ear plugs/muffs	( ) goggles (✓) other high visibility reflective vest_____
Gloves (outer) (inner)	( ) nitrile_____ (✓) nitrile _____	( ) neoprene ( ) vinyl	( ) other_____ ( ) other_____
Footwear	(✓) safety-toe leather ( ) hip waders	( ) overboots/covers ( ) shin/knee guards	( ) safety-toe rubber ( ) other _____

Modifications: Must wear USCG approved PFD while on-board vessel or working within 6 feet of the shoreline; must use safety rope when ascending and descending steep slopes (river bank, if applicable)

X = required PPE; * = modifications permitted; † =in case of upgrade.

TASK NAME: OBSERVING/MONITORING SEDIMENT REMEDIATION INCLUDING DREDGING AND CAPPING ACTIVITIES. Amec Foster Wheeler will be observing contractors/subcontractors performing work on the water and may be required to access boats/barges at some point in the process. Amec Foster Wheeler will abide by the contractor's vessel safety plan while accessing and working on the vessel.

Equipment/tools: Heavy Equipment (Contractor for Wynn) including vessel (barges, dredges, boat), vessel anchors, PFDs, emergency equipment required for all vessel operations;

Hazardous chemicals: DREDGING AND CAPPING OF IMPACTED SEDIMENTS (SEE TABLE 2 FOR LIST OF CONTAMINANTS)

Potential hazards: Check or add all that apply to site conditions

(✓) Ground intrusion (underline) Drilling Sampling Excavation (dredging) (✓) Heavy equip. operation (✓) Physical exertion/strain (✓) Slick/wet surfaces (✓) Uneven terrain ( ) Falls from elev. >6 ft ( ) Trench collapse/engulf. ( ) Confined space/O_2 def. (✓) Heat stress (✓) Cold stress	(✓) Chemical (underline) Vapor generation Dust generation Mat'l contact (✓) Electrical (underline) Ovrhd./underg. utilities Energized equipment Power tools ( ) Pedestrian traffic ( ) Vehicle traffic (✓) Noise (>85 dBA) (✓) Ergonomic (lifting, repetitive motion)	(✓) Biological (underline) Toxic or irritant plants Pathogens Insects ( ) Fire/explosion (underline) Flammable materials Fuel lines Hot work Compressed gases (✓) Boat operation/usage (✓) Work over water ( ) Explosive ordnance (✓) Other: Observation of barge dismantling and removal

Control and protective measures:

(✓) Equip. Operator Training (✓) Equip. Certific./Inspections (✓) PPE Level D w/ high visibility reflective vest

( ) Air Monitoring Equipment: _____

(✓) Specialized Training: OSHA Hazwoper 40-hour and refreshers, and OSHA Supervisor for supervisory staff. USCG Boat Safety course if operating a boat. Water safety awareness prior to site assignment.

(✓) Site Control/Safe Access: Use cones to mark off work area where appropriate. Use public boat ramp to access vessel as appropriate.

(✓) SOPs/Guidelines: HSSE Manual Section 1.7 Safety Programs/Safe Work Practices/Standard Operating Procedures, Section 2.4 Safety Planning, Section A – Administrative, and Section S – Safety. Procedure: Safety Draft HSSE-P-2.1.2 (new draft procedure) Working Over or Near Water and Boating Safety, Draft HSSE-P- HSSE-S-2.2.19. Section 3.1.4 of the HASP.

( ) Engineering Controls: _____

(✓) Safe Work Practices: Working around equipment, and Table 3 of the HASP and Safe Boating including filing a Float Plan and establishing a rescue plan.

(✓) Other: Contractor's HASP for Dredging and Capping activities.

Personal Protective Equipment (PPE)			
Initial levels of protection were assigned to this work task based on the potential risk of exposure. These levels may be changed if warranted by monitoring data (see Action Levels) and site conditions (as determined by the SHSC). Any change to these initial levels must be noted here and documented with a completed ROC form.			
EPA level of protection	( ) A (✓) D Modified	( ) B ( ) D	( ) C
Respirator **(Level C and up)**	( ) SCBA, airline ( ) P-100 Filter	( ) purif. resp. ( ) dust pre-filters	( ) OV/AG cart ( ) other_____
Protective clothing	( ) encap. suit ( ) Saranex ® or equiv.	( ) Tyvek ® or equiv. ( ) splash suit	( ) PE Tyvek ® or equiv. (✓) other: Must wear USCG approved PFD while on-board vessel or when working within 6 feet of the shoreline.
Head, face, eyes, ears	(✓) hard hat ( ) splash shield	(✓) safety glasses (✓) ear plugs/muffs	( ) goggles (✓) other high visibility reflective vest

Gloves (outer) (inner)	( ) nitrile_____ (✓) nitrile (if contact with contaminated media)	( ) neoprene ( ) vinyl	( ) other_____ ( ) other_____
Footwear	(✓) safety-toe leather ( ) hip waders	( ) overboots/covers ( ) shin/knee guards	( ) safety-toe rubber ( ) other _____

Modifications: _____

X = required PPE; * = modifications permitted; † =in case of upgrade.

3.0 PERSONNEL PROTECTION

The prescribed methods and procedures used to protect personnel (site workers and adjacent community) from overexposure to hazardous materials and hazardous conditions posed by site operations are grouped into three primary categories: Administrative Controls, Engineering Controls, and PPE.

3.1 Administrative Controls

3.1.1 Medical Surveillance

Periodic Comprehensive Exam:

All personnel requiring access to controlled work areas will have completed a pre-assignment medical examination and a periodic (usually annual) update examination prior to assignment, in accordance with OSHA 29 CFR 1910.120(f). The exam must be performed by an Occupational Health Physician, who will provide written clearance for hazardous waste site work and for respirator usage. Protocols for the baseline, periodic, and exit exams must be at least as stringent as those defined in the Amec Foster Wheeler Medical Surveillance Program as described in *Section 4.3 – Medical Surveillance (US)*, of the Amec Foster Wheeler HSSE Manual.

Emergency Medical Treatment:

Personnel who exhibit signs and symptoms of chemical or heat overexposure, or have been injured on the job, might also seek medical services. See also the Medical Emergency Response (Section 9.3) for specific information regarding emergency services and logs, reports, and record keeping and Section 3.1.5 for required report submittals. Subcontractors should provide internal Workers' Compensation information to the SHSC during the pre-work meeting, for emergency use.

Medical Clearance Record Keeping:

Amec Foster Wheeler employees' clearance documents are on file at the home Amec Foster Wheeler office or in the Chelmsford Health and Safety Department. To ensure confidentiality,

results of the medical exams or treatment records are maintained at the WorkCare's corporate offices.

3.1.2 Training

Comprehensive:

All routine on-site general site workers performing intrusive activity or having the potential to receive exposures exceeding permissible limits will have completed the OSHA 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) Training. Three days of on-site supervised training must be completed upon initial assignment. Appropriate annual refresher (within 12 months) updates must be completed by all HAZWOPER personnel. Supervisors, which includes the SHSC, will have completed the above and an additional 8 hours of OSHA Management and Supervisory Training.

Occasional site workers who are not expected to receive exposures exceeding permissible exposure limits (e.g., geophysical and land surveyors) require only 24 hours of OSHA HAZWOPER Training and 1 day of on-site training and supervision.

First Aid/CPR Instruction:

All Amec Foster Wheeler staff will have completed training in and be current in first aid/cardiopulmonary resuscitation (CPR).

Specialized:

Work In, On or Near Water and Vessel Operation

Vessels may be used on this project for transport to and from barges, as a base for performing tasks on the water (e,g., water quality monitoring, bathymetric surveys), for dismantling derelict barges, and for dredging. Health and safety procedures and policies relative to vessel operations are to be covered in detail the sediment remediation contractor's HASP. A general overview of the procedures and policies to be covered is provided below:

- Inspection, Certification, and Registration. All vessels used for the Wynn sediment remediation project that are regulated by the US Coast Guard (USCG) must have current inspections and certificates issued by USCG prior to being placed into service for this project. A copy of the inspection and certificate must be posted in a public area on board the vessel. A daily inspection of the vessel following USCG recommendations must be completed by the operator. Any mechanical problems must be corrected before vessel operation.
- Vessel Personnel Qualifications. Personnel who operate vessels shall have the required USCG safety boating course and be knowledgeable in the USCG boating safety requirements (33 CFR Subchapter S Boating Safety and other parts as applicable). The vessel operator is responsible for the safety of all personnel on board the vessel that he/she is operating and for the safe operation of the vessel.
- Vessel Safety Requirements. The vessel operator is responsible for providing all the required safety equipment for safe vessel operation for all occupants, and for providing a safety briefing for all vessel occupants prior to moving the vessel from shore.
- Vessel Safety Equipment Requirements. The vessel operator is responsible for providing safety equipment (PFDs, fire extinguishers, air horn, tool kit, navigation lights, etc.) for safe operation of the vessel in accordance with USCG requirements.
- Personnel Safety Requirements. A USCG approved personal flotation device (PFD) will be provided to and be properly worn by all vessel occupants. Each vessel will have the appropriate number of Type IV PFD (e.g., life ring) that is designed to be thrown to and held by a person in the water for rescue purposes.

Prior to finalizing the HASP, the PM must confirm the vessel contractor and Amec Foster Wheeler responsibilities as they apply to vessel operation and safe vessel operation requirements. The PM will conduct a pre-field work meeting between the field team members and the contractor(s) (via conference call) to discuss the responsibilities for vessel operation and safe boating requirements. The contractor must provide proof of license to operate the vessel on navigable waters, USCG safety training, and a safety plan that describes the methods the contractor will implement to maintain safety including filing a Float Plan, implementing an immediate Rescue Plan for person overboard, medical emergency, etc.

Prior to initiation of site activities, the SHSC and PM/FM will conduct a health and safety "kickoff" meeting, which will discuss the known on-site hazards. At this meeting, pertinent Amec Foster Wheeler SOPs and the site-specific HASP will be discussed in detail with special attention given to site chemical and physical hazards, PPE, emergency procedures, working in, on or near water, vessel safety, etc. Upon completion of this briefing, all routine field personnel, including contractors and subcontractors, will be required to read and sign the acceptance sheet of this HASP.

Site visitors and nonroutine subcontractors who do not attend this meeting will be briefed by the SHSC or PM/FW on the hazards to be expected on the site and the safety and health controls required as documented on the Subcontractor Health and Safety Orientation Form in Appendix 2. An escort will be provided for visitors while on site and a visitor Daily Roster (also in Appendix 2) shall be maintained.

If Amec Foster Wheeler employees will be operating a vessel, the employees must be provided boating safety training in accordance with the draft: *HSSE-S-2.2.19 Boating Safety Procedure.* Training can be obtained through a USCG approved boating safety course or from a Company employee who has completed a USCG approved boating safety course. If Amec Foster Wheeler employees will be riding in a vessel, Amec Foster Wheeler must confirm the operator is qualified to operate the vessel as described above. Amec Foster Wheeler will maintain copies of employees' training certifications.

Daily:

"Tailgate" safety meetings will be conducted each morning by the PM/FM, SHSC, or a rotation of Amec Foster Wheeler and contractor team members for all phases of work. The tailgate meetings will be conducted in accordance with Amec Foster Wheeler *SOP A-9, Guidance for Conducting Tail-gate Safety Meetings*. This meeting will commence prior to work beginning each day at the site. Topics of discussion will include work tasks to be conducted that day and designated PPE, emergency procedures, evacuation routes, instruction in use of safety equipment (as required), prior safety problems, recognition of signs and symptoms of overexposure, importance of proper decontamination, and personal hygiene, water/boating safety, etc. Additional guidance is available in the *Section 2.7 - Construction Management*

Project Hazards and Controls of the Amec Foster Wheeler HSSE Manual. These meetings must be documented in the onsite log book, and be memorialized on the Tailgate Safety Meeting Form contained in *Section 2.7 - Construction Management Project Hazards and Controls* of the Amec Foster Wheeler HSSE Manual. This Amec Foster Wheeler form serves to document the required daily tailgate meeting.

Fire Extinguisher Usage:

In accordance with 29 CFR 1910.157, all field personnel who are provided portable fire extinguishers for use will be familiar with general principles of use, received training within the past year and be knowledgeable off the hazards of incipient (early stage) firefighting.

All contractors and subcontractors operating heavy equipment and all vessels are required to have a suitable fire extinguisher with each heavy equipment on site and each motorized vessel.

DOT Hazardous Materials Shipment/Receipt (HM 126F):

In accordance with 49 CFR 172, Department of Transportation (DOT) HM126F training is required for all employees who handle, transport, or prepare to transport hazardous materials and hazardous wastes.

Equipment Operators:

In accordance with state and federal OSHA regulations, all heavy equipment operators (forklifts, backhoe, excavators, vessels, etc.) must be trained for safe operation. Proof of documentation may be requested.

3.1.3 Accident Prevention

The SHSC, as well as all site employees, will inspect the work site daily to identify and correct any unsafe conditions. The SHSC will conduct daily housekeeping and safety inspections and audits of the Amec Foster Wheeler and subcontractor activities to identify unsafe acts or conditions and to verify that safe working conditions are being maintained. The SHSC will implement appropriate corrective actions and inform all affected site workers.

Adherence to the Safe Work Practices (to follow) and procedures outlined in this HASP will assist with accident prevention. In addition, the HSSE Representative of Amec Foster Wheeler and its subcontractors and contractors will participate in all on-site safety meetings held the remediation Contractor.

3.1.4 Safe Work Practices:

Personal Conduct

- Unauthorized personnel are not allowed on-site, particularly in the Exclusion Zone (EZ).
- Work groups will always consist of at least two team members.
- A high standard of personal hygiene will be observed. Smoking, eating, drinking, chewing gum or tobacco, taking medication, and applying cosmetics will not be permitted within any restricted area or EZ.
- Personnel under the obvious influence of alcohol or controlled substances are not allowed on-site; those taking medications must notify the SHSC.
- All site personnel will familiarize themselves with these practices and the emergency procedures during daily tailgate and pre-work safety meetings.
- Workers who are passengers or drivers of vehicles (both off-site and on-site) will wear their seat belts any time the vehicle is in motion.
- Cell phones are *strictly prohibited* while driving any vehicle or mobile equipment and vessels at the site.

Personal Protection

- Personnel will avoid skin contact with contaminated or potentially contaminated media. If such contact occurs, the affected areas should be washed thoroughly with soap and water.
- Personnel will discard and replace any damaged or heavily soiled protective clothing.
- Personnel should notify the SHSC of any defective monitoring, emergency, or other protective/safety equipment.

Equipment and Activities

- Open flames are not allowed anywhere on-site without a hot-work permit.

- Owners/operators of heavy equipment will ensure that the equipment is in good working order by performing daily inspections and routine maintenance. Deficiencies affecting health and safety shall be corrected prior to equipment use.
- All unsafe conditions shall be made safe immediately. All unsafe conditions not in the scope of the project shall be reported to the PM/FM and the condition corrected.
- Loose-fitting clothing or loose long hair are prohibited near moving machinery.
- All internal combustion engines must have spark arrestors that meet the requirements for hazardous atmospheres if they are to be used in such areas.
- Do not fuel engines while vehicle is running.
- Install adequate on-site road signs, lights, and devices.
- Where portable electric tools and appliances can be used (where there is no potential for flammable or explosive conditions), they will be equipped only with 3-wire grounded power and extension cords to prevent electrical shock.
- Store tools in clean, secure areas so they will not be damaged, lost, or stolen.
- When exiting a vehicle, shift into park, set the parking brake, and shut off the engine. Never leave a running vehicle UNATTENDED.
- When ascending or descending a steep river bank, use a safety rope and carabineer attached to a fix point. The rope must be inspected prior to each use and the inspection noted in the field logbook.

3.1.5 Logs, Reports, and Record Keeping

Submittal of Certifications:

Proof of health and safety training and medical certifications must be submitted to the PM or FM and SHSC by the subcontractor prior to mobilization of field crews. The SHSC will maintain a copy of the certifications (and all record of changes for revisions of personnel additions and substitutions) certifying that all Amec Foster Wheeler and subcontracted personnel have satisfied the minimum training and medical requirements listed above. Supporting documentation and certificates will remain on file with the HSSE Coordinator in the home office. Field projects will not be allowed to take place in the absence of adequate documentation.

Site Monitoring, Reports, and Records:

The health and safety field files maintained by the SHSC, or his/her designee, will be the primary form of record keeping and documentation of site health and safety activities. These documents will be completed in sufficient detail to document the work performed; any unusual or significant circumstances under which the work was performed; any unanticipated/unplanned action taken to mitigate or to otherwise cope with unexpected field conditions; and pertinent comments about site-specific conditions that could have a bearing on the work performed. Documentation is required for all phases of work. See also the SHSC duties listed under Section 1.6, Personnel Responsibilities. Record keeping practices will follow 29 CFR 1910.20. The health and safety records will contain the following documents; all blank forms (designated by an asterisk) are provided in Appendix 2 to this HASP:

- Certification of medical and training requirements
- Signed acceptance sheet of this HASP (signed by all routine on-site personnel)
- Health and safety notations made in the Site Log Book that is held by the PM or FM
- *Employee/Visitor Daily Roster
- *Amec Foster Wheeler Tailgate Safety Meeting Form
- *Incident Analysis Report (for injuries/illnesses, environmental incidents, equipment damage, and work stoppages)
- Completed record of changes to this HASP

3.2 Engineering Controls

3.2.1 Dust Suppression

Although not expected to be an issue during dredging activities, when necessary, dust suppression techniques will be employed to minimize the generation of dust/particulates and associated contaminants into the atmosphere, to the greatest extent possible. Also, stationary sources of dusts, e.g., soil stockpiles, should be covered with plastic (visqueen) or canvas tarping.

3.2.2 Noise Reduction

Site activities in proximity to construction and heavy equipment often expose workers to excessive noise. It is anticipated that situations may arise when noise levels may exceed the OSHA Action Level of 85 decibels (A-weighted scale) (dBA) in an 8-hour time-weighted average (TWA). An example of this possibility is working in close proximity to the contractor during dredging activities. If excessive noise levels occur, ear plugs will be issued to all personnel and a system of hand signals understood by all will be implemented (see Section 4.4).

3.3 Personal Protective Equipment (PPE)

Initial levels of protection for this site may vary depending on the task. All personnel entering controlled work zones will initially be required to wear the U.S. Environmental Protection Agency (EPA)/OSHA Level of Protection as specified in Section 2.4, Hazard Analysis of Each Site Work Task, and summarized in Table 4 below.

Table 4
INITIAL ASSIGNMENTS OF PROTECTION LEVELS,
FOR SITE WORK TASKS

Task Name ***List in same order as in Section 2.4, Hazard Analysis of Each Site Work Task***	**Level of Protection***	**HAZWOPER**		
		40-hour Classroom Training	**24-hour Classroom Training**	**Medical Surveillance**
Observing Bathymetric survey	D modified with PFD	✓		✓
Phase IV Implementation – Sediment Remediation including dredging, barge dismantling, etc.	D modified with vest or PFD	✓		✓

* Initial assignments may be modified by the SHSC as additional data are received from monitoring data and compared to action levels (Table 5), or as warranted by site conditions. Any changes will be noted in this HASP and/or documented on record of changes.

Refer to *SOP H-12, Personal Protective Equipment*, in *Section H – Health* of the Amec Foster Wheeler HSSE Manual for levels of protection definitions and examples.

Protection may be upgraded or downgraded depending on monitoring data (compared with action levels) and site conditions, as determined by the SHSC. All changes must be noted in this HASP and documented on record of changes. The following outlines the minimum requirements for each level of protection that is assigned or potentially assigned.

Note: Although levels of protection above Modified Level D are listed (e.g., Level C and Level B), the HASP as written does not provide all of the necessary procedures to conduct field work in these higher levels of protection. In the event that Level C or Level B are warranted, the HASP will be updated and affected workers will be provided additional information and training as necessary. All proposed work in Level B requires prior notification to the HSSE Manager Cindy Sundquist.

Level D PPE:

- Work shirt with sleeves that are a minimum 4 inches in length, and full-length cotton pants or coveralls
- American National Standards Institute (ANSI) standard safety-toe work boots
- ANSI standard hard hat (when working around heavy equipment or overhead "bump" hazards)
- ANSI standard safety glasses
- EPA-approved hearing protectors (when working in high noise areas, e.g., steam cleaners and heavy equipment)
- Safety rope and carabineer for ascending and descending a river bank (if applicable)

Modified Level D PPE:

- Level D equipment
- Class 2 High Visibility Reflective Vest when not on-board watercraft
- USCG approved PFD while on-board any watercraft
- Safety rope and carabineer for ascending and descending a river bank (if applicable)

Level C PPE:

- Modified Level D equipment, with taping of coverall to boots and gloves, as necessary
- National Institute of Occupational Safety and Health (NIOSH)-approved, half-face or full-face air-purifying respirator with organic vapor/acid gas cartridges and particulate pre-filters (respirator usage clearance is defined in *SOP H-13, Respiratory Protection*, Amec Foster Wheeler HSSE Manual)
- Safety rope and carabineer for ascending and descending the river bank (if applicable)

Level B PPE:

- Modified Level D equipment, use of chemical-resistant coverall, taped to boots and gloves
- NIOSH-approved, pressure-demand, full-facepiece self-contained breathing apparatus (SCBA) or pressure-demand supplied-air respirator with escape-SCBA (additional employee training is required for Level B operations)
- Safety rope and carabineer for ascending and descending the river bank (if applicable)

3.3.1 Chemical Cartridge Change Out Schedule

Although not expected for this site, if respiratory protection is required, a cartridge change out schedule will be developed and implemented.

3.3.2 PPE Donning/Doffing Procedure

The following procedures are given as a guide; failure to adhere to these procedures may result in the PPE being ineffective against contaminants. These procedures may be altered by the SHSC if improvements can be made and these changes are warranted in the field. Also, some articles of PPE may not be necessary for all site tasks.

PPE Donning Procedure (for Level C and greater):

- Inspect all protective gear before donning.
- Don Tyvek® coverall or equivalent, inner gloves and outer gloves, secure with tape, as required, leave pull tab. If coverall is loose secure with tape to avoid capture in moving or rotating equipment.
- Don respirator. If not in Level C, maintain respirator in a sealed plastic bag on-site in case of an upgrade.

PPE Doffing Procedure (see also SOP H-6, Personnel Decontamination, in Section H – Health, of the Amec Foster Wheeler HSSE Manual):

- Wash/rinse (if necessary) excess mud or other debris from outer boots, gloves, and clothing.
- Remove tape using pull tab and remove outer clothing in the order of boots, outer gloves, and coverall suits. Place disposable and reusable PPE in designated (separate) containers.
- Remove respirator (if applicable). Decontaminate and fit-check prior to reuse.
- Remove inner gloves.
- Wash face, neck and hands.
- Enter the Support Zone (SZ).

3.3.3 PPE Failure/Chemical Exposure

In the event of PPE failure, worker and buddy will cease work, perform personal decontamination procedures, and exit to the SZ. Refer to the SDS and Section 9.0, Emergency Actions, if emergency medical response is needed. If chemicals contact the eyes, irrigate for 15 minutes and consult a physician.

3.3.4 PPE Inspection, Storage, and Maintenance

Reusable PPE will be decontaminated, inspected, and maintained, as necessary, after each use. Personal equipment (e.g., respirators, leather safety-toe boots) shall be properly stored by the employee/subcontractor.

The SHSC will periodically inventory the disposable and reusable PPE on-site and will replenish stocks in a timely manner.

4.0 SITE CONTROL

4.1 Site Security

Access will be limited to all controlled areas via the prescribed administrative (certifications) and engineering controls. All site staff and visitors will note arrival and departure times in the project logbook. All equipment, tools, and property shall be secured at the end of each day.

4.2 Visitor Access

All site visitors (except OSHA inspectors) must receive prior approval from the FM, PM, and client, and may do so only for the purposes of observing site conditions or operations. Upon arrival, visitors will report to the SHSC to receive and sign the Site Visitor Daily Roster (Appendix 2). All visitors, regardless of their rank or professional level, will not be allowed into controlled work areas without escort and site orientation.

4.3 Work Zones

Work zones will be determined on-site prior to initiation of specific activities.

Support Zone (SZ):

The SZ will be upwind or crosswind and away from the contaminated area, onshore. Vehicles, emergency equipment, the telephone and break area, and any nonessential personnel will be maintained in this area.

Contamination Reduction Zone (CRZ) (Established only if Level C PPE is required):

Two separate decontamination lines shall be established for personnel and sampling equipment in the CRZ. The CRZ should be marked as narrow corridors through which personnel and equipment pass from the EZ to the SZ.

Transition Zone (TZ) (Established only if Level C PPE is required):

An additional buffer, or TZ, will be established upwind or crosswind of the contaminated zones (i.e., anywhere contaminated sediment is handled/processed) and will serve as support for sample quality assurance/quality control (QA/QC) and packing. Coolers in this zone will be protected from contamination using polyethylene sheeting and decontaminated prior to leaving the site.

Exclusion Zone (EZ):

The EZ is defined as an area with an approximately 30-foot radius around intrusive activities. Access should be restricted to field sampling crews and necessary equipment operators.

4.4 Communications

The “buddy system” will be enforced for field activities involving potential exposure to hazardous or toxic materials, during any work within the EZ, and for any activity that involves work in, on or near water (i.e., all vessel work). Each person will observe his/her buddy for symptoms of chemical or heat overexposure and will provide first aid or emergency assistance when warranted. A mobile phone will be maintained on-site for emergency use. The vessel operator will have appropriate warning device (e.g., air horn) as required for operating a vessel on the

Mystic River. The emergency signals selected for vessel emergencies must not interfere with signals selected for other site emergencies.

The following emergency signals will be used:

Thumbs up	=	OK; understand
Thumbs down	=	No; negative
Grasping buddy's wrist	=	Leave site now
Hands on top of head	=	Need assistance
Horn - one long blast	=	Evacuate site
Horn - two short blasts	=	All clear, return to site

5.0 AIR SURVEILLANCE

5.1 Type and Frequency of Monitoring

Although airborne VOCs are not expected to create an exposure issue during site activities, breathing zone will be monitored for VOCs when personnel are expected to process / handle impacted sediment and when sediment is brought to the surface vessel. Visual and olfactory observations will be used to determine when it is appropriate to monitor the breathing zone using the instrument described in section 5.2. Dust is also not expected to create an exposure issue during site activities.

5.2 Monitoring Instruments

During sediment processing / handling activities, the breathing zone will be monitored using a calibrated Photoionization Detector (PID) equipped with a 10.2 or 10.6 electron volt (eV) lamp during intrusive and sampling activities. Since the sediment will be wet, creation of airborne dust is not expected to create an exposure issue. Therefore, monitoring for dust will not be conducted.

5.3 Action Levels

Although the semi-volatile compounds are not readily volatile, volatile fractions of the contamination may be present. For this project a conservative action level of 5 ppm total VOCs has been established. This action level is based on ½ the OSHA PEL for naphthalene (5 ppm using a PID). If total VOCs are sustained at 5 ppm on the PID, work must stop until detections drop below 5 ppm total VOCs or upgrade to Level C is required. If total VOC readings are sustained at 50 ppm on the PID, upgrade to Level B is required. Action levels are described in Table 5 below. However, note that the HSSE Manager must be notified of all Level B work prior to the work commencing and additional coordination and training are required. Level C work requires more than one Amec Foster Wheeler person.

Table 5
AIR MONITORING ACTION LEVELS

	Upgrade/Action Levels			
Instrument	**Level D/ Modified D**	**Level C**	**Level B**	**Action**
PID [1]	< 5 ppm	≥ 5 ppm HSSE MGR Notification is required	≥ 50 ppm HSSE MGR Notification is required.	Continue monitoring breathing zone with PID.

[1]Monitor breathing zone

6.0 DECONTAMINATION PROCEDURES

Procedures for the decontamination of sampling tools and other related equipment are specified in the sampling plan.

6.1 Personnel Decontamination

All personnel decontamination will be done before leaving the site for the day. As this site will be done almost exclusively in level D PPE decontamination will consist of removing and disposing of gloves and over-boots (if worn), and rinsing additional PPE (including safety glasses and hardhats) with liquinox and water as needed to remove sediment. Decontamination wash water and discarded PPE will be stored in drums in a secure location.

6.2 Equipment Decontamination

All equipment that will potentially contact samples will be decontaminated prior to, and following, sampling events according to procedures specified in the sampling plan and field procedures. Heavy equipment in direct contact with contaminated sediment, such as the dredging equipment, shall be cleaned with a pressurized stream of water to remove visible sediment on-site and inspected by the PM or FM prior to being decommissioned. Decontamination water will be contained; however, a permanent decontamination area will not be necessary.

6.3 Emergency Decontamination

In the event of an accident or incident where work must cease and staff must exit the EZ, emergency decontamination should be performed to the greatest extent feasible. In an emergency, the primary concern is to prevent the loss of life or severe injury. If immediate medical attention is required to save a life, decontamination should be delayed until the victim is stabilized. If the decontamination can be performed without interfering with essential life-saving techniques or first aid, or if a worker has been contaminated with an extremely toxic or corrosive material that could cause severe illness or loss of life, decontamination must be performed immediately. If an emergency due to a heat-related illness develops, protective equipment should be removed carefully from the victim as soon as possible.

Any time emergency decontamination methods must be used, an Incident Analysis Report (Appendix 2) must be completed by the SHSC and submitted to the HSSE Manager.

6.4 Disposal Procedures

Decontamination fluids and investigation derived waste (e.g., visually-contaminated sediment) will be segregated and stored in DOT approved 55-gallon drums until analysis of the contamination has been obtained. At which time the will be disposed of offsite per the state regulations and client specifications.

All discarded materials, if necessary, that accumulate from on-site activities (PPE, supplies, etc.) will be disposed of in proper trash receptacles. If there is reason to believe that the materials are contaminated, they will be segregated and stored in DOT approved 55-gallon drums until analysis of the contamination has been obtained. At which time the will be disposed of offsite per the state regulations and client specifications.

7.0 SANITATION AND ILLUMINATION

7.1 Sanitation

Potable drinking water, restrooms and a field washing area with potable water will be available within a reasonable distance from the site. No permanent on-site shower/change facility will be provided.

7.2 Illumination

It is anticipated that site work will primarily be conducted during daylight hours. If circumstances arise in which field work is to be conducted before or after daylight, or sunlight is obstructed, illumination within all general site areas will be maintained at or above 5 foot-candles for general site areas. The contractor's HASP will discuss safety precautions and include safety provisions in the HASP to address work on or near the water during non-daylight hours.

8.0 SPILL PREVENTION

Fuels and other hazardous chemicals brought on-site will be limited in quantity. Stored flammable liquids will be confined to flammable storage cans. If larger quantities of fuel are required, a proper storage area with appropriate containment must be instituted.

9.0 EMERGENCY ACTIONS

9.1 Preplanning and General Procedures

General Emergency Information:

Site personnel should be constantly alert to recognize potentially unsafe work practices, hazardous work environments, and IDLH conditions, and they should be routinely reminded of signs and symptoms of chemical and heat overexposure. Emergency response procedures (this section) should be reviewed daily and updated, as necessary, following incidents. Prearrange access for emergency crews when necessary.

In the event of a large-scale spill, fire/explosion, or major emergency, the FM is expected to notify the PM; the PM notifies the client, evacuates the area, and lets appropriately trained

emergency staff respond to the situation. The safety and well-being of site personnel, visitors, and the adjacent community will be of utmost importance in determining the appropriate response to a given emergency. An Employee Emergency Action and Fire Prevention Plan has been prepared in accordance with OSHA 29 CFR 1910.38 for Amec Foster Wheeler offices; annual training is required for all Amec Foster Wheeler personnel.

The vessel operator must submit a safety plan to Amec Foster Wheeler that includes outlining the procedures to be followed if a person falls off the vessel-into the water. The "Person Overboard" procedure must include a rescue plan.

Emergency Coordinator (EC):

The PM or FM will serve as the EC during an actual emergency response situation. The PM or FM will serve as the primary EC at all times; first aid and rescue duties are shared between the first aid/CPR trained team members. All foreseeable first aid and rescue equipment should be stored on-site in an accessible area in accordance with Amec Foster and Contractor requirements. The EC will contact off-site emergency response agencies and will serve as the main spokesperson when the responders arrive on-site.

Site Maps:

An updated site map (see Section 4.0, Site Control) that is used during daily tailgate meetings will be used to inform the staff of hazardous areas, zone boundaries, site terrain, evacuation routes, work crew locations, and any site changes. In the unlikely event that an emergency occurs, the problem areas will be pinpointed on the site map, and pertinent information, such as weather and wind direction, temperature, and forecast, will be added as obtained. This map will be provided to the responding agencies.

Emergency Decontamination:

For first aid of non-life-threatening injuries, evacuate to decontamination line (if in level C or above) and decontaminate as much as possible or practical; contaminated clothing should be removed. For life-threatening injuries/exposures, field decontaminate as much as possible for the person's own safety, wrap in a blanket or polyethylene sheeting, and immediately transport to the designated medical facility. Also, phone ahead and bring this HASP for informational purposes and SDS access by medical staff.

Safe Refuge Area:

To be determined; this will be discussed in the tailgate meetings by the ECs daily, once on-site. It will be set up in the SZ or at an off-site location in the event of a sitewide evacuation. This area will be upwind, and the location and escape routes will be designated. It will contain emergency equipment, escape route maps, communications, and the Emergency Reference (call) List. This is required for all phases of work. In an emergency, the EC (PM or FM) will take a "head count" against the Employee/Visitor Daily Roster (Appendix 2), initiate search/account for missing persons, notify the emergency crews (as applicable), and limit access into the hazardous emergency area to necessary rescue and response personnel in order to prevent additional injuries and possible exposures.

Emergency Equipment:

Emergency equipment will be maintained in field vehicle or on vessel (V), in the Support Zone (SZ), except for * items that will be kept in the Exclusion Zone (EZ) and as applicable in the field trailer (FT). Emergency equipment related to boating safety must be maintained on the vessel at all times and be readily available for use. All items must be checked and maintained by the SHSC at least weekly and after each use.

(✓) First Aid Kit, V/FT	(✓) Fire Extinguisher, V/EZ	( ) Field Showers, FT or V
( ) SCBA, V/FT	( ) Escape Packs	(✓) Alarms*, V/EZ
( ) Spill Equipment	(✓) Mobile or Cellular Phone, V/FT	( ) Fire Blanket*, V/EZ
(✓) Other: On Vessel: PFD, life ring, navigation means, oars, kill switch, radio, fire extinguisher, warning device (e.g., air horn)	(✓) Hospital Route Map, V/FT	(✓) Emergency Stretcher

Evacuation Procedures:

Expeditious evacuation routes to the Safe Refuge Area(s) will be established daily for all work area locations, with respect to the wind direction. Evacuation notification will be a **continuous blast on a canned siren, vehicle horn, or direct verbal communication.** Emergency drills

should be performed periodically. Any additions to evacuation procedures require an update to this HASP.

In the unlikely event that an evacuation is necessary, all personnel will immediately proceed to the predetermined Safe Refuge Area, decontaminating to the extent possible for personal safety, based on the emergency. The EC should then begin the site security and control measures.

The vessel operator's safety plan shall include evacuation procedures from the vessel.

9.2 Site-Specific Response Scenarios

9.2.1 Weather-related Emergencies

All work will cease should any of the following weather conditions arise:

- Poor visibility
- Precipitation severe enough to impair safe movement/travel
- Lightning in the immediate area
- Winds in excess of 40 miles per hour
- Flooding
- Other conditions as determined by the SHSC, PM or FM, or vessel operator

9.2.2 Spill and/or Discharge of Hazardous Materials

Training:

Responses to incidental releases or spills of hazardous substances that can be absorbed, neutralized, or otherwise controlled at the time of release by employees in the immediate release area are not considered to be emergency responses under 29 CFR 1910.120(l) and do not require additional specialized training.

Spill Control and Response:

There is a low potential for incidental spillage/leakage of hazardous materials (fuels, grouts, detergents) that are brought on-site to implement project activities. Store these materials properly and maintain the appropriate spill response equipment in or easily accessible to the

area where the materials are used/stored. In case of incidental spills or leaks, follow these steps:

1. Notify the SHSC and FM.
2. Select appropriate PPE and response equipment.
3. Contain the spill to the extent possible.
4. Neutralize or solidify the liquid per the SDS.
5. Transfer to an IDW container.
6. Document with an Incident Analysis Report (Appendix 2).
7. Notify the Client.

Discharge Control and Response:

In the event of an uncontrollable discharge of hazardous material from an existing client structure (impoundment, tank, etc.) the EC will immediately contact the client to coordinate implementation of the client's Emergency Response Plan. If safe to do so, shut off affected lines and activate the alarm system at locations predetermined by the client. Other than to take diligent measures to prevent further discharge, Amec Foster Wheeler personnel shall not assist in emergency response activities but will evacuate to the prearranged Safe Refuge Area(s) and implement the site security and control measures.

9.2.3 Fire or Explosion

Sound the emergency alarm (continuous blast on a canned siren, vehicle horn, or direct oral communication) to summon the EC, who will then decide whether to call the Fire Department for outside assistance (see Section 9.1, Preplanning and General Procedures). Small-scale fires (less than one-half of the responder's height) should be extinguished with an accessible ABC fire extinguisher by any team member who has received training. Fires in boreholes may be smothered with a fire blanket. Trained emergency crews will be summoned to control any large-scale or potentially unmanageable incident. Any off-site responding agencies will be given the Site Map (Figure 1-1) and briefed about site-specific hazards so they can be optimally helpful in an emergency situation. The EC will evacuate all non-response personnel and visitors to the Safe Refuge Area; will notify the PM, as applicable, the client, and the Amec Foster Wheeler HSSE Manager (see call list); and will complete the appropriate reports.

9.2.4 Vessel-related Emergencies

The vessel operator's safety plan shall include provisions for addressing emergencies that may occur while onboard the vessel (e.g., fire, sinking, person overboard, etc.) including person overboard, medical emergency, etc. Emergency contact information is included in the emergency call list in Section 9.5 of this HASP.

9.3 Medical Emergency Response

Amec Foster Wheeler has implemented an Early Injury Case Management Program for all project sites, which includes the following steps (see next page):

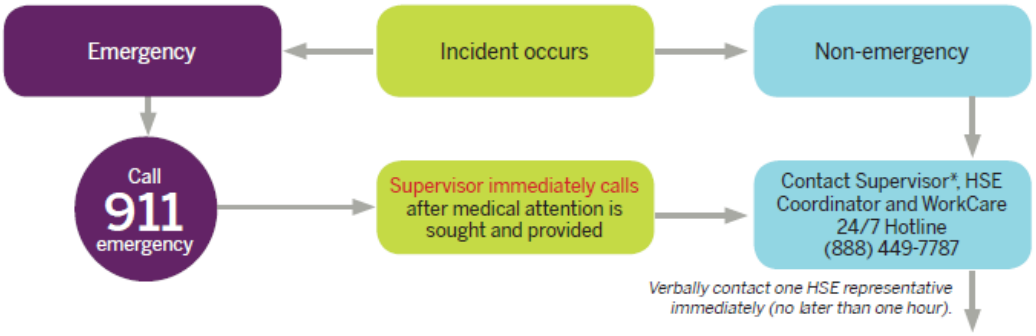
<table>
<tr><th>NON-EMERGENCY INCIDENT</th><th>EMERGENCY INCIDENT</th></tr>
<tr><td>Steps 1 & 2 must be completed before seeking medical attention other than local first aid.
1. Provide first-aid as necessary. Report the situation to your immediate supervisor AND HSSE coordinator (all incidents with the apparent starting event should be reported within 1 hour of occurrence).
2. Injured employee:</td><td>1. Provide emergency first aid. Supervisor on duty must immediately call 911 or local emergency number; no employee may respond to outside queries without prior authorization. Any outside media calls concerning this incident must be referred immediately to referred immediately to external communications manager, Lauren Gallagher 602-757-3211.
2. Once medical attention is sought and provided, the supervisor must:</td></tr>
<tr><td colspan="2">Call WorkCare 24/7 Hotline*
(888) II-XPRTS or (888) 449-7787</td></tr>
<tr><td>WorkCare will assess the situation and determine whether the incident requires further medical attention. During this process, WorkCare will perform the following:
• Explain the process to the caller.
• Determine the nature of the concern.
• Provide appropriate medical advice to the caller.
• Determine appropriate path forward with the caller.
• Maintain appropriate medical confidentiality.
• Help caller to execute path forward, including referral to the appropriate local medical facility.
• Send an email notification to the Corporate HSSE Department.</td><td>WorkCare will be responsible for performing the following:
• Contact the treating physician.
• Request copies of all medical records from clinic.
• Send an email update to the Corporate HSSE Department.</td></tr>
<tr><td colspan="2">3. IMMEDIATELY after contacting WorkCare send a brief email notification AND inform verbally (direct contact is required) ONE of HSSE corporate representatives See the Amec Foster Wheeler Incident Flow Chart on the next page.</td></tr>
</table>

4. Make all other local notifications and client notifications.
5. Local Supervisor, HSSE Coordinator, SSHO and any applicable safety committees to complete preliminary investigation, along with the initial Incident Report within 24 hours.
6. Corporate Loss Prevention Manager to complete Worker's Compensation Insurance notifications as needed.
7. Corporate HSSE to conduct further incident notifications, investigation, include in statistics, classify, and develop lessons learned materials.

* - **NOTE: Step 2 is only applicable to the North-American operations and to incidents involving AMEC personnel. High potential near misses, subcontractors' incidents, regulatory inspections, spills and property damages above $1,000 should be reported immediately, following directions from Step 3.**

Incident flow chart

Call immediately



E&I Corporate HSE department contact list

Name/email	Office location	Contact information
Bruce Voss bruce.voss@amecfw.com	Cathedral City, CA	760.202.3737 (office) 951.897.6381 (cell)
Chad Barnes chad.barnes@amecfw.com	Phoenix, AZ	602.733.6000 (office) 480.495.9846 (cell)
Cindy Sundquist cynthia.sundquist@amecfw.com	Portland, ME	207.828.3309 (office) 207.650.7593 (cell) 207.892.4402 (home)
Gabe Sandholm gabe.sandholm@amecfw.com	Minneapolis, MN	612.252.3785 (office) 206.683.9190 (cell)
Lori Dowling lori.dowling@amecfw.com	Prince George, BC	250.564.3243 (office)
Philip Neville philip.neville@amecfw.com	Thorold, ON	905.687.6616 (office) 905.380.4465 (cell)
Tim Kihn tim.kihn@amecfw.com	Edmonton, AB	780.944.6363 (office) 780.717.5058 (cell)
Vladimir Ivensky (can call 24/7) vladimir.ivensky@amecfw.com	Plymouth Meeting, PA	610.877.6144 (office) 484.919.5175 (cell) 215.947.0393 (home)
Kirby Lastinger kirby.lastinger@amecfw.com	Lakeland, FL	836-667-2345 x207 (office) 863-272-4775 (cell)

High potential near misses, workplace violence/harassment and security incidents, subcontractor incidents, regulatory inspections, spills, and property damage should be reported immediately to one of the above HSE Representatives.

***Supervisor Responsible For:**

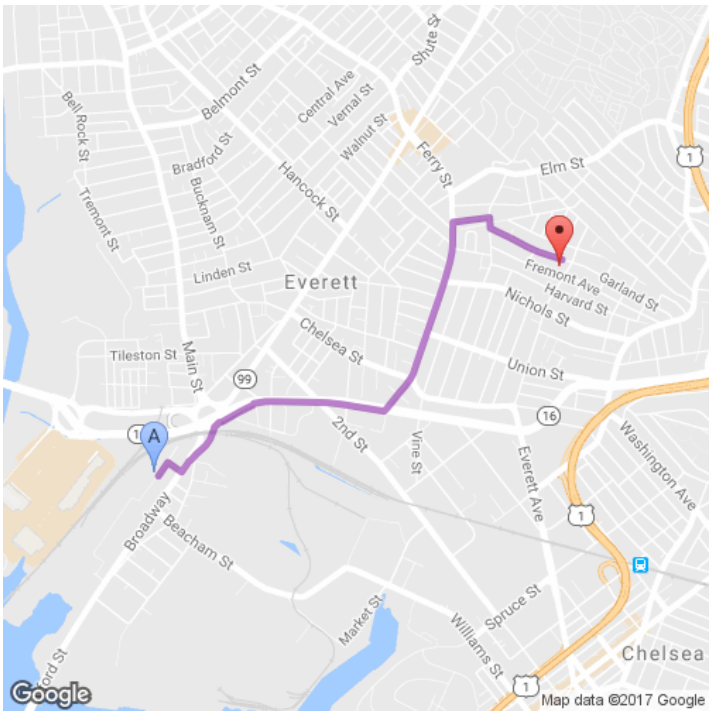
- **D&A Testing Coordination as per client and AmecFW requirements, Local/Client Notifications, and Completing Initial IAR within 24 hours and forwarding to Corporate HSE.**

Rev. Mar 2017

9.3.1 Hospital Information

In the event of a serious injury or an accident that occurs transport the victim to the hospital emergency room listed below. The routes to the hospital and clinic assume a starting point of 3 Charlton Street, Everett which is the office location/site entrance.

HOSPITAL NAME:	HOSPITAL TELEPHONE:
Whidden Memorial Hospital 103 Garland St Everett, MA 02149	617-389-6270



Map and directions courtesy of Google

From: 3 Charlton Street
Everett, MA

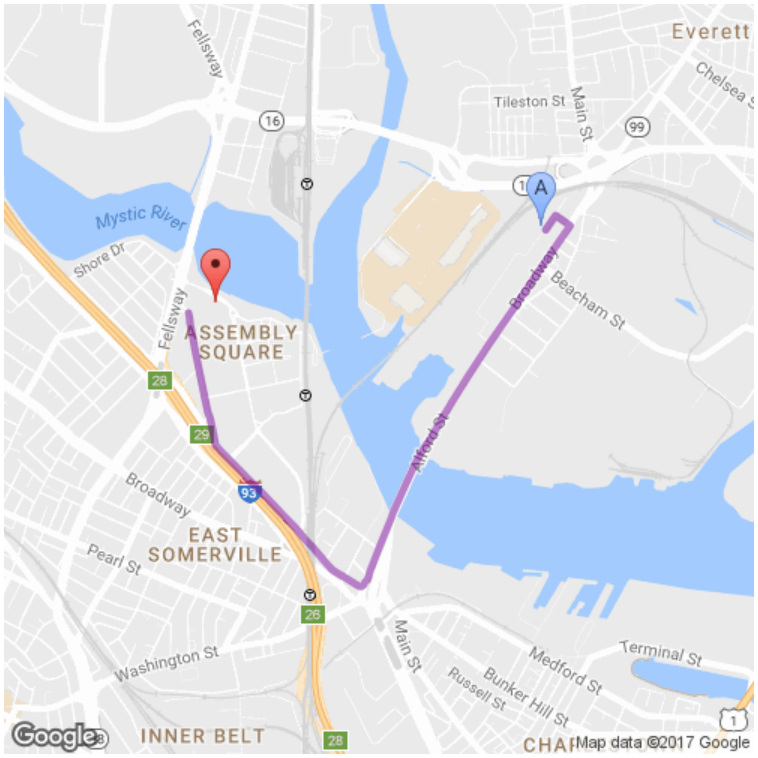
To: 103 Garland St
Everett, MA 02149

1. Head **northeast** on **Charlton St** toward **Bowdoin St**269 ft
2. Turn **right** onto **Bowdoin St**272 ft
3. Turn **left** onto **Broadway**0.2 mi
4. At the traffic circle, take the **1st** exit onto the **Revere Beach Pkwy** ramp to **US-1 N** 0.1 mi
5. Merge onto **Revere Beach Pkwy**0.4 mi
6. Turn **left** onto **S Ferry St**0.6 mi
7. Turn **right** onto **Shirley St**0.1 mi
8. Turn **right** onto **Woodlawn St**177 ft
9. Turn **left** onto **Garland St**0.2 mi
   Destination will be on the right. 1.9 mi. Estimated driving time: 9 minutes

Alternate Hospital/Clinic Information

The following hospital may be used as an alternative.

HOSPITAL NAME:	HOSPITAL TELEPHONE:
Occupational Medicine Clinic Dr. Rose Goldman 5 Middlesex Avenue, Suite 102 Somerville, MA 02145	617-591-4660



Map and directions courtesy of Google.

From: 3 Charlton Street, Everett, MA

To: 5 Middlesex Ave Suite 102, Somerville, MA 02145

1. Head **northeast** on **Charlton St** toward **Bowdoin St** 269 ft
2. Turn **right** onto **Bowdoin St** 272 ft
3. Turn **right** onto **Broadway** 0.5 mi
4. Continue onto **Alford St** 0.5 mi
5. Keep **right** to stay on **Alford St** 0.2 mi
6. At the traffic circle, take the **1st** exit onto **Main St** 0.2 mi
7. Continue onto **Mystic Ave** 0.5 mi
8. Slight **right** onto **Middlesex Ave** 0.4 mi
   Destination will be on the right. 2.3 mi. Estimated driving time: 8 minutes

Site Personnel Response Actions:

Sound emergency alarm (continuous blast on a (*canned siren, vehicle horn*), or direct verbal communication) to summon the ECs who will assess the situation, taking first necessary precautions for personal safety. The ECs will determine whether to transport the injured party to the nearest hospital, or summon an ambulance by calling 911 (see Section 9.1, Preplanning and General Information). The site control measures will be implemented. Any off-site responding agencies will be given the Site Map and informed about the site-specific hazards so they can be optimally helpful in an emergency situation.

The EC will direct that the employees responding follow the Emergency Decontamination procedures described in Section 6.3 and provide first aid to the extent possible while awaiting medical attention. In emergencies, the injuries and illnesses that may arise will vary from incident to incident; check Tables 2 and the SDSs (Appendix 1) or contact the Poison Control Center for emergency first aid procedures. Medical treatment may range from bandaging of minor cuts and abrasions to lifesaving techniques; therefore, first aid/CPR training is required for all Amec Foster Wheeler staff. The SHSC will serve as the primary caregiver and bloodborne pathogen officer (see also Bloodborne Pathogen Exposure Control Plan below), but these duties are shared between qualified team members. It is essential that all site personnel in need of emergency care receive treatment. Appropriate documentation and notification will be discussed later in this section.

9.3.2 Bloodborne Pathogen Exposure Control Plan

The Bloodborne Pathogen Exposure Control Plan for Field Operations, located in the Health, Safety, and Emergency Response SOPs, Volume VI of the Corporate HSSE Manual, provides detailed procedures for controlling exposure to bloodborne pathogens. Procedures are summarized herein.

Exposure Determination:

First aid responders have the potential to be exposed to bloodborne pathogens. The potential for exposure to bloodborne pathogens outside of emergency response is not anticipated.

Exposure Control

Universal Precautions:

Use the Center for Disease Control "Universal Precautions" as an approach to infection control, which assumes that all human blood and certain human body fluids are treated as if known to be infectious for Human Immunodeficiency Virus (HIV), Hepatitis B Virus (HBV), and other bloodborne pathogens.

Personal Protection Equipment:

While rendering first aid where exposure to blood may occur, Amec Foster Wheeler employees will don, at a minimum, latex or nitrile gloves. Gloves will be available in the field first aid kit in a packet. Other items included in the packet that are to be used to control the "spill" are absorbent beads, a plastic scooper, a biohazard bag for waste, and surface disinfecting and hand-cleaning towelettes. Other suggested PPE in the event of a serious blood-producing injury includes safety glasses, Tyvek® coveralls, boot covers, and nitrile outer gloves – all of which should be available on-site. In addition, a disposable, one-way CPR mask to prevent direct contact between the rescuer and recipient will also be available in the first aid kit should the need arise.

Personal Hygiene:

A hand-washing facility must be present in the event of bloodborne pathogen exposure. Basins, water, soap, and towels are available at all sites for this purpose.

Hepatitis B Vaccination:

First aid providers to job site injuries do not need to receive a pre-exposure Hepatitis B vaccine but are encouraged to do so. All first aid providers assisting in any exposure incident must be offered the full Hepatitis B immunization series no later than 24 hours after an incident.

Exposure Incident Evaluation:

All first aid incidents involving exposures must be reported to the Corporate VP of HSSE before the end of the work shift in which the incident occurs. A First Aid Incident Report (Appendix 2) must be completed describing the circumstances of the accident and response in addition to the Supervisor's Report of Injury or Illness (Appendix 2) and the Incident Analysis Report.

Following a report of an exposure incident, Amec Foster Wheeler shall provide to the exposed employee monitoring for HIV or HBV antibodies and medical counseling in cases of positive tests for HIV or HBV.

Waste Disposal:

Should biohazardous waste be generated as a result of a field-related injury, the "contaminated" waste and area will be cleaned to the extent possible with items provided in the packet, and arrangements for the pickup and final disposal of the waste will be made.

HBV Vaccination Declination:

For whatever reason (religious, personal, or otherwise), employees may decline or refuse the HBV vaccination by contacting the Corporate VP of HSSE. In instances where the vaccination is required, the employee will be required to sign a Hepatitis B (HBV) Vaccination Declination waiver indicating he/she has chosen at that time to refuse the vaccination, but may elect to receive it in the future at no expense to him/her.

9.4 Accident Reporting and Record Keeping

The SHSC will contact the Corporate VP of HSSE and conduct an investigation jointly with the PM or FM. The FM or PM will complete the Incident Analysis Report (IAR) (Appendix 2). These completed reports must be transmitted to the Corporate VP of HSSE within 24 hours of an occurrence; an email or fax is acceptable. The Corporate VP of HSSE will submit the appropriate reports to the Amec Foster Wheeler Human Resources department in Kirkland, WA (for Workers' Compensation), and OSHA (as applicable).

The foreman or field supervisor of subcontracting crews will investigate and complete an injury/illness report (similar in content to the Amec Foster Wheeler report) in accordance with their internal company policy. This report must be transmitted to the Amec Foster Wheeler Corporate VP of HSSE within 24 hours.

In case of environmental incidents, property damage, power disruption, or mandated work "shutdowns," an Incident Analysis Report (Appendix 2) will be prepared by the FM or PM. Any damage, loss, or theft of Amec Foster Wheeler property (items/tools/equipment) will be reported to the PM or FM.

Any release of information in these reports to unauthorized persons or agencies is prohibited unless it is first approved by the client. Certain agencies or persons, such as OSHA or OSHA inspectors, can request this information and its release will be permitted. Review the Emergency Call List for additional contact names and phone numbers.

9.5 Emergency Reference List

Keep posted in vehicles and near communication system.

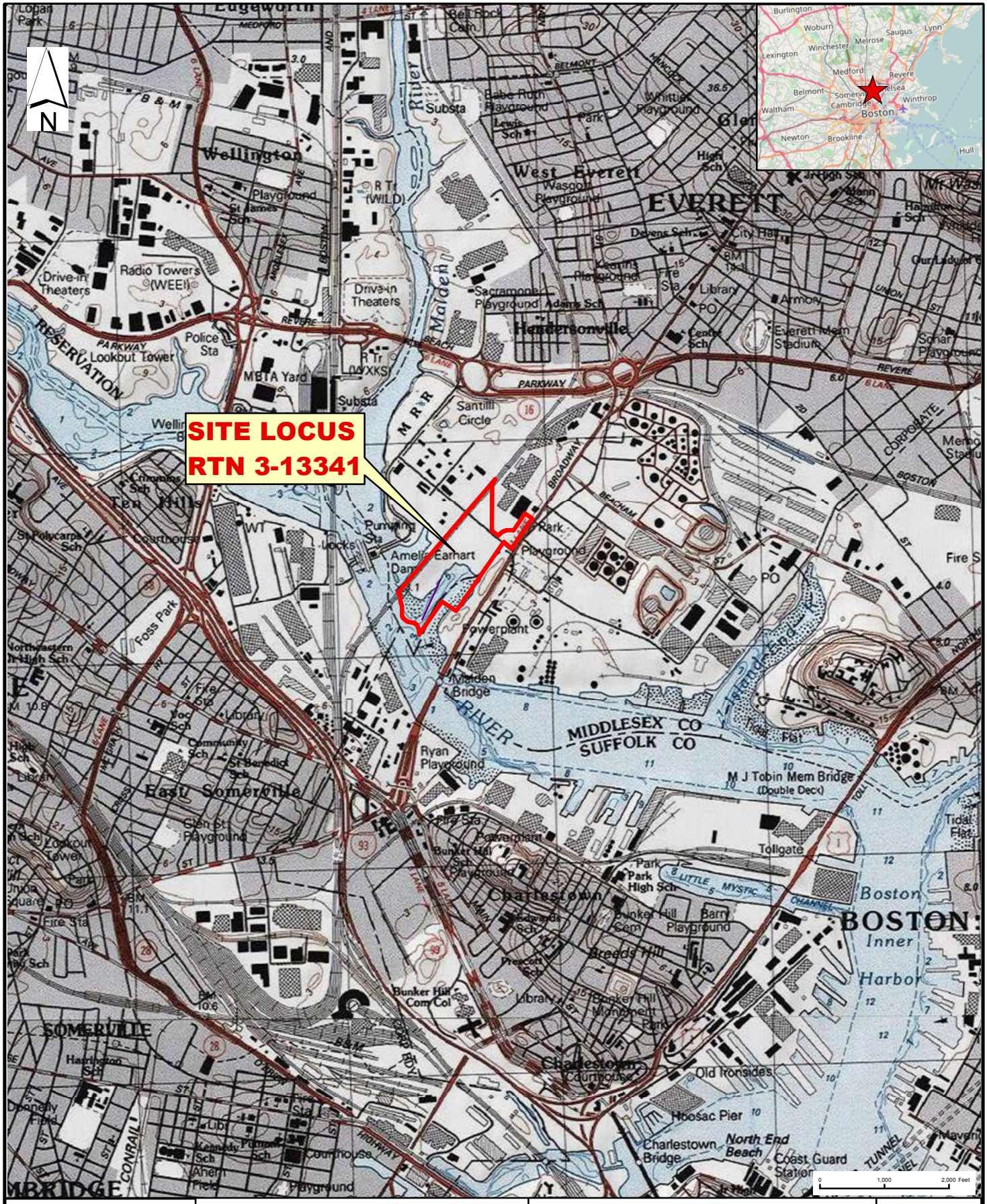
RESPONDING EMERGENCY AGENCIES

NAME	TELEPHONE NUMBERS	
Everett Fire Department: 384 Broadway Everett, MA 02149	911 or 617-387-7443 (non-emergency)	
Whidden Memorial Hospital: 103 Garland St Everett, MA 02149	617-389-6270	
Clinic: Occupational Medicine Clinic, Dr. Rose Goldman 5 Middlesex Avenue, Suite 102 Somerville, MA 02145	617-591-4660	
Attach directions from project site(s) to hospital if applicable.		
Ambulance:	911	
Everett Police Department: 45 Elm Street Everett, MA. 02149 **Boston Police Department (HQ):** Roxbury Crossing, MA 02120	911 or Non-emergency Everett: 617-389-2120 Boston: 617-343-4500	
WorkCare	**1-888-449-7787**	
Client Contact: Natalie Brown	Office: 857-770-7856	Cell: 617-770-7856
Project Manager: Matt Grove	Office: 978-392-5398	Cell: 978-265-1458
Field Team Leader: TBD	Office: 978-392-XXX	Cell: TBD
Health & Safety Coordinator: Annette McLean	Office: 978-392-5396	Cell: 978-614-5355 Home: 978-433-6561
Division ES&H Manager: Cindy Sundquist	Office:207-828-3309	Home:207-892-4402 Cell: 207-650-7593
Corporate VP of HSSE: Vlad Ivensky	Office: 610-877-6144	Cell: 484-919-5175 Home: 215-947-0393
Site Owner/Operator: Wynn (Natalie Brown)	Office: 857-770-7856	Cell: 617-770-7856
Remediation Contractor: TBD	Office: _____	Cell: 508-326-3686
Applicable Regulatory Agencies:	888-304-1133	

EPA/DEP (if applicable): Report a Spill of Oil or Hazardous Materials		

* In the event of an occupational accident or incident, see Section 9.3. Please indicate to the medical facility that this is a Workers' Compensation case and that your employer is Amec Foster Wheeler; and that the Workers Compensation insurance company is Zurich Insurance Company. Subcontractors will provide internal Workers' Comp. policy information; this should be provided to the SHSC at the pre-work meeting.

FIGURES



amec foster wheeler

SITE:
Former Everett Staging Yard
1 Horizon Way, Everett, MA
RTN 3-13341

Approximate Parcel Boundary

TITLE:
Site Location Map

SCALE:	DATE:	PROJECT:
1 inch = 2,000 feet	12/23/2016	3651160042.003

DRAWN BY: M. Martin **CHECKED BY:** C. Platt

LOCATION: P:\Comm-Ind\Projects\Clients T to Z\Wynn\3651160042\GIS

1

Disposal Site Boundary

Limit of Sediment Posing Significant Risk

Low pH Area

Limit of Sediment Posing Significant Risk

CES Area (High Arsenic Area)

Limit of Sediment Posing Significant Risk and Disposal Site Boundary

Source:
1) The base map was developed from plans or electronic files provided by"Feldman Land Surveyors" entitled " Existing Conditions" Dated 02-20-2015, Original scale 1"=20', Drawing NO. 14517, CAD file, "14517-EX-DRAFT-03-20-15.DWG
2)The locations and elevations of the corings, sampling locations, selected site features and explorations were approximatly determined by GPS. This data should be considered accurate only to the degree implied by the method used.
3) The base data and map package were provided by GZA GeoEnvironmental, Inc.

0 100 200 Feet

amec foster wheeler

- Approximate Parcel Boundary
- 2013 and 2015 Sediment Core Locations
- 2013 Core Locations for Dredge Permits
- Limit of Sediment Posing Significant Risk
- Disposal Site Boundary
- Mean High Water
- Mean Low Water
- Bathymetric Contour (<0) NAVD88
- Topographic Contour (>0) NAVD88
- CES Area (High Arsenic Area)
- Low pH Area
- Salt Marsh

Site Plan
Former Everett Staging Yard
1 Horizon Way, Everett, MA
RTN 3-13341

Drawn By: E. Flanary	Checked By: D. Ahern
PROJECT NO: 3651160042.003	Date :3/24/2017

FIGURE NO: 2

Document Path: P:\BOS\Wynn Design & Development\3651160042 - Wynn Everett Sediments\7.0 Drawings\7.3 GIS\Figure_site_plan_3-24-2017.mxd

APPENDIX 1
SAFETY DATA SHEETS FOR CHEMICALS AMEC FOSTER WHEELER WILL BRING TO THE SITE
(to be added once chemicals have been identified)

APPENDIX 2
HEALTH AND SAFETY FORMS

Check one
Initial Report: ☐
Update: ☐
Final Report: ☐ ___

INCIDENT ANALYSIS REPORT (IAR)

Amec Foster Wheeler E&I
Confidential - Privileged

Incident Potential Severity
Letter: Select One
Number: Select One
Investigation Level: Select One
Severity Matrix (LINK)

Group: Select One Group HSE Manager: ____ Incident Review Panel Team (if applicable): ____

Incident Date: _____ Report Date: _____ Incident Assigned to: Select One

Section 1 – General Information

Employee Name: ____ Sex: ☐ M ☐ F Date of Birth: ____ or Age Range: Select One

Job Position: Select One Hire Date: ____ Time employee began work: _____ Time of incident: ____ ☐ am | ☐ pm

Business Line: Select One Department Number: ____ Project Manager: ____

Project Name: ____ Project Number: ____ Client: ____

Employee home office: ____ State/Province: ____ Immediate Supervisor: ____ Hours employee worked during last 7 days: ____ hrs

Location: Select One Is this a Company controlled work site: ☐ Yes ☐ No Location description: ____

Section 2 – Incident Type - Process (**mark at least ONE BOLD TYPE** and all that apply)

☐ **Fatality** ☐ **Environmental** ☐ **Injury/Illness Incident** If Injury/illness: Select One

☐ **Security** ☐ **Near Miss/Hazard ID** ☐ **Property Damage** If Damage: Select One ☐ 3rd Party?

☐ Hospitalization ☐ **Regulatory Inspection** ☐ **Notice of Violation or Citation** ☐ Agency Reportable

☐ Motor Vehicle Incident Involving Injury ☐ Other (describe): ___

Outcome/Result: Select One If "other", specify: ___ Source of Hazard: Select One If "other", specify: ___

Immediate Cause: Select One

A. If **injury/illness**: Indicate the part of the body: Select One If "other", specify: ___

Indicate body part location: Select One If "other", specify: ___

Injury Type: Select One If "other" specify: ___ Illness Type: Select One If "other", specify: ___

☐ Bleeding? Select One If yes, "First Aider" name: ___ ☐ Contact with blood/infectious material? Select One

Exposure Control Precautions taken by First Aider (check all that apply):

☐ None (If none, contact WorkCare) ☐ Gloves ☐ Previous HBV Immunization
☐ Immediate Personal Hygiene ☐ One-way CPR valve ☐ Recommended for HBV Immunization
☐ Eye protection ☐ Face mask ☐ Other (describe): ____

☐ Blood contaminated work area / surface? If contaminated, describe cleanup/disposal: ___

☐ Medical treatment provided (i.e. prescriptions, referrals, etc.). If medical treatment, describe: ___

☐ Physical limitations received from physician? If limitations, describe: ___ ☐ Modified Work Offer provided.

☐ Second medical opinion? If second opinion, describe: ___

☐ Workers Compensation claim filed? If filed, claim number: ___

B. If **property damage**: describe what happened and estimate ($) of damage to all objects involved? ___

C. If **environmental**: Environmental incident category: ☐ Pollution Event ☐ Non-conformance

Was Regulatory Action Taken: Select One If "Yes" describe: ___

Type of pollution event: Select One Type of substance: Select One Name, CAS#, physical state: ___

Quantity: ___ Substance Unit: Select One Source of release: Select One If "other", specify: ___

Duration of Breach: Select One Receiving Environment: Select One If "other", specify: ___

Level of Non-conformance: Select One Describe Non-conformance: ___

D. If **security**: Security Incident Type: Select One If Physical: Select One If Criminal: Select One If Intellectual: Select One

E. If an **inspection by a regulatory agency**, what agency, who were the inspectors, inspector contact information? ___

Section 3 – Incident Description

Attach and number additional pages, as needed, to ensure all details related to the incident are captured.

A. List the names of all persons involved in the incident, and employer information: ___

B. List the names of any witnesses, their employer, and a local/company telephone number or address: ___

C. Name of Employee's supervisor: ___ Contact phone number for supervisor: ___

D. What specific job/task or action was the employee(s) doing just prior to the incident: ___

E. Was a tool or equipment involved? ☐ Yes ☐ No What was it: ___ Last Inspection Date: ___Defects: ___

F. Explain in **detail** what happened: ___

G. Explain in **detail** what object or substance directly harmed the employee: ___

H. What were the weather conditions at time of incident?: ___

I. What was the lighting like at time of incident? Bright ☐ Shadows ☐ Dark ☐ Other: ___

J. List any damaged equipment or property (other than motor vehicles). Provide model and serial number **and** estimated costs to repair/replace damaged equipment or property, if applicable: ___

Section 4 - Incident Analysis

A. Was a Health and Safety Plan (HASP) or Activity Hazard Analysis (AHA) completed for the work being performed? ☐ Yes ☐ No
If "yes", Who prepared the document?: ___

B. Who and when was the last manager (Project, Unit, etc.) at the site of the incident?: ___

C. When and what safety training **directly related** to the incident has the person(s) involved had?: ___

D. List attached documentation (HASP acknowledgement forms, kickoff/daily/weekly meetings, inspections, photographs): ___

Section 5 - Incident Investigation Results and Corrective Actions

This section to be completed by the Group HSE Manager/IRP with support from location where incident occurred, in accordance with A-Z List of Accident Causes and Glossary of A-Z Causes (click links).

Causal Factors (Acts or Omissions / Conditions)

(Attach and number any additional pages as needed to completely address this section)

	IMMEDIATE CAUSE	IMMEDIATE CAUSE SUB-TYPE	DESCRIPTION
1	Select One	_____	_____
2	Select One	_____	_____
3	Select One	_____	_____
4	Select One	_____	_____

Root Cause(s) Analysis - The below items represents major root cause categories which have been determined to be Less Than Adequate (LTA). A more detailed determination of the root cause will be facilitated, if needed, by the applicable Group HSE Manager / IRP.

	ROOT CAUSE TYPE	ROOT CAUSE SUB-TYPE	DESCRIPTION
1	Select One	_____	_____

2	Select One	____	____
3	Select One	____	____
4	Select One	____	____

Amec Foster Wheeler Global Safety Rules and Safety Essentials (click links).

Safety Rules **Select all applicable breaches of rules or** ☐ None		**Safety Essentials** **Select all applicable breaches of behavioral expectations or** ☐ None	
☐ Confined Space ☐ Working at Height ☐ Suspended Loads ☐ Driving ☐ Permit to Work	☐ Isolation (energy) ☐ Dropped Objects (height) ☐ Excavations ☐ Overhead electricity ☐ Personal Security	☐ Always Take Care ☐ Follow the Rules ☐ Do a Risk Assessment	☐ You Must Intervene ☐ Manage Any Change ☐ Wear the Correct PPE

Corrective Actions

Root Cause #	**Corrective Actions Taken** (Attach additional pages as needed to completely address this section)	**Responsible Person**	**Proposed Completion Date**	**Closed on Date**	**Verified by and Date Verified**
____	____	____	____	____	____
____	____	____	____	____	____
____	____	____	____	____	____
____	____	____	____	____	____
____	____	____	____	____	____

Section 6 - Notifications, Certification & Approvals

Check the appropriate boxes indicating the applicable reports have been made to the following applicable organizations:

Auto Insurance Carrier was called ☐ **Group HSE Manager Notified** ☐

WorkCare was called ☐ **Post-incident Drug/Alcohol Testing Performed** ☐

Incident Report prepared by: ___

Employee (s): ___	Date: ___	Employee's Supervisor: ___	Date: ___
HSE Coordinator/Project/Unit Manager: ___	Date: ___	Group HSE Manager: ___	Date: ___

VEHICLE INCIDENT REPORT (VIR)

Amec Foster Wheeler E&I

Confidential - Privileged

Section 1 - General Information

Date of Incident: _____

Time incident occurred: _____ ☐ am | ☐ pm | Illumination: ☐ Dark ☐ Dusk ☐ Light | Road Condition: ☐ Dry ☐ Wet ☐ Icy/snow

Were police summoned to scene? ☐ Yes ☐ No Police Department and Location: _____

Report #; _____ Officer's Name: _____ Officer's Badge Number: _____

Section 2 - Company Driver and Vehicle

Driver's name: _____ D/L #: _____ State: _____

Driver's home office address: _____ Driver's Phone #: _____

Company Vehicle #: _____ Year: _____ Model: _____ License #: _____ State: _____

Company car?: ☐ Yes ☐ No Personal Vehicle?: ☐ Yes ☐ No Rental Vehicle?: ☐ Yes ☐ No

If rental, rented from: _____

Passenger/Witness Name(s): _____ Address: _____ Telephone: _____

Passenger/Witness Name(s): _____ Address: _____ Telephone: _____

Damage to vehicle: _____

Was an employee injured?: ☐ Yes ☐ No If yes, please describe: _____

Injuries to others?: ☐ Yes ☐ No If yes, please describe: _____

Vehicle was being used for: Company business ☐ Yes ☐ No Personal business ☐ Yes ☐ No

Towed?: ☐ Yes ☐ No If yes, by whom?: _____ To Where?: _____

Section 3 - Other Driver and Vehicle Information

Driver's Name: _____ D/L # : _____ State: _____

Current address: _____ City: _____ State: _____

Telephone: _____ Work: _____ Cell: _____

Registered Owner's Name: _____ Address: _____ City: _____ State: _____

(verify registration document)

The Other Vehicle: Make: _____ Model: _____ Year: _____ License #: _____ State: _____

Insurance company name: _____ Address: _____ Phone #: _____

Policy No.: _____ Contact Person: _____ Phone #: _____

Passenger/Witness Name(s): _____ Address: _____ Telephone: _____

Passenger/Witness Name(s): _____ Address: _____ Telephone: _____

Damage: (*Make note of pre-existing damage and take pictures if possible – you may attach additional pages if necessary):* _____

Injuries to other driver/passengers: _____

Section 4 – Approvals (signatures required)

Form completed by (please print): _____ Date: _____

Signature: _____

Office/Project Manager (please print): _____ Date: _____

Signature: _____

Things to Do First In The Event Of a Motor Vehicle Incident

GENERAL INFORMATION

1. Do not decide on your own whether a particular incident is "covered" by insurance. Should there be any doubt, it is always preferable to report an occurrence, as this allows underwriters, the Risk Management Department and insurance adjusters to determine if a covered loss has taken place.

2. Policy Conditions do require that all losses and occurrences, which may result in a claim be promptly reported.

3. Do not admit liability or offer your opinion of liability to anyone.

4. Complete this IAR/VIR form promptly and forward with all applicable supporting documentation. It is essential both division and location information be provided.

5. For automobile collisions within the **United States**, please indicate on the IAR form that you have contacted Zurich at:

Zurich Insurance Company
1-800-987-3373 or
1-877-928-4531
24 hours a day, 7 days a week

6. For automobile collisions within **Canada**, please indicate on the IAR form that you have contacted Zurich at:

Crawford Adjusters Canada
Claims Alert
1-888-218-2346
24 hours a day, 7 days a week

7. Information on the use of rental and personal vehicles at work and insurance are at the links for **Canada** and **US**.

The more details you have the better but, don't delay reporting if you don't have all of the information - that may be obtained later. A Zurich trained operator will answer your call and ask for all relevant information regarding the incident. The initial information required includes:

- Your division,
- Office location and division contact name – advise that you are an AMEC Company
- Name, drivers license and phone number of the driver involved in the loss
- Description of the vehicle which he/she was driving (i.e., year, make, model, license plate number, serial number)
- Date, time and location of incident
- Passenger information (if applicable)
- Third party information (i.e., name, phone number, address, vehicle information, insurance information)
- If any injuries occurred (if applicable)
- Police information
- Witness information (if applicable)

Call 911 if there are serious injuries!

If you are injured or think you were injured, **contact your supervisor and call WorkCare at 888-449-7787**. Your supervisor will notify your HSE Coordinator and your Group HSE Manager. For additional instructions on what to do, go to Amec Foster Wheeler's HSE website at:

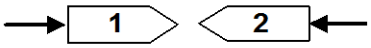
http://ee.amecnet.com/she/sheweb/incident_reporting.htm

1. Call for an officer if the incident occurred on public property (streets, highways or roads). Disputes often arise between the parties involved as to who was at fault; therefore, a police report is important. If an officer is unable to attend the scene of the collision, a counter police report may be filed at most stations. Insurance companies rely on police reports to determine liability.
2. Complete the Incident Investigation Report and the Vehicle Incident Report forms. It is important that both these forms are completed in detail. Include a diagram of the incident on the provided sheet. Incomplete information may lead to delays in processing associated claims and in helping to prevent this type of incident from occurring again.
3. Give only information that is required by the authorities or as directed by Amec Foster Wheeler contractual requirements.
4. Sign only those statements required by the authorities or as directed by Amec Foster Wheeler contractual requirements. Do not sign away your or the company's rights.

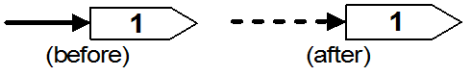
Vehicle Incident Diagram

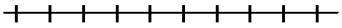
This or a similar diagram must be completed with all VIRs

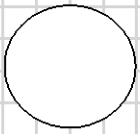
Instructions:

1. Number each vehicle and show directions 

2. Use a solid line to show path before incident and use a dotted line to show path after incient



3. Show pedestrian/non-motorist by: 
4. Show railroad by: 
5. Indicate north by arrow as: 
6. Show street or highway names or numbers
7. Show signs, signals, warning and traffic controls.



Indicate North
by Arrow

Prepared by: _____ **Date:** _____

GROUND DISTURBANCE INCIDENT REPORT (GDR)

Amec Foster Wheeler E&I

Section 1 – General Information

Employee Name: _____ Time of incident: _____ ☐ am | ☐ pm Time Reported:_____ ☐ am | ☐ pm Report Date: _____

Project Name: _____ Project Number: _____ Client: _____

List of All Parties Present

Name	Company	Telephone No.	Role
____	____	____	____
____	____	____	____
____	____	____	____
____	____	____	____
____	____	____	____

Describe the chronological description of the incident and response:____

Section 2 – Date and Location of Event

A. *Date of Event: (MM/DD/YYYY)

B. ***Country** ***State** ***County** **City**

C. **Street address** **Nearest Intersection**

D. *Right of Way where event occurred

E. Public: ☐ City Street ☐ State Highway ☐ County Road ☐ Interstate Highway ☐ Public-Other

F. Private: ☐ Private Business ☐ Private Land Owner ☐ Private Easement

G. ☐ Pipeline ☐ Power /Transmission Line ☐ Dedicated Public Utility Easement

☐ Federal Land ☐ Railroad ☐ Data not collected ☐ Unknown/Other

List attached documentation (Public Utility Locates, Private Utility Locates, Copy of notifications submitted to Owner or other utility Owners, photographs): _____

Section 3 – Affected Facility Information

***What type of facility operation was affected?**

☐ Cable Television ☐ Electric ☐ Natural Gas ☐ Liquid Pipeline ☐ Sewer (Sanitary Sewer)

☐ Steam ☐ Telecommunications ☐ Water ☐ Unknown/Other

***What type of facility was affected?**

☐ Distribution ☐ Gathering ☐ Service/Drop ☐ Transmission ☐ Unknown/Other

Was the facility part of a joint trench?

☐ Unknown ☐ Yes ☐ No

Was the facility owner a member of One-Call Center?

☐ Unknown ☐ Yes ☐ No

Section 4 – Excavation Information

***Type of Excavator**

☐ Contractor ☐ County ☐ Developer ☐ Farmer ☐ Municipality ☐ Occupant
☐ Railroad ☐ State ☐ Utility ☐ Data not collected ☐ Unknown/Other

***Type of Excavation Equipment**

☐ Auger ☐ Backhoe/Trackhoe ☐ Boring ☐ Drilling ☐ Directional Drilling
☐ Explosives ☐ Farm Equipment ☐ Grader/Scraper ☐ Hand Tools ☐ Milling Equipment
☐ Probing Device ☐ Trencher ☐ Vacuum Equipment ☐ Data Not Collected ☐ Unknown/Other

***Type of Work Performed**

☐ Agriculture ☐ Cable Television ☐ Curb/Sidewalk ☐ Bldg. Construction ☐ Bldg. Demolition
☐ Drainage ☐ Driveway ☐ Electric ☐ Engineering/Survey ☐ Fencing
☐ Grading ☐ Irrigation ☐ Landscaping ☐ Liquid Pipeline ☐ Milling
☐ Natural Gas ☐ Pole ☐ Public Transit Auth. ☐ Railroad Maint. ☐ Road Work
☐ Sewer (San/Storm) ☐ Site Development ☐ Steam ☐ Storm Drain/Culvert ☐ Street Light
☐ Telecommunication ☐ Traffic Signal ☐ Traffic Sign ☐ Water ☐ Waterway Improvement
☐ Data Not Collected ☐ Unknown/Other

Section 5 – Pre-Excavation Notification

***Was the One-Call Center notified?**

☐ Yes ☐ No If Yes, which One-Call Center? Ticket number:

Was Private Contract Locator used?

☐ Yes ☐ No

Section 6 – Locating and Marking

***Type of Locator**

☐ Utility Owner ☐ Contract Locator ☐ Data Not Collected

***Were facility marks visible in the area of excavation?**

☐ Yes ☐ No ☐ Data Not Collected

***Were facilities marked correctly?**

☐ Yes ☐ No ☐ Data Not Collected

What technology was used to locate utilities?

☐ Maps ☐ Active(transmitter+receiver) ☐ Passive (receiver only) ☐ GPR
☐ Acoustic ☐ Magnetic ☐ Infrared ☐ Unknown/Other

What Factors affected the ability to locate services?

☐ Soil Type:_____ ☐ Non-Grounded ☐ Common Bonded ☐ Depth
☐ Electromagnetic interference ☐ Parallel facilities ☐ Congested facilities ☐ Unknown/Other

Section 7 – Excavator Downtime

Did Excavator incur down time?

☐ Yes ☐ No

If yes, how much time?

☐ Unknown ☐ Less than 1 hour ☐ 1 hour ☐ 2 hours ☐ 3 or more hours Exact Value _____If

Estimated cost of down time?

☐ Unknown ☐ $0 ☐ $1 to 500 ☐ $501 to 1,000 ☐ $1,001 to 2,500 ☐ $2,501 to 5,000
☐ $5,001 to 25,000 ☐ $25,001 to 50,000 ☐ $50,001 and over Exact Value _____

Section 8 – Description of Damage

***Was there damage to a facility?**
☐ Yes ☐ No (i.e. near miss)
***Did the damage cause an interruption in service?**
☐ Yes ☐ No ☐ Data Not Collected ☐ Unknown/Other
If yes, duration of interruption
☐ Unknown ☐ Less than 1 hour ☐ 1 to 2 hrs ☐ 2 to 4 hrs ☐ 4 to 8 hrs ☐ 8 to 12 hrs ☐ 12 to 24 hrs
☐ 1 to 2 days ☐ 2 to 3 days ☐ 3 or more days ☐ Data Not Collected Exact Value _____
Approximately how many customers were affected?
☐ Unknown ☐ 0 ☐ 1 ☐ 2 to 10 ☐ 11 to 50 ☐ 51 or more Exact Value _____
Estimated cost of damage / repair/restoration
☐ Unknown ☐ $0 ☐ $1 to 500 ☐ $501 to 1,000 ☐ $1,001 to 2,500 ☐ $2,501 to 5,000
☐ $5,001 to 25,000 ☐ $25,001 to 50,000 ☐ $50,001 and over Exact Value _____
Number of people injured
☐ Unknown ☐ 0 ☐ 1 ☐ 2 to 9 ☐ 10 to 19 ☐ 20 to 49 ☐ 50 to 99
☐ 100 or more Exact Value _____
Number of fatalities
☐ Unknown ☐ 0 ☐ 1 ☐ 2 to 9 ☐ 10 to 19 ☐ 20 to 49 ☐ 50 to 99
☐ 100 or more Exact Value _____

Was there a Product Release?
Product Release: ☐ No ☐ Yes ☐ N/A Type: ____ **If Yes, Incident Type is Environmental Report.**
Volume: ____ Spill Controls: ____
Repair Process: ____

Section 9 – Description of the Root Cause Link to GDR Root Cause Tip Card

Please choose one

One-Call Notification Practices Not Sufficient
☐ No notification made to the One-Call Center
☐ Notification to one-call center made, but not sufficient
☐ Wrong information provided to One Call Center

Locating Practices Not Sufficient
☐ Facility could not be found or located
☐ Facility marking or location not sufficient
☐ Facility was not located or marked
☐ Incorrect facility records/maps

Excavation Practices Not Sufficient
☐ Failure to maintain marks
☐ Failure to support exposed facilities
☐ Failure to use hand tools where required
☐ Failure to test-hole (pot-hole)
☐ Improper backfilling practices
☐ Failure to maintain clearance
☐ Other insufficient excavation practices

Miscellaneous Root Causes
☐ One-Call Center error
☐ Abandoned facility
☐ Deteriorated facility
☐ Previous damage
☐ Data Not Collected
☐ Other

Provide explanation of selected root cause/s:____

Section 10 - Notifications, Certification & Approvals

Check the appropriate boxes indicating the applicable reports have been made to the following applicable organizations:

One Call was called ☐ **Spills Reporting Agency Notified** ☐

Emergency Responders (Fire) was called ☐ **Post-incident Drug/Alcohol Testing Performed**

List of All Agencies Contacted

Name/Agency	Phone #	Date	Time

Incident Report prepared by: ____

Employee (s): ____	Date: ____	Employee's Supervisor: ____	Date: ____
HSE Coordinator/Project/Unit Manager: ____	Date: ____	Group HSE Manager:____	Date: ____

EMPLOYEE/VISITOR DAILY ROSTER

SIGNATURE	PRINTED NAME	COMPANY	DATE

PROJECT SITE OCCUPATIONAL HEALTH & SAFETY AUDIT CHECK LIST

DATE	JOB NUMBER	PROJECT LOCATION (ADDRESS, TOWN, STATE)	NAME OF PERSON CONDUCTING AUDIT
AMEC FOSTER WHEELER PROJECT MANAGER:			
AMEC FOSTER WHEELER SITE SUPERVISOR (A/K/A FIELD LEADER):			
AMEC FOSTER WHEELER FIELD STAFF PRESENT:			
PRIME CONTRACTOR:			
AMEC FOSTER WHEELER SUBCONTRACTORS AND DESCRIPTION OF THEIR ROLE/ACTIVITIES:			
DESCRIPTION OF AMEC FOSTER WHEELER (AMEC FW) ROLE/ACTIVITIES:			

Please check **(X)** the appropriate box next to the specific item.

"Y" **Indicates compliance.**
"N" **Indicates non-compliance and requires immediate correction.**
"NA" **Indicates that the item is not applicable at the project.**
"CA" **Corrective action – Initials of responsible person to complete.**

Planning and Documentation	Y	N	N/A	CA
Project Specific Job Hazard Assessment or HASP completed and signed by	☐	☐	☐	
Site Specific Activity Hazard Analysis (AHA) completed and signed.	☐	☐	☐	
Does AHA address all hazards for the job/task?	☐	☐	☐	
Is AHA renewed and signed off on a daily basis by all workers?	☐	☐	☐	
Proof of HAZCOM/WHMIS training provided by all workers – check all	☐	☐	☐	
MSDS sheets available for all products on-site and current to last three	☐	☐	☐	
Are chemicals properly stored/identified as per WHIMIS/HAZCOM?	☐	☐	☐	
Do workers have Transportation of Dangerous Goods training & valid	☐	☐	☐	
Tailgate/Tool Box safety meetings held, documented and signed by all	☐	☐	☐	
Kick-off meeting held, documented and signed by all workers.	☐	☐	☐	
Weekly safety meeting held, documented and signed (for projects exceeding	☐	☐	☐	
Project Specific Safety training provided where necessary i.e.) fall protection.	☐	☐	☐	
Appropriate sized First-aid kit with standard first aid manual on-site and	☐	☐	☐	
Is location of first aid kit clearly identified and location known by workers –	☐	☐	☐	
Qualified first aid person on project – check for valid certification.	☐	☐	☐	
Incident Reporting Procedure posted	☐	☐	☐	
Eye wash station on-site with current inspection tag or within expiry date.	☐	☐	☐	
Occupational Health and Safety Act and Regulations available on-site.	☐	☐	☐	

Amec FW Field Safety Handbook available on-site.	☐	☐	☐	
Amec FW corporate safety policy available on-site via computer or online	☐	☐	☐	
Emergency Response Plan and telephone numbers posted.	☐	☐	☐	
Do workers know emergency procedures for site – check one worker.	☐	☐	☐	
Have there been any near miss/incidents? Have they been documented and	☐	☐	☐	
Communication system in place.	☐	☐	☐	
Workers know where safety documentation located – check one worker.	☐	☐	☐	
Supervisor has Drug/Alcohol testing information on-site & knows	☐	☐	☐	
Are copies of previous inspection reports on-site?	☐	☐	☐	
Have deficiencies on previous inspections been addressed?	☐	☐	☐	
Signs posted where necessary	☐	☐	☐	

General Safety	**Y**	**N**	**N/A**	**CA**
Slip, Trip & Fall hazards identified and cleared.	☐	☐	☐	
Overhead hazards marked and structural integrity hazards managed?	☐	☐	☐	
Are pressurized systems, lines and containers identified? QR-connections	☐	☐	☐	
Safety Zones established (Exclusion, Contamination Reduction, Support)	☐	☐	☐	
Decontamination procedure/area established.	☐	☐	☐	
Confined space procedures followed.	☐	☐	☐	
Adequate ventilation in work areas.	☐	☐	☐	
Adequate lighting provided and maintained in work areas.	☐	☐	☐	
Sharp objects properly disposed of or protected.	☐	☐	☐	
Proper storage of tools and materials.	☐	☐	☐	
Accumulation of contaminated debris within acceptable levels.	☐	☐	☐	
Adequate trash containers provided.	☐	☐	☐	
Adequate number of toilets and washing facilities.	☐	☐	☐	

Personal Protective Equipment	**Y**	**N**	**N/A**	**CA**
Hardhats worn by workers.	☐	☐	☐	
Appropriate gloves being worn by workers.	☐	☐	☐	
Protective eyewear (and secondary face protection, if applicable) worn as	☐	☐	☐	
Appropriate respiratory protection used when required.	☐	☐	☐	
Proper work boots worn by all workers.	☐	☐	☐	
Appropriate hearing protection used when required.	☐	☐	☐	
Appropriate high visibility garments worn when required.	☐	☐	☐	
Proper protective clothing used when required – appropriate for task and	☐	☐	☐	
Personal Flotation Devices (PFD) utilized when required.	☐	☐	☐	

Fire Protection and Prevention	**Y**	**N**	**N/A**	**CA**
Fire suppression equipment available and inspected.	☐	☐	☐	
Test that supervisor knows proper procedure for inspecting fire extinguisher.	☐	☐	☐	
Have workers received recent instruction on fire extinguisher use.	☐	☐	☐	
Flammable and combustible materials stored properly.	☐	☐	☐	
Flammable liquid stored in approved containers.	☐	☐	☐	
Flammable containers properly labeled.	☐	☐	☐	
Are hot work permits available and procedures being followed?	☐	☐	☐	

Tools: Hand and Power	**Y**	**N**	**N/A**	**CA**
Proper tool used for job.	☐	☐	☐	
Hand tools in good condition and free of visible defects.	☐	☐	☐	
Guards in place.	☐	☐	☐	
Tool handles not broken.	☐	☐	☐	

Electric tools double insulated or properly grounded.	☐	☐	☐	
Power cords on electric tools in safe working condition.	☐	☐	☐	
Powder actuated tools: operators certified.	☐	☐	☐	
All belts, chains, sprockets and pulleys properly guarded.	☐	☐	☐	
Air lines and tools inspected and in good condition.	☐	☐	☐	
Safety lanyards being used at air line connection points.	☐	☐	☐	
Power finishing machines equipped with dead man's switch.	☐	☐	☐	
Electrical	**Y**	**N**	**N/A**	**CA**
Are lock out/tag procedures being used?	☐	☐	☐	
GFCI or assured grounding in use.	☐	☐	☐	
Extension cords are approved three wire construction grade.	☐	☐	☐	
Extension cords free of visible defects.	☐	☐	☐	
Extension cords not running through water.	☐	☐	☐	
Extension cords strung to avoid damage.	☐	☐	☐	
Temporary lighting properly guarded.	☐	☐	☐	
Temporary lighting properly suspended.	☐	☐	☐	
All live circuits and panels clearly posted.	☐	☐	☐	
Live panels secured to prevent unauthorized access.	☐	☐	☐	
Only qualified persons working on electrical circuits and panels.	☐	☐	☐	

Fall Protection	**Y**	**N**	**N/A**	**CA**
Workers utilizing fall protection trained and proof of certification - work	☐	☐	☐	
Excavations properly guarded to prevent fall.	☐	☐	☐	
Rescue Plans and Equipment available.	☐	☐	☐	
Harnesses are properly worn and inspected by worker.	☐	☐	☐	
Lanyard of proper length to limit fall to less than six feet.	☐	☐	☐	
Lanyards secured to proper anchorage.	☐	☐	☐	
Lifelines secured to proper independent anchorage.	☐	☐	☐	
Controlled access zone warning lines in place.	☐	☐	☐	

Heavy Equipment (Backhoe,Excavator, Drill Rig, Loader etc.)	**Y**	**N**	**N/A**	**CA**
Permits, inspections and licenses in order and valid	☐	☐	☐	
Valid driver's license for vehicle type.	☐	☐	☐	
Daily inspection of equipment performed i.e. kill switches operational.	☐	☐	☐	
Backup alarm operational.	☐	☐	☐	
Qualified signal person provided.	☐	☐	☐	
Is hoisting equipment inspected and in good condition?	☐	☐	☐	
Clearance to power lines is adequate (20ft/6m minimum unless voltage	☐	☐	☐	
Backhoe outriggers fully extended and supported during operation.	☐	☐	☐	
Seatbelts worn where Roll Over Protective Systems (ROPS) provided	☐	☐	☐	
Boom down prior to drill rig movement.	☐	☐	☐	
Personnel properly positioned and wearing high visibility garments.	☐	☐	☐	
Rigging and hoisting via inspected equipment by qualified and designated	☐	☐	☐	

Ladders	**Y**	**N**	**N/A**	**CA**
Ladders are free of visible defects.	☐	☐	☐	
Ladders proper height for work.	☐	☐	☐	
Workers do not overextend reach of ladders.	☐	☐	☐	
Ladders erected on solid level surface.	☐	☐	☐	

Nonconductive ladder is used when necessary.	☐	☐	☐	
A-frame ladders used in open position.	☐	☐	☐	
Workers do not use top two steps of A-frame ladders.	☐	☐	☐	
Workers do not climb back of A-frame ladders.	☐	☐	☐	
Straight ladders secured.	☐	☐	☐	
Straight ladders extend 36 inches above landing.	☐	☐	☐	
Straight ladders pitched at 1 to 4 ratios.	☐	☐	☐	
No skid feet provided on straight ladders.	☐	☐	☐	

Public Liability	**Y**	**N**	**N/A**	**CA**
Delineation provided where necessary to isolate work area i.e.) fencing,	☐	☐	☐	
Warning signs/caution tape posted where necessary.	☐	☐	☐	
Road work permits obtained and copies on-site.	☐	☐	☐	
Traffic signage of correct type for road work.	☐	☐	☐	
Traffic Management Plan developed for road work as required.	☐	☐	☐	
Flag persons used to direct pedestrian and vehicle traffic if needed.	☐	☐	☐	
Flag persons have written instructions.	☐	☐	☐	
Plans to Notify and Respond to Spills	☐	☐	☐	
Loads secured and covered as needed before leaving site?	☐	☐	☐	

Life Safety	**Y**	**N**	**N/A**	**CA**
Emergency response plan developed and known by all workers – check with	☐	☐	☐	
Paths of emergency egress kept clear.	☐	☐	☐	

Excavation	**Y**	**N**	**N/A**	**CA**
Is Ground Disturbance authorization and copies of locates on-site and	☐	☐	☐	
Entered excavation inspected by a competent person daily/PE signature as	☐	☐	☐	
Are walls of excavation sloped as required?	☐	☐	☐	
Has supervisor filled out excavation/trench entry checklist?	☐	☐	☐	
Sheeting, shoring and bracing in place (excavation greater than 4').	☐	☐	☐	
Sloping and bracing where necessary (excavation greater than 4').	☐	☐	☐	
Ingress and egress provided (excavation greater than 4').	☐	☐	☐	
Hand or air knife excavation within 4' proximity to utilities?	☐	☐	☐	
Are open areas marked and secure if left unattended?	☐	☐	☐	
Spoils 1.0m from excavation edge (excavation greater than 4').	☐	☐	☐	

NOTE: Deficiencies and non-compliance issues identified during this audit are to be corrected immediately, and if necessary work is to be stopped until corrective actions have been taken.

Copies of this report to: Project Manager, Office Manager, HSE Coordinator, Office Safety Committee

COMMENTS:

Sign Offs

Inspection performed by: _____

Amec FW Site Supervisor _____

Unit HSE Coordinator: _____

RECORD OF CHANGES TO SITE-SPECIFIC HASP

Project Name: _____ Project #: _____ Date: _____

Items 1-3 are low risk and can be addressed solely by the SSHO for the project. Items 4-6 required full review and approval.

1. Is the only change in regards to the staff listed in the original HASP?	☐ Yes ☐ No
If Yes, Stop Here: Verify training and medical monitoring and revise HASP accordingly	☐ Done
2. Is the only change that a new subcontractor been added to the project?	☐ Yes ☐ No
If Yes, Stop Here: Verify subcontractor qualifications to do the work and verify training and medical monitoring. Revise HASP accordingly	☐ Done
3. Is the only change in regards to a chemical or product to be used that is not included in the HAZCOM list of Chemicals brought to the site?	☐ Yes ☐ No
If Yes, Stop Here: Verify Safety Data Sheet (SDS) is on site. Review contents of SDS with all affected workers and add new chemical to the list.	☐ Done

I certify that the above changes have been made in the HASP.

Printed Name: _____ Title: _____ Signature: _____

4. Have additional tasks been added which were not originally addressed in the HASP?	☐ Yes ☐ No
5. Have new contaminants or higher than anticipated levels of original contaminants been encountered?	☐ Yes ☐ No
6. Has other hazards been encountered that are not addressed in the HASP?	☐ Yes ☐ No

If any are answered "Yes", complete the rest of the form and provide additional information:

_____

_____

_____

_____

Will other project documents be affected? ☐ Yes ☐ No If yes, specify: _____

APPROVALS: (Refer to original HASP for required signatures)

	Printed Name	Signature	Date
SHSO			
Site Manager			
Project Manager			
HSE Qualified Person			

RECORD OF CHANGES TO SITE-SPECIFIC HASP

Project Name: _____ Project #: _____ Date: _____

DECLARATION OF UNDERSTANDING
Site-Specific Health and Safety Plan (HASP) Change Acknowledgment
I have read and understand this HASP change and agree to abide by the procedures and limitations specified here, in the original project HASP. Individuals who have questions on information found in this plan should discuss their questions with their supervisor for clarification.

Name (print)	Company	Signature	Date

NOTES:
1. All project personnel, including subcontractors, must abide by the specifications and limitations contained in this technical change.
2. All personnel working on site must sign this form.
3. This change to the HASP will be discussed at all appropriate daily Tailgate Safety Briefings.
4. This change to the HASP will be maintained in the project files in conjunction with the original project HASP.

Amec Foster Wheeler Environment & Infrastructure

PROJECT-SPECIFIC HEALTH AND SAFETY ORIENTATION

TITLE	NAME	SIGNATURE
Project Manager:		
Project HSSE Coordinator:		

I have received site-specific information and orientation regarding the identified physical, chemical and biological hazards anticipated at this site. My signature certifies that I understand the procedures, equipment, and restrictions applicable to this project site and agree to abide by them.

SIGNATURE*	PRINTED NAME	COMPANY	DATE

Amec Foster Wheeler Environment & Infrastructure

SIGNATURE*	PRINTED NAME	COMPANY	DATE

* This acceptance form is required for all Amec Foster Wheeler E&I site staff.

SUBCONTRACTOR HEALTH AND SAFETY ORIENTATION FORM

SITE _____ DATE _____

SITE HEALTH AND SAFETY COORDINATOR _____

SITE DESCRIPTION _____

_____

_____

_____

_____

_____

POSSIBLE SITE CONTAMINANTS AND HAZARDS _____

_____

_____

_____

_____

The information summarized below is important for you to read and fully understand. This information has been extracted from the site-specific Health and Safety Plan, and has been compiled to help ensure your health and safety on-site. If you have any questions regarding the information presented below, please ask your escort for clarification.

HEALTH, SAFETY, AND SECURITY INFORMATION

1. All subcontracting personnel must acknowledge their presence on-site by checking in with the Site Health and Safety Coordinator. This assists in identifying all the personnel at the site in the event of an emergency.

2. All subcontracting personnel will be restricted to their "contracted" area(s). Do not enter any of the contaminated areas (marked with yellow-and-black caution tape) unless you have been authorized by site management and are wearing the proper protective equipment.

3. Hard hats, safety glasses, and safety boots are REQUIRED to be worn while you are working on-site.

4. Please read and heed all safety signs on-site. These signs are there to alert you to possible physical and chemical hazards.

5. Eating and smoking is not allowed on-site. You may eat or smoke in designated clean areas or in your vehicle.

6. Shirts are required at all times; long-sleeved shirts are preferred.

7. Before beginning any HOT WORK (welding, burning, and grinding) you must notify the Site Health and Safety Coordinator. The work area must be checked for flammables and combustibles, and a proper fire extinguisher must be close by before beginning the hot work.

8. Observe the proper lockout/tagout procedure before working on electrical and/or rotating equipment.

9. Normal subcontractor shift hours coincide with the regular AEE work schedule.

10. Report any accident or injury (even if minor to you) to the Site Health and Safety Coordinator.

11. No one under the age of 18 is permitted on-site without prior approval of the client.

12. No domestic animals are permitted on-site.

13. Complete cooperation with the Health and Safety Plan must be maintained. Any violation may result in expulsion from the site.

14. In the event of an on-site emergency, please walk immediately to the designated meeting area for the site. You will receive further instructions from this location. Please stay in the meeting area until the all-clear signal is given from the Site Health and Safety Coordinator or off-site emergency support personnel.

15. Please cooperate fully with those in authority in the event of an emergency.

ACKNOWLEDGEMENT OF INFORMATION

I have read and understand the above information provided by AEE and have had an opportunity to direct questions of a health and safety nature, and have received adequate answer or explanations from my escort or other site staff member.

Subcontractor Signature	**Print Name**	**Affiliation**	**Date**

Tailgate Safety Meeting Report

amec foster wheeler

Check One:

❑ Initial Kickoff Safety Meeting ❑ Regular/Daily Tailgate Safety Meeting ❑ Unscheduled Tailgate Safety Meeting

Date: _____ Site: _____

Field Manager: _____ Site Health and Safety Coordinator: _____
(print) *(print)*

Order of Business

Topics Discussed (check all that apply):

❑ Site History/Site Layout
❑ Scope of Work
❑ Personnel Responsibilities
❑ Medical Surveillance Requirements
❑ Training Requirements
❑ Safe Work Practices
❑ Logs, Reports, Recordkeeping
❑ Sanitation and Illumination
❑ Air Surveillance Type and Frequency
❑ Monitoring Instruments and Personal Monitoring
❑ Action Levels
❑ Accident Reporting Procedures
❑ Site Control (visitor access, buddy system, work zones, security, communications)
❑ Discussion of previous "near misses" including work crew suggestions to correct work practices to avoid similar occurrences
❑ Engineering Controls
❑ PPE Required/PPE Used
❑ Define PPE Levels, Donning, Doffing Procedures
❑ Physical Hazards and Controls (e.g., overhead utility lines)
❑ Decontamination Procedures for Personnel and Equipment
❑ General Emergency Procedures (e.g., locations of air horns and what 1 or 2 blasts indicate)
❑ Site/Regional Emergency Procedures (e.g., earthquake response, typhoon response, etc.)
❑ Medical Emergency Response Procedures (e.g., exposure control precautions, location of first aid kit, etc.)
❑ Hazardous Materials Spill Procedures
❑ Applicable SOPs (e.g., Hearing Conservation Program, Safe Driving, etc.)
❑ Injury/Illness Reporting Procedures
❑ Route to Hospital and Medical Care Provider Visit Guidelines
❑ Hazard Analysis of Work Tasks (chemical, physical, biological and energy health hazards and effects)

Safety suggestions by site workers: _____

_____

_____

Action taken on previous suggestions: _____

_____

_____

Injuries/accidents/personnel changes since previous meeting: _____

_____

_____

Tailgate Safety Meeting Report *(continued)*

amec foster wheeler

Observations of unsafe work practices/conditions that have developed since previous meeting: _____

_____

_____

Location of (or changes in the locations of) evacuation routes/safe refuge areas: _____

_____

_____

Additional comments: _____

_____

_____

Attendee signatures below indicate acknowledgment of the information and willingness to abide by the procedures discussed during this safety meeting.

Name (print)	Company	Signature

Meeting conducted by: _____ Title: _____
(print)

Signature: _____ Time: _____